Introduction


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

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

Standard Specifications are available at:
http://www.udot.utah.gov/go/2012standards

Web references within these Standards are listed at

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

Layout

SECTION NUMBER
TITLE

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

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

Page Numbering

The Table of Contents, Standard Sections, and Index of this book each have
separate numbering systems. The Standard Sections are numbered from
1 – 978 along with individual Section numbers.

Example:

Title
Section Number – Page 3 of 5 (Individual section number)
746 (Combined number)

The combined numbers are used in the Table of Contents and Index.

Content Search

Use the Web published PDF version of the Standard Specification Book for
extended search beyond basic Table of Contents and Index look up.
### New Sections, Title Changes, Section Deletions

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SECTION 00120

BIDDING REQUIREMENTS AND CONDITIONS

PART 1  GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS

A. Section 01284: Prompt Payment

B. Section 01455: Material Quality Requirements

1.3 REFERENCES

A. Sherman Antitrust Act

B. United States Department of Treasury Circular

C. Utah Administrative Code

D. Utah Procurement Code

E. Utah 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 $1.5 million.

1. Prequalification information is due 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 on 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 according to a filed affidavit of change in firm name or ownership.

B. Obtain bidding documents and instructions from the Department Web site. Refer to this Section, article 1.13.

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

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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 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 ground conditions.
      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 as far as this information is obtainable 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 with no additional cost to the Department.

1.13 PREPARE THE PROPOSAL

A. Obtain current version of the Department Electronic Bid System (EBS) from the Web site. Refer to http://www.udot.utah.gov/go/standardsreferences

1. Contact the UDOT Construction Division for Contractor ID and EBS training.

B. Prepare and 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 of alternate items in EBS when the proposal permits a choice. EBS 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.

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<th>Names and Office Addresses Required</th>
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<td>Joint Venture</td>
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<tr>
<td>Corporation</td>
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F. Bidders submitting electronic or manual bids must sign the Bid Report to certify they understand and are in compliance with all terms and conditions of the contract for bid acceptance by the Department.

1.14 CERTIFY NON-COLLUSIVE BIDDING

A. Each person signing on behalf of any bidder certifies under penalty of perjury that to the best of his or her knowledge and belief their own organization complies with the following:

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 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 bidder’s board of directors. 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 IRREGULAR PROPOSALS

A. The Department considers a proposal irregular and rejects the proposal as non-responsive if:
   1. It is 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. It is noncompliant with any prequalification regulations.

7. It does not furnish a properly executed proposal guaranty according to this Section, article 1.16, paragraph A.

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. It 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. It does not meet any other material or bidding requirement of the invitation for bids.

14. It is received after date and time for bid opening.

15. It does not acknowledge receipt of or meet the requirements of addenda.

16. Award of additional work could impede or prevent timely completion of work currently under contract.

17. Failure to pay or settle all outstanding labor and material bills or claims for a contract current at the time the proposal is issued.

18. More than one proposal for the same work is submitted from an individual, firm, or corporation under the same or different names.

19. Default under previous contracts.

20. Unsatisfactory performance on previous or current contracts.

21. Debarment by the Department, any State, or the Federal Government.

22. Serious misconduct that adversely affects the ability to perform future work.

23. Failure to reimburse the Department for money 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.

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24. Bid Guaranty received after date and time specified.
25. Non-attendance of a mandatory pre-bid meeting.
26. Manual bid submission does not contain both a signed hard copy and electronic version. Electronic media device (CD/Flash Drive) is blank, unreadable, not properly signed or does not contain the correct electronic bid items .txt file, such as Proj#_UDOTContractorID_bidopendate.txt.
27. Proposal not submitted using Department’s current EBS.

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 PROPOSAL GUARANTY

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

1.17 PROPOSAL DELIVERY

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

B. A manually submitted bid must include both a signed hard copy and electronic version. Electronic media device (CD/Flash Drive) must not be blank or unreadable and must contain the correct electronic bid items .txt file in the indicated format.
1. File format – Proj#_UDOTContractorID_bidopendate.txt
2. The signed hard copy takes precedence over a manually delivered electronic version in the case of discrepancies or initialed changes to unit prices or DBE commitment.
1.18 WITHDRAWING OR REVISIONING 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.

1.19 COMBINED OR CONDITIONAL PROPOSALS

A. Proposals may be issued for combined projects or separately.
   1. Proposals may be submitted either on the combined portions or on separate units of the combined project.
   2. The award of combined proposals or separate proposals is made to the advantage of the Department.
   3. The Department will specify which proposals may be combined.

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

1.20 PUBLIC OPENING OF PROPOSALS

A. Proposals are publicly opened at the time indicated in the invitation for bids.

1.21 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 seq., 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 venture, stockholder of 5 percent or more of the contract, an affiliate, or any immediate relatives of the aforementioned has been debarred by the Federal Government or by another State government or affiliated with another debarred person or Contractors.

7. The Department 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 contracts 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 money 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 money owed.

12. The Department Deputy Director has reasonable grounds to believe and finds that the public health, welfare, or safety imperatively requires such action.

13. Contract violations consisting of but not limited to failure to make prompt payment according to Section 01284 or subletting more than 70 percent of the original contract bid amount.
1.22 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.

1.23 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. Debarment will 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.
1.24 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 Department 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 its 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 Department Deputy Director 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 Department 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 Department Deputy Director is administratively final following an informal hearing and specifies the facts justifying the Department’s actions and conclusion.

1.25 CERTIFY REGISTRATION AND USE OF EMPLOYMENT STATUS VERIFICATION SYSTEM

A. Certify each bidder and each person signing on behalf of any bidder, as to its own organization, under penalty of perjury, that to the best of their knowledge and belief the named Contractor has registered with and uses a “Status Verification System” to determine the work eligibility status of an employee hired after July 1, 2009, pursuant to Utah Code Section 63G-12-302.
   1. Apply only on projects that require a Request for Proposal (RFP) with sole source.

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.

C. Manually or electronically signing the Bid Proposal certifies compliance with all provisions of this employment status verification certification.

1.26 DRUG AND ALCOHOL TESTING

A. Manually or Electronically signing the Bid Proposal demonstrates to the Department that the Contractor will have and will maintain a drug and alcohol testing program that complies with all applicable provisions of Utah Administrative Code 916-6 and Utah Procurement Code Section 63G-6-604 throughout the term of this contract.

B. This requirement is also applicable to all subcontracts under this Contract that provide services or labor for design or construction.

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

B. Utah Code

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 Electronic Bid System (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 released 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 releases 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 material suppliers 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 if a Contractor’s surety is unable to provide payment, unless the Department determines it is in the public interest to continue the work.

G. Furnish a cash bond of two cashier’s checks, each in the amount of Contractor’s bid amount as an alternate contract bond.
   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 contracts, 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, bonds, and insurances.
   2. The contract is not considered in effect until executed by all parties.

B. Qualified Health Benefit Plan
Demonstrate to the Department that an offer of qualified health insurance coverage care has been or will be maintained for the employees and their dependents for the duration of any contract entered between the Department and the Contractor that requires prequalification where the Department Engineer’s advertised Estimate is greater than or equal to $1,500,000.
1. Provide certification of equivalency to a “qualified health insurance” plan as required by Utah Code 72-6-107.5.
2. Demonstrate compliance of this requirement before the Notice of Proceed or approval to sublet work. Refer to http://www.udot.utah.gov/go/standardsreferences for guidance on this process for Qualified Health Insurance Coverage.
3. Failure to demonstrate compliance of this requirement may result in cancellation of the contract.

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 contract completion according to Section 00570.
   3. The required performance bond may be reduced upon contract completion to conform to the total amount of the contract bid prices for the items of work to be guaranteed. This amount continues in full force and effect for the duration of the guaranty period. Refer to this Section, article 1.10.

1.13 FAILURE TO EXECUTE CONTRACT

A. The Department can cancel the notice of award and keep the proposal guaranty if the successful bidder does not execute the contract and file acceptable bonds and insurance certificates that prove coverage within 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 Releasing Bid Documentation
a. Submit bid documentation in a sealed container clearly marked “Bid Document” and labeled with the bidder’s name and address, submission date, and project number.
b. Bid documentation is released to all but the successful bidder after the contract has been executed.

2. Affidavit
a. Submit a signed and certified affidavit, in addition to bid documentation, 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. 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 after executing the contract.
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. The Department will direct the depository to release the sealed container to the Contractor provided the Contractor signs the final standard release form if a claim or notice of the Contractor’s intent to file a claim is absent.
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, if 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. The materials become the property of the Department until the claim is resolved or litigation is concluded if either occurs.
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 protect the confidentiality of bid documentation to the extent allowed by the Governmental Records Access and Management Act, Title 63G, Chapter 2, Utah Code.

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
1.1 SECTION INCLUDES  Not Used

1.2 RELATED SECTIONS

A. Section 00120: Bidding Requirements and Conditions
B. Section 00570: Definitions
C. Section 00725: Scope of Work
D. Section 00727: Control of Work
E. Section 01282: Payment
F. Section 01355: Environmental Compliance

1.3 REFERENCES

A. Utah Transportation Code

1.4 DEFINITIONS

A. Total Project Float – The cumulative length of time activities can be delayed before they affect the project substantial completion date or a contractual milestone. Float is a shared commodity between the Contractor and the Department and not for the exclusive use or financial benefit of either party. Either party has the full use of the project float until it is depleted.

B. Excusable Delay – Refer to Section 00570.

1.5 SUBMITTALS

A. Qualified Health Benefit Plan – Refer to this Section, article 1.8.
B. Subcontracts – Refer to this Section, article 1.8.
C. Construction Schedule – Refer to this Section, articles 1.9 and 1.10.
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 do not relieve liability under the contract and bonds whether committed to in writing or by an informal, unwritten arrangement or transfer of the contract or any part of it or its obligations.

   1. Accept liability for any claims for damages or liability resulting from an act or omission of any person who carries out work as part of the contract with the Department, whether the working relationship is through a formal subcontract or carried out by an informal, unwritten agreement. Agree to indemnify the Department for any damages or liability, including attorney’s fees and court costs that may be incurred by such a person.

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

   1. The Engineer will not approve a request to sublet work for any subcontract valued at or above $750,000 unless the subcontractor has demonstrated that they have and will maintain an offer of “qualified health benefit plan” to employees and dependants of employees as required by Utah Transportation Code 72-6-107.5.

   2. Demonstrate compliance using one of the following methods.

      a. Provide appropriate documentation during the pre-qualification process specified in Section 00120 or annual registration process.

      b. Include appropriate documentation demonstrating compliance with health care requirement listed above with request to sublet work.
3. The Engineer will review the information to verify compliance with this article.

E. The Department considers an item as subcontracted in its entirety in computing the percentage of subcontracted work unless otherwise designated in the subcontract.
   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 items such as bonds, insurance, profit, and office transaction.

F. All Subcontracts
   1. Provide for a reduction in retained money equal to the percentage retained according to 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 items such as fuel, asphalt, cement, and common carrier rates.
   3. Include a certification by affidavit that the subcontractor, at any tier, uses an electronic “Status Verification System” to determine the work eligibility status of an employee hired after July 1, 2009.
      a. Apply only on projects with a Request for Proposal (RFP) and Sole Source.

1.9 BASELINE CONSTRUCTION SCHEDULE

A. Provide the Engineer with a baseline construction schedule meeting the requirements of this section using a version of Oracle’s Primavera P6 or Primavera Contractor as approved by the Engineer.

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 perform the work with diligence to maintain the production rates defined in the accepted baseline construction schedule.
D. Schedule
1. Provide a baseline construction schedule to the Engineer with schedule narrative within 14 calendar days of the Notice to Proceed. Provide one hard copy and one electronic copy in a format acceptable to the Engineer. Email is an acceptable method of providing the electronic copy.
2. The Engineer reviews the schedule and returns it within seven calendar days from the date of receipt as accepted, accepted with comments, or rejected with comments.
3. Complete the final baseline schedule and obtain Engineer’s acceptance within 30 calendar days from the Notice to Proceed.
   a. Address the Engineer’s comments and revise the schedule as necessary to obtain acceptance.
   b. 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 according to 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 requirements.

E. Schedule Requirements
Address the following with as much detail as necessary:
1. Define a complete and logical plan, consistent with how the project was bid, that can realistically accomplish the work defined in the contract.
2. Include sufficient activities for adequate project planning.
3. Define a continuous critical path in the schedule using the longest path definition. Start at the earliest occurring schedule activity and run through physical completion.
4. Clearly define significant interaction points with the Department and other entities such as subcontractors, vendors and suppliers, utilities, local governments, and special service districts.
5. Designate the “Data Date” as the day before Notice to Proceed.
6. Clearly and uniquely define each activity description. Do not use descriptions referring to a percent complete of a multi-element task such as “construction of 50 percent of deck.”
7. Define the duration of each activity. Limit the maximum duration of any activity to 21 calendar days for calendar day contracts or 15 working days for working day contracts unless otherwise accepted by the Engineer.

8. Clearly identify the relationships tying activities together.

9. All activities must have at least one predecessor, except for the start milestone and one successor, except for the finish milestone.

10. Do not constrain activities unless accepted by the Engineer. Eliminate constraints by using additional activities, relationships, or calendars where possible.

11. Do not sequester project total float through manipulating calendars, extending activities durations, or other methods.

12. Use resource loading if resource limitations may affect the prosecution of the work. 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.

13. Include milestones to define significant contractual events including, but not limited to, Notice to Proceed, substantial completion, physical completion and coordination points with outside entities such as utilities and special service districts.

14. Define a Work Breakdown Structure (WBS) that organizes the project into geographic areas (at least two) and bid item under these areas. This is not required on small projects with less than 25 activities.

15. Assign WBS codes to all activities in the schedule.

16. Use calendars that reflect actual working day constraints and restrictions as specified in the contract. Define the “work hour/day” in all calendars to match the Primavera Admin Preference “Hours per Time Period.” For example, if the Hours per Time Period is defined as eight hours/day, the “work hour/day” for the calendar is defined as eight hours.

17. Use days as the planning unit, not hours. For example, if a work activity will take 40 hours to complete and the contractor is working ten hour days, then the planned activity duration will be four days, not 40 hours. The planned duration of the activity will be five days if the contractor works eight hours per day.

18. Do not use resource dependent activities unless the schedule is resource loaded and leveled.

19. Define the percent complete type for the schedule as “physical percent complete.”

20. Split activities that contain contract work performed by more than one subcontractor.

21. Document and explain the Primavera settings used if different from the software default settings.

22. Represent the full scope of the contract work in the schedule.
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 work sequences.
      b. The justification for activities with durations exceeding 21 calendar days for calendar day contracts or 15 working days for working day contracts.
      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.
      f. The potential problems that may impact the scheduled completion date along with proposed solutions.
      g. How the coordination with other entities will be handled.
      h. The production rates and crew requirements, as bid by the contractor, for all major activities. No time extension will be granted for labor inefficiencies if production rates and crew requirements are not provided in this initial schedule narrative.
   2. Certify that the baseline schedule represents how the work was bid or explain how it is different.

G. All costs to maintain the project schedule are solely the Contractor's obligation and at no additional cost to the Department.

H. The Engineer defines any additional Department costs required to support an accelerated schedule for early completion such as increased staff for inspection, testing, and overtime.
   1. Pay for these added costs unless waived by the Engineer on the basis of other benefits accrued to the Department.

1.10 CONSTRUCTION SCHEDULE UPDATES

A. Update the construction schedule each month during the life of the contract until physical completion.
   1. The Engineer does not approve progress payment until an acceptable schedule update has been received.
   2. Show the following:
      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. The data date is one day after the closing date for the monthly progress payment.
g. Retained logic when scheduling progressed activities.

3. Show all activities as 100 percent complete in the final schedule submittal.

B. Provide one hard copy and one electronic copy to the Engineer with a certification signed by the contractor’s project manager stating that progress shown on the schedule update accurately represents work completed through the date indicated, for review and acceptance.

C. Provide a schedule narrative describing:
1. All deviations in the work performed to date from the previous schedule update or baseline on the first update. Explain the cause of each deviation, the party responsible for each deviation, the impact of each deviation on the project to date, the projected future impact if any, and potential solutions to the problem if the deviation delays the work.
2. The work to be accomplished during the next period that deviates from the previous schedule update and the potential impact of these changes on the project completion date.
3. Potential problems that may be encountered during the next period and the proposed solutions. Specifically identify all potential problems the Department may be party to and explain what action the Department needs to take and the date by which the action needs to be taken to avoid or mitigate the problem.
4. 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.

D. Participate in a progress meeting at the request of the Engineer, to review and discuss the status of the project. The purpose of the meeting is to identify in detail, deviations in the schedule from the original baseline or the previous month’s update. Address the causes, responsible party, impacts, and potential solutions to all issues identified, with the intent of finding the most effective solutions to problems.
1. Make the project manager, scheduler, and appropriate field personnel available 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. Provide a revised schedule update if necessary.

E. Provide an updated four-week look-ahead schedule each week. This schedule must be consistent with the most current schedule update.

1.11 LIMITATION OF OPERATIONS

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

B. Sunday and Category II Holiday Work
   1. Do not perform any work without written approval except for repairing or servicing equipment, protecting work, maintaining or curing concrete, and maintaining traffic on Category II holidays as defined in Section 00570.
   2. Provide advance notice to the Engineer no later than noon on the Wednesday before any Sunday or Category I holiday work, except Veteran’s Day, as defined in Section 00570, unless otherwise restricted in the contract.
      a. Provide the Engineer 3 days notice before working on Veteran’s Day.

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 according to Section 01355.

1.12 CHARACTER OF WORKERS

A. Provide sufficient resources to complete all work according to the contract. Employ workers with the skills and experience necessary to perform the work.

B. Remove from the project any employee who performs the work in an improper or unskilled manner or who is 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.
1.13 METHODS AND EQUIPMENT

A. Use equipment designed to perform and produce the specified work.

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

C. Obtain written permission from the Engineer to deviate from the means and methods specified in the contract.
   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.

1.14 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 documented written protest explaining the contractor’s discrepancies with the Monthly Status of Contract Time report is submitted to the Engineer within seven calendar days of receipt.
   2. Failure to file a protest is acceptance of the time assessments provided by the Engineer in the Monthly Status of Contract Time.

D. Refer to Section 00570 for definitions of substantial completion, physical completion, and contract completion.
1.5 DETERMINING COMPENSATION AND CONTRACT TIME EXTENSION FOR EXCUSABLE DELAYS

A. Request a contract time extension for excusable delays according to this article.
   1. Time may be granted for excusable 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 excusable compensable delays that impact the project schedule’s critical path and the Contractor’s costs.
   3. Neither time nor money will be granted for non-excusable delays.

B. Provide written notification to the Engineer within seven calendar days of the occurrence of an alleged excusable delay justifying the request for a time extension and additional compensation, where 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 a delay are not reimbursable.
   3. Provide the Engineer with a schedule impact analysis showing the impact of the delay-causing event on the project activity sequences and durations.
   4. Maintain daily records of all labor and material costs, station locations, and equipment costs for all operations affected. Obtain the Engineer’s written 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 according to this article.

D. Time will be added to the contract based on a mutually agreed to schedule impact analysis showing lost time attributable to the delay-causing event.

E. Delay compensation for excusable delays is made as specified in Section 01282.

F. The Contractor may pursue a claim for additional compensation or contract adjustment as specified in Section 00727 if disagreeing with the Engineer’s decision to reject a request for added time and compensation.

1.16 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 or working day, whichever is specified in the contract, 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 receipt of notification of substantial completion that includes the punch list. The Department deducts $560 per day from any money due for each calendar day beyond 30 calendar days following receipt of notification for any work necessary for physical completion. Refer to Sections 00570 and 00727.

C. Achieve contract completion no later than 30 calendar days after receipt of notification of physical completion that includes the final documents punch list. The Department deducts $100 per day from any money due for each calendar day beyond 30 calendar days following receipt of notification of physical completion that includes the final documents punch list, that any Contractor obligation under the contract remains unfulfilled. Refer to Sections 00570 and 00727.
Table 1

<table>
<thead>
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<th>Schedule of Liquidated Damages</th>
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<tr>
<td><strong>Original Contract Amount</strong></td>
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</tbody>
</table>

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

1.17 CONTRACT TERMINATION FOR DEFAULT

A. The Department may declare the Contractor to be in default and terminate the contract if the Contractor:
1. Does not begin the work under the contract within the time specified.
2. Does not perform the work with sufficient resources to secure the prompt completion of the work.
3. Does not meet contract work requirements 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 cost exceeds the sum that would have been payable under the contract.

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

1.18 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.

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. Complete and partially complete work and all materials produced or acquired before the Notice of Termination.
   b. Completed or partially completed plans, drawings, information, and other property required to be furnished to the Department if the contract had been completed.

6. Complete work not terminated.

7. Coordinate a time and date with the Engineer to inventory materials obtained but not yet used for the project.

8. Take all necessary or directed actions to protect contract-related property that is in the possession of the Contractor and in which the Department has or may have an interest.

D. The Department pays for:
   1. All completed items of work as of that date at the contract bid price when the Department orders termination of a contract effective on a certain date.
   2. Partially completed work either at agreed prices or by force account methods.
   3. Items that are eliminated in their entirety according to Section 01282.

E. Support all claimed costs associated with contract termination with internal cost records that show actual costs. The Department reserves the right to obtain and review all contractor cost records associated with such a request.

F. Termination of a contract or portion thereof does not relieve the Contractor of contractual responsibilities for the work completed or relieve the Surety of its obligation for and concerning any just claim arising out of the work performed.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION
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. AREA American Railway Engineering Association
   15. AREMA American Railway Engineering and Maintenance-of-Way Association
   16. ARTBA American Road and Transportation Builders Association
   17. ASCE American Society of Civil Engineers

Definitions
<table>
<thead>
<tr>
<th>Number</th>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.</td>
<td>ASLA</td>
<td>American Society of Landscape Architects</td>
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<tr>
<td>19.</td>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>20.</td>
<td>ATMS</td>
<td>Advanced Traffic Management System</td>
</tr>
<tr>
<td>21.</td>
<td>AWPA</td>
<td>American Wood Preservers' Association</td>
</tr>
<tr>
<td>22.</td>
<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>23.</td>
<td>AWG</td>
<td>American Wire Gauge</td>
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<tr>
<td>24.</td>
<td>AWS</td>
<td>American Welding Society</td>
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<tr>
<td>25.</td>
<td>CCTV</td>
<td>Closed Circuit Television</td>
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<tr>
<td>27.</td>
<td>CSI</td>
<td>Construction Specification Institute</td>
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<tr>
<td>28.</td>
<td>DMS</td>
<td>Dynamic Message Sign</td>
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<tr>
<td>29.</td>
<td>EBS</td>
<td>UDOT’s Electronic Bid System</td>
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<tr>
<td>30.</td>
<td>ESS</td>
<td>Environmental Sensor Sign</td>
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<tr>
<td>31.</td>
<td>EUSERC</td>
<td>Electric Utility Service Equipment Requirements Committee</td>
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<tr>
<td>32.</td>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>33.</td>
<td>FSS</td>
<td>Federal Specifications and Standards (General Service Administration)</td>
</tr>
<tr>
<td>34.</td>
<td>GRC</td>
<td>Galvanized Rigid Conduit</td>
</tr>
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<td>35.</td>
<td>GSA</td>
<td>General Services Administration</td>
</tr>
<tr>
<td>36.</td>
<td>HAR</td>
<td>Highway Advisory Radio</td>
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<tr>
<td>37.</td>
<td>ID</td>
<td>Identification</td>
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<tr>
<td>38.</td>
<td>IMSA</td>
<td>International Municipal Signal Association</td>
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<td>39.</td>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>40.</td>
<td>ITE</td>
<td>Institute of Traffic Engineers</td>
</tr>
<tr>
<td>41.</td>
<td>ITS</td>
<td>Intelligent Transportation System</td>
</tr>
<tr>
<td>42.</td>
<td>LRFD</td>
<td>Load and Resistance Factor Design</td>
</tr>
<tr>
<td>43.</td>
<td>MIL</td>
<td>Military Specifications</td>
</tr>
<tr>
<td>44.</td>
<td>MMF</td>
<td>Multi-Mode Fiber</td>
</tr>
<tr>
<td>45.</td>
<td>MUTCD</td>
<td>Manual on Uniform Traffic Control Devices</td>
</tr>
<tr>
<td>46.</td>
<td>NEC</td>
<td>National Electric Code</td>
</tr>
<tr>
<td>47.</td>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
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<tr>
<td>48.</td>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
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<td>49.</td>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>50.</td>
<td>OTDR</td>
<td>Optical Time Domain Reflectometer</td>
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<tr>
<td>51.</td>
<td>P + T</td>
<td>Price + Time</td>
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<tr>
<td>52.</td>
<td>PCA</td>
<td>Portland Cement Association</td>
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<tr>
<td>53.</td>
<td>PTI</td>
<td>Post-Tensioning Institute</td>
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<tr>
<td>54.</td>
<td>RMS</td>
<td>Ramp Metering Station</td>
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<td>55.</td>
<td>RWIS</td>
<td>Roadway Weather Information System</td>
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<tr>
<td>56.</td>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
</tr>
<tr>
<td>57.</td>
<td>SMF</td>
<td>Single-Mode Fiber</td>
</tr>
<tr>
<td>58.</td>
<td>SSPC</td>
<td>Society for Protective Coatings</td>
</tr>
<tr>
<td>59.</td>
<td>SWPPP</td>
<td>Storm Water Pollution Prevention Plan</td>
</tr>
<tr>
<td>60.</td>
<td>TMS</td>
<td>Traffic Monitoring Station</td>
</tr>
<tr>
<td>61.</td>
<td>TOC</td>
<td>Traffic Operations Center</td>
</tr>
</tbody>
</table>
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 if there is 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 insure 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.

14. **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.

15. **Certification** – A written document or affidavit officially declaring confirmation of a statement or information as being true, accurate, or genuine.

16. **Calendar Day** – Every day shown on the calendar, beginning and ending at midnight.

17. **Certificate of Compliance** – A certification, including a signature by a person having legal authority to act for the manufacturer, stating that the product or assembly to be incorporated into the project was fabricated according to the applicable specifications.

18. **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.

19. **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.
20. **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.

21. **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.

22. **Commission** – The Utah Transportation Commission.

23. **Completion Date** – The date when the contract work is specified to be substantially complete.

24. **Concrete-Small Structure** – Eight cubic yards or less of concrete.

25. **Conformity** – Conformance to and 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.

26. **Construction Limits** – Area of established boundaries within the highway right-of-way or construction easements that defines the construction area.

27. **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. Standard Specifications
   e. Supplemental Specifications
   f. Special provisions
   g. Standard Drawings
   h. Plans
   i. Notice of award
   j. Notice to proceed
   k. Authorized contract time extensions
   l. Change orders and agreements required to complete the work in an acceptable manner

28. **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.

29. **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.
30. **Contract Bonds** – The approved form of security, executed by the Contractor and the Contractor’s surety or sureties, guarantying complete execution of the contract, including change orders, and the payment of all legal debts pertaining to the construction of the project.
   a. **Contract Payment Bond** – The security executed by the Contractor and furnished to the Department to guaranty payment of all Contractor legal debts pertaining to the construction of the contract.
   b. **Contract Performance Bond** – The security executed by the Contractor and furnished to the Department to guaranty completion of the work under the contract.
31. **Contract Completion** – The day, determined by the Engineer, when all work specified in the contract is satisfactorily completed and all obligations of the Contractor under the contract are fulfilled. Furnish all documentation required by the contract and required by law before this date.
32. **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.
33. **Contract Time** – The date or number of working days or calendar days allowed for substantial completion of the contract, including authorized time extensions. Reach substantial completion on or before that date when a completion date is specified, even when that date is a Saturday, Sunday or holiday.
34. **Contractor** – The individual or legal entity contracting with the Department for performance of prescribed work.
35. **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.
36. **County** – The County where the contracted work is located.
37. **Culvert** – Any structure that provides an opening under the roadway not meeting the classification of a bridge as defined in this section.
38. **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.
39. **Delay** – An event, action, force, or factor causing work to extend beyond the specified contract time.
   a. **Excusable Delay** – A critical delay that is beyond the Contractor’s control, not the fault or responsibility of the Contractor, or could not have been foreseen by the Contractor, for which a time extension may be granted.
      1) **Compensable Delay** – An excusable delay caused by Department action or inaction, or under the Department’s control, including delays resulting from change orders, differing site conditions, work suspensions caused by conditions beyond the control of the Contractor, lack of site access, and delayed shop drawing approval. The Department may grant additional time and compensation for such compensable delays as specified in Section 01282.
      2) **Non-compensable Delay** – Unforeseen and unanticipated excusable delay caused by acts of God, acts of the public enemy, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays not the fault of the Contractor or Department. The Department will not grant additional compensation for such delays.
   a) **Concurrent Delay** – A non-compensable delay that occurs when both the Contractor and the Department independently delay work on critical path activities during approximately the same time period.
   b. **Non-excusable Delay** – A delay that was within the Contractor’s control, was the fault or responsibility of the Contractor, or could have reasonably been foreseen by the Contractor and for which there is no monetary compensation or time extension. Examples of such delay-causing events are normal weather or the failure by the Contractor to assign sufficient resources to the work.

40. **Department** – The Utah Department of Transportation

41. **Differing Site Conditions** – Subsurface or latent physical conditions at the project site that:
   a. Differ significantly from those indicated in the contract.
   b. Present unknown physical conditions of an unusual nature that differ materially from those normally encountered and generally recognized as inherent in the nature of the required work.

42. **Electronic Communication** – A communication transmitted through facsimile (fax), e-mail, or other electronic means where a hard copy can be produced.
43. **Engineer** – The UDOT Deputy Director, acting directly or through a duly authorized representative, usually the Resident Engineer or Consultant Engineer, responsible for engineering and administration of the contract. A Consultant Engineer hired by the Department for construction project management is considered an extension of the Department and has the same responsibility and authority as a Resident Engineer.

44. **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.

45. **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.

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**

<table>
<thead>
<tr>
<th>Holiday Categories</th>
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<tbody>
<tr>
<td>Category I</td>
</tr>
<tr>
<td>Martin Luther King, Jr. Day</td>
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<tr>
<td>Presidents’ Day</td>
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<tr>
<td>Veteran’s Day</td>
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<tr>
<td>Category II</td>
</tr>
<tr>
<td>New Year’s Day</td>
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<tr>
<td>Memorial Day</td>
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<tr>
<td>Independence Day</td>
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<tr>
<td>Pioneer Day</td>
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<tr>
<td>Labor Day</td>
</tr>
<tr>
<td>Thanksgiving Day</td>
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<tr>
<td>Christmas Day</td>
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</tbody>
</table>

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

a. **Category I Holiday** – Holiday typically worked by Contractors.

b. **Category II Holiday** – Holiday typically not worked by Contractors.
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 other designated testing laboratory.

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 added cost of engineering, supervision, contract administration, 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. **Sub-base** – One or more layers of specified material thickness placed on a subgrade to support a base course.

   d. **Sub-grade** – The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.

   e. **Sub-grade 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 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.

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 procedure for bidding Price on contract bid items and Time to complete project milestones.

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 (l).

82. **Specifications** – The compilation of provisions and requirements for the performance of prescribed work.
   - **Special Provisions** – A unique specification or a modification or revision to the standard specifications applicable to an individual contract.
   - **Supplemental Specifications** – Approved additions and revisions to the Standard Specifications.
   - **Standard Specifications** – Specifications approved for general application and repetitive use.


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 including all Intelligent Transportation Systems (ITS) and Advanced Traffic Management Systems (ATMS).
   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 bid item that identifies a daily value based on user costs or liquidated damages. Time value is the sum of the products of the time-related cost rates multiplied by the time bid by the Contractor to achieve the 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. **User Costs** – Costs incurred by the traveling public due to construction activities.

99. **Utility** – All privately, publicly, or cooperatively owned lines, facilities, and systems for producing, transmitting, or distributing communications, power, heat, gas, oil, water, waste, and storm water not connected with the highway drainage, signal systems, and other products that directly or indirectly serve the public. The utility company.

100. **Value Engineering Change Proposal** – A change proposed by the Contractor and considered by the Department intended to result in project cost savings to contract pay items without reducing the essential functions and characteristics of the project. Refer to Section 00725.

101. **Work** – The elements, activities, and incidentals necessary to complete a project (including labor, materials, equipment, and the interim products and stages attained in the course of reaching completion), and all alterations, amendments, or extensions made by change order or other written orders of the Engineer.

102. **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.
103. **Working Drawings** – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work. Working drawings do not supersede the contract drawings.

104. **Written Permission of the Engineer** – A letter signed by the Engineer granting specific permission and outlining limitations of the permission.

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**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 Compliance
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 incidental 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.

1. Decide with the Engineer whether to use an independent third party to facilitate partnering or to share in facilitation.
   a. Contact the Engineer within 5 days of Notice of Award and before the preconstruction conference to implement a third party facilitated partnering initiative.

2. Coordinate with the Engineer to select a facilitator for the meeting and develop an attendee list, agenda, duration, and location of a partnering workshop.

C. Share all partnering costs equally with the Department.

D. Agree with the Engineer whether follow-up partnering workshops will be held.

E. Project personnel, as identified in UDOT/AGC Partnering Field Guide, must have completed UDOT/AGC provided Partnering Training before beginning work or be scheduled to attend the next available training session.

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 cost 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. Basis for a claim that the work is not required by the contract.
c. 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. 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. The Engineer will provide a written response within seven calendar days of receiving the notice that:
   1. Confirms the change, condition, or event and when necessary, directs how the work will proceed.
   2. Denies the change, condition, or event.
3. Advises 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 which it must be received.

E. Contract adjustment is made as a written modification to the contract by change order when warranted.

F. No contract adjustment that benefits the Contractor is allowed unless the Contractor provides written notice as specified in this article.

G. The Contractor may pursue a claim for additional compensation or contract adjustment if the Engineer denies the Contractor’s request for a contract adjustment 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.

B. Meet notification requirements under this Section, article 1.8, 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. The Department will adjust contract time as specified in Section 00555 for directed changes that extend the longest path (critical path) of the project.
   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 as specified in 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 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 areas such as parking lots, garages, businesses, residences, and farms.
   3. Exclude snow removal.

B. The Department does not provide additional compensation 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 by 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 cost to the Department.

C. Salvageable material is the property of the Contractor unless otherwise specified in the contract.
1.13 FINAL CLEANUP

A. Clean all rubbish, excess materials, temporary structures, 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 responsible for the area the project is in before beginning work.

E. Execute a Contractor's Right of Entry Agreement with the railroad company before performing any work within the railroad right-of-way.
   1. Obtain all insurance required under the Contractor's Right of Entry Agreement.
   2. Provide a copy of the executed agreement to the Engineer.
F. Determine the cost of required railroad flagging, inspection, and cleanup crew. Include these costs in mobilization. No other compensation is allowed.
   1. The Department deducts payment under a construction accounting item for “Railroad Flagging, Inspection, and Cleanup” and pays the railroad directly for verified billings.

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 physical completion.

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 physical completion.

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 not on anticipated VECPs that are subject to Department approval. Complete the contract as bid if a VECP is rejected.

D. Submitting VECP 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 does not 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, or at the discretion of the Engineer.

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

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Claims – Refer to this Section, article 1.23.
B. Safety – Make documented evaluations available to the Department upon request from the Engineer. Refer to this Section, article 1.28.

1.6 ENGINEER AUTHORITY AND DUTIES

A. The Engineer decides all questions regarding the quantity, quality, and acceptability of materials furnished and work performed, work progress, contract interpretation, project acceptance, and acceptable contract completion.
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.
2. Perform work properly or comply with contract provisions.
3. Comply with the Engineer’s orders.

C. The Engineer can suspend work wholly or partially for:
1. Periods of unsuitable weather.
2. Conditions unsuitable for the prosecution of the work.
3. Any other condition or reason determined to be in the Department’s interest.

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:

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<thead>
<tr>
<th>Dimensions</th>
<th>Information</th>
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<tr>
<td>2. Calculated</td>
<td>2. Plans</td>
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<tr>
<td>4. Supplemental Drawings</td>
<td>4. Supplemental Drawings</td>
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<tr>
<td>5. Measurement and Payment</td>
<td>5. Measurement and Payment</td>
</tr>
<tr>
<td>7. Standard Drawings</td>
<td>7. Standard Drawings</td>
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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.

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.
E. Do not use or attach permanent or temporary contractor logos or branding identification on any project physical features within the project limits.
   1. Logos or branding identification other than those permanently attached to vehicles, equipment, and apparel are prohibited.

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 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 additional work at or near the work covered by the contract.
B. Cooperate with other contractors working within the project limits. Conduct work without interrupting or inhibiting the progress or completion of work by other contractors.

C. Each Contractor involved accepts all liability, financial or otherwise, in connection with 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 cost 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 cost, if ordered by the Engineer.
   1. Remove and uncover portions of finished work as directed.
   2. Restore work to contract requirements after inspected.
      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, 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 nor obligate the Department to accept the final work or materials.
   1. The Department is not responsible for losses suffered due to necessary removals or repairs of such defects.

D. The representative of any government agency, utility, or railroad company that pays a portion of the contract cost may inspect that portion of the work. 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 all unacceptable work before physical completion.
   1. Work is considered unacceptable if it does not meet the contract requirements unless accepted under this Section, article 1.8.

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 cost.

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. Comply with the following for materials imported to the job site such as asphalt, cement, concrete, or steel:
   1. Provide the Engineer with invoices showing the gross 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 physical completion.
   1. Maintain traffic detour routes and project travel ways according to the Traffic Control Plan.

B. The Engineer immediately notifies the Contractor of failure to meet these provisions.
   1. The 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 according to 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 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 within 14 calendar days of the inspection 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 from receipt of the notice of substantial completion, including punch list.

C. Project 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 when the project is determined to be physically complete and identifies any documents required for contract completion within 14 calendar days of the final inspection.

2. Furnish all documentation identified by the Engineer for contract completion within 30 days from receipt of notification of physical completion that includes the final documents punch list.
   a. 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 as specified in Section 00725.
   2. The Engineer responds for differing site conditions changes and requests or claims for additional compensation as specified in 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 an opportunity for strict accounting of actual costs.
D. Submit claim with enough detail to enable the Engineer to understand the basis for entitlement and the resulting costs. Submit the following information with each claim:

1. A detailed statement providing all necessary dates, locations, and items of work affected by the claim.
2. The date on which actions or conditions resulting in the claim occurred or became evident.
3. The specific contract provisions that support the claim and a statement of why they support it.
4. Identification of pertinent documents and the substance of any relevant verbal communications relating to the claim.
5. A statement whether the additional compensation or extension of time is based on contract provisions or an asserted breach of contract.
6. Include the following for time extension or compensation for delay requests:
   a. A schedule impact analysis that clearly defines the delay.
   b. The specific reasons a time extension should be granted.
   c. Documents and reports specified for determining compensation and contract time extension for excusable delays under Section 00555.
7. The exact amount of additional compensation sought and a breakdown of the cost into the following categories:
   a. Direct labor
   b. Direct materials
   c. Direct equipment
      1) Do not exceed actual internal costs on rates claimed for each piece of equipment.
   d. Field indirect costs
   e. Home office overhead
   f. Subcontractor's claims
      1) Provide the same level of detail as specified in contract documents for any subcontractor’s claims.
8. Certification – Submit a statement to the Engineer containing the following language:

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Company</th>
</tr>
</thead>
</table>

hereby certifies that the claim for extra compensation and time, if any, made herein for work on this contract is a true statement of the actual costs incurred and time sought, and is fully documented and supported under the contract between the parties.
Dated _______________ signed ______________________________
Subscribed and sworn before me this _______day of ______________
Notary Public ________________________________________________
My Commission Expires _________________________________________

E. Failure to either submit information and details as specified in this Section for any claim or failure to submit any claim before the date of final payment 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 payment.

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 project 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. Make the following documents available to auditors at a minimum:
   1. Daily time sheets and supervisor’s daily reports.
   2. Union agreements, if any.
   3. Insurance, welfare, and benefits records.
   4. Payroll registers.
   5. Earnings records.
6. Payroll tax forms.
7. Material invoices, purchase orders, requisitions, and all material and supply acquisition contracts.
9. Equipment records including internal rates charged to the project.
10. Vendor rental agreements and subcontractor invoices.
11. Subcontractor payment certificates.
12. Canceled checks (payroll and vendors).
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.
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.
22. Any other Contractor documents that the Department deems necessary to assess the validity of a claim.

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

1.26 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. 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 based on the Contractor’s request for a higher-level review.
   1. The claim may be presented informally with or without legal counsel.
   2. Notify the Department at least 10 calendar days before the hearing when using legal counsel.

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

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

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

E. The Contractor has the option of rejecting and appealing the Department’s decision to the State Procurement Appeals Board according to Utah Procurement Code Title 63G, Chapter 6.

1.28 SAFETY PERSON PROJECT REQUIREMENTS

A. Protect the health and safety of the contractor, subcontractors, employees, and the public.

B. Employ a qualified safety person.
   1. Required qualifications
      a. Verifiable broad based safety background.
      b. Completed OSHA 500 Train the Trainer Course.
   2. Responsibilities
      a. Perform on-site safety inspections on a weekly basis. Refer to the UDOT Safety and Health Manual.
      b. Coordinate all safety related efforts with the on-site competent safety person.
      c. Cannot include production-related responsibilities.

C. Designate an on-site competent safety person.
   1. Qualifications
      a. Must have taken and passed an OSHA 30 class or have equivalent training and education.
2. Responsibilities
   a. Perform daily documented pre-shift and post-shift work activity evaluations for the purpose of preventing work place accidents.
   b. Oversee and correct any condition that is unsanitary, hazardous, or dangerous in any way to the health or safety of the project employees or the public.
   c. Identify existing and predictable hazards and take prompt corrective measures to eliminate them.

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 Compliance
D. Section 01554: Traffic Control

1.3 REFERENCES

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

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 caused from violations of any of the above listed items resulting from any negligent or wrongful act, error or omission, or other liability imposed by law, whether violated by employees, agents, or contractors of the following:
1. The Contractor
2. Subcontractors at any tier
3. Suppliers of materials or services
4. Design Professionals engaged by the Contractor and persons under their control
5. Any others 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:
1. Discrimination because of race, religion, color, sex, age, disability, or national origin and that define actions required for Affirmative Action and Minority/Disadvantaged Business programs.
2. Employment and verification of employment eligibility of all people employed by any Contractor or Sub-Contractor performing work. Compliance must be according to provisions of USC Section 1324A and Utah Code Section 63G-12-302.

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.
G. Coordinate with and receive written approval from the Utah Department of Technology Services (DTS) Information Technology (IT) Director assigned to the Department through the Engineer before beginning any IT related activities as defined in Utah Code, Section 63F-1-102.
1. Do not engage in software development without such prior written approval from the Engineer.
2. The Department will not consider modifying this contract to include or alter IT elements without coordination and written approval from the DTS IT Director assigned to the Department through the Engineer.

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, that it may be obligated to pay as a result of an infringement during 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 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 protect the safety and convenience of the public and property.

C. Provide, erect, and maintain all traffic control devices such as barriers, barricades, and warning signs according to the TC Series Standard Drawings and Section 01554 requirements to protect the work and the public safety.
   1. Use barriers and barricades to delineate highway sections closed to traffic.
   2. Illuminate obstructions during darkness and provide warning signs to control and direct traffic.
D. Erect warning signs for work that may interfere with traffic or where new work crosses or coincides with an existing road.
   1. Place and maintain warning signs according to the project traffic control plan.
   2. Obtain approval before dismantling or removing traffic control devices.

E. 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 the location of monuments and property line markers and provides written approval before they are moved, disturbed, or damaged.

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

D. Restore damaged property and items removed temporarily during construction to a condition similar or equal to that existing before the damage at no 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. 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. The Department’s authorized representatives are not liable either personally or as employees of the Department for actions in their ordinary course of employment.

1.16 NO WAIVER OF LEGAL RIGHTS UPON COMPLETION

A. The Department makes final inspection and notifies the Contractor of acceptance upon completion of the work.
   1. Acceptance does not prevent the Department from correcting any measurement, estimate, or certificate made before or after completion of the work.
   2. The Department is not prevented from recovering from the Contractor or Surety or both, overpayment sustained for failure of the Contractor to fulfill the obligations under the contract.
   3. A waiver from the Department for any breach of any part of the contract is not held as a waiver of any other or subsequent breach.

B. Assume liability to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud or as regards to the Department’s rights under any warranty or guaranty without prejudice to the terms of the contract even after completion.

1.17 RESPONSIBILITY FOR DAMAGE CLAIMS

A. Protect, indemnify, and hold the State of Utah, the Department, and their officers, agents, and employees 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. The Department pays for its own attorneys’ fees, costs, and expenses if it has its own counsel. Total defense costs will be apportioned accordingly upon determination by the court of the proportionate liability for the claim. For example, if the court finds the Department to be 60 percent liable for the claim and the Contractor 40 percent liable, then the
C. Contractor and the Department agree to provide each other with a copy of the summons and complaint within two working 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 1.18 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 contract completion.
   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 Department 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 carrier believes is pertinent to the determination of any liability.
   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 will hold in-person hearings and rely 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

A. The Contractor must bid using Insurance Program #1 for projects where the Engineer’s Estimate is less than $75,000,000. The Contractor must bid using Insurance Program #2 for projects where the Engineer’s Estimate is equal to or greater than $75,000,000.

B. Insurance Program #1
   Provide insurance according to the requirements listed in this section. Include cost for insurance in the bid prices.
   1. Workers' Compensation Insurance
      a. Provide Workers’ Compensation Insurance to cover full liability. Comply with the statutory limits defined by the State of Utah as a minimum.
   2. General Liability Insurance
      a. Provide General Liability insurance with the following minimum limits of liability:
         1) $1 million Bodily Injury and Property Damage – Each Accident
         2) $2 million General Aggregate
         3) $2 million Products and Complete Operations Annual Aggregate
   3. Automobile Liability Insurance
      a. Provide Automobile Liability Insurance for claims arising from the ownership, maintenance, or use of motor vehicles involved in project work with the following minimum limits:
         1) $1 million combined single limit bodily injury and property damage per occurrence
4. Provide the following for all required liability insurance policies:
   a. Name the State of Utah and all institutions, agencies, departments, authorities, and instrumentalities, and while acting within the scope of their duties, all volunteers as well as members of governing bodies, boards, commissions, and advisory committees as insured where and when applicable in respect to work to be performed under this contract.
   b. Coverage for the above insured is primary and not contributing.
   c. Incorporate into the insurance policy this statement: “Insurance coverage is extended to include claims reported up to one year beyond the date of substantial completion of this contract.”

5. Provide the Department with certificates of insurance showing that they are covered as required 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 notice before cancellation or change in coverage. The Department may object within five days of receiving written notice that the Contractor intends to cancel its insurance or change coverage to the extent that it does not comply with the contract requirements. The Department may cancel this contract immediately or sue for an injunction or any other legal remedy to require Contractor to keep its current coverage if Contractor cancels coverage or changes coverage despite that objection.

6. Regardless of the Contractor insurance requirements required in this section, insolvency, bankruptcy, or failure of any insurance company to pay all claims accrued does not relieve Contractor of any obligations.

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

8. The Engineer gives the Contractor written notice that the certificates need to be modified so as to give the Department the required endorsements if the Department discovers that the Contractor’s policies are not endorsed to the Department.
   a. Complete within 10 calendar days.
   b. Provide new certificates to the Engineer at that time.
   c. The Department may terminate the Contractor for Default as specified in Section 00555 if certificates are not obtained.

C. Insurance Program #2
   The Contractor must participate in the Department Owner Controlled Insurance Program (OCIP). Include cost for insurance in the bid prices.
   1. Refer to http://www.udot.utah.gov/go/standardsreferences for OCIP General Conditions for coverage limits and conditions.
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. Subletting or contracting for material hauling by truck, including from an owner-operator, an approved subcontract is required before work when:
   1. Hauling from any point or place within the project to any other point or place within the project.
   2. Hauling material that is not the property of the contractor from a point or place on the project to a point or place outside of the project.
   3. Hauling from a site of work location as defined in Section 00570 to a point or place on the project.
   4. Hauling from a point or place on the project to a site of work location as defined in Section 00570.
   5. Hauling is performed by a commercial materials supplier or an independent third-party that places and incorporates the material into the project.
   6. Hauling is performed by a Disadvantaged Business Enterprise (DBE) firm.
      a. Refer to Part XII Bid Conditions Disadvantaged Business Enterprise (DBE) Section F. Counting DBE Participation Toward Goals for Performance.

C. Contracting for material hauling by truck, including from an owner-operator, an approved subcontract is not required when:
   1. Hauling Contractor-owned materials from a point or place on the project to a point or place outside of the project.
   2. Hauling is performed by a commercial materials supplier or a third-party and unloaded at a point or place on the project solely for the convenience of the supplier or transporter.
   3. A DBE trucking company leases additional trucks.
      a. Provide lease agreement to the Engineer before work.
      b. Refer to Part XII Bid Conditions Disadvantaged Business Enterprise (DBE) Section F. Count DBE Participation Toward Goals for Performance.
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, 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
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 according to 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.
   2. Consider “lump sum” or “each” payment as full compensation for all resources necessary to complete the work.

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

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

F. Volume
   1. The Department measures 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 to volume as determined by the Engineer before using this method of measurement for computing pay quantities.

G. Weight
   1. The term “ton” means 2,000 pounds avoirdupois.
   2. Measure aggregate weight in the saturated surface dry condition.
H. Standard manufactured items such as fence, wire, plates, rolled shapes, or pipe conduit are identified by gauge, unit, weight, or section dimensions.
   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 an inch.

1.7 WEIGHING REQUIREMENTS AND PROCEDURES

A. Weigh all materials that are measured or proportioned by weight, or contract items measured by the ton, such as aggregates and asphalt materials, on scales that have been approved, certified, and that meet specification requirements.
   1. Obtain certified haul truck tares at times as directed by the Engineer and place a legible identification mark on each truck.
   2. The Department may return to be reweighed any loads that appear to be deficient or questionable.

B. Furnish, erect, certify, and maintain, or use permanently installed and certified commercial scales for weighing highway and bridge construction materials that are required to be proportioned or measured and paid for by weight.
   1. Scales must be accurate within the limits set by the laws of the State of Utah and meet requirements of the U.S. Bureau of Standards.
   2. Scales must bear a current seal of acceptance from the State of Utah Department of Agriculture, Division of Weights and Measures.
   3. Have the Utah State Department of Agriculture Division of Weights and Measures inspect and seal all scales at least once a year and after each setup before use, or as requested by the Engineer.
   4. Install and maintain platform scales with rigid bulkheads at each end. The platform must be level.
      a. Platform scales must be of adequate size and capacity so the entire power unit and hauling unit can be weighed at the same time.
   5. Physically arrange electronic, beam, dials, platform, and other scale equipment for convenient and safe viewing by the operator and inspector.
C. Include costs in the unit contract prices for the various pay items of the contract 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.

D. Request written approval to use alternate weighing devices.

PART 2  PRODUCTS  Not Used

PART 3  EXECUTION  Not Used

END OF SECTION
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 00727: Control of Work
   D. 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 release 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 cost, 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 change order authorizing the work. Use one of the following methods as agreed upon by the contractor and Engineer.

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. The Engineer may use average unit bid prices that are representative of the work to be performed when contract unit prices are not representative of the changed or added work to be performed.

1. The Engineer will modify average unit bid prices to reflect location and quantity when possible.
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.

b. The following markups will be allowed (on the subcontracted amount only) when the work is performed by a subcontractor:
   1) 15 percent on first $75,000
   2) 10 percent on amounts exceeding $75,000 up to $250,000
   3) 7.5 percent on any amount in excess of $250,000

2. No other expenses will be compensated unless approved by the Engineer.

D. Negotiated lump sum or unit prices 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 assessment. Support the price with a detailed cost estimate that includes the following information:

1. Estimated Labor hours based on agreed upon productivity rates.
   a. Use the actual cost of wages, benefits, burdens, and other labor related expenses for the labor rates applied to the estimated man-hours.
   b. Include certified accounting records verifying these costs or make them available upon request of the Engineer.

2. Estimated Material quantities based on agreed upon quantities.
   a. Use actual material costs as verified by supplier estimates or invoices.
   b. Use agreed to production rates for material produced on site such as granular borrow or UTBC.

3. Estimated Equipment hours based on agreed upon productivity rates.
   a. Use the lesser of the following for determining equipment costs:
      1) Rental rates obtained from the Rental Rate Blue Book for Construction Equipment according to this Section, article 1.11.
      2) Actual cost of the equipment to the Contractor based on internal equipment billing rates or actual rental rates supported by rental agreements for equipment applied to the estimated equipment hours. Include certified accounting records substantiating these costs or make them available upon request of the Engineer.

4. A 15 percent markup will be paid on all expenses identified above. This markup compensates the Contractor for home office overheads, profit, and incidental costs.
5. The following additional markups will be allowed on work performed by subcontractors:
   a. 15 percent on first $75,000.
   b. 10 percent on amounts exceeding $75,000 up to $250,000.
   c. 7.5 percent on any amount in excess of $250,000.
6. No other expenses will be compensated unless approved by the Engineer.

1.10 COMPENSATION FOR EXCUSABLE DELAYS

A. Document all claimed costs resulting directly from a delay caused by the Department. Refer to Section 00555.
   1. Use actual internal cost records kept in the usual course of business to justify added costs. Such records must comply with generally accepted accounting principles.
   2. The Department does not compensate for the following:
      a. Profit more than provided according to this Section.
      b. Loss of profit.
      c. Labor inefficiencies.
      d. Consequential damages, including but not limited to, loss of bonding capacity, loss of bidding opportunities, and insolvency.
      e. Any indirect costs or expenses.
      f. Attorney’s fees, claims preparation expenses, or litigation costs.

B. Compensable costs will be determined as follows:
   1. Direct Costs – Actual certified costs of the Contractor’s workforce and equipment idled by the delayed activity.
   2. Field Indirect Costs – Actual certified cost increases for job-site supervision and field office operating costs or other costs not directly associated with a particular work activity for the period of delay.
   3. Home Office Overhead – The markup allowed on all change orders includes the cost of home office overheads associated with that change in the project scope of work.
      a. Demonstrate the following to be entitled to alleged additional compensation for under-absorbed home office overhead costs:
         1) Under absorption actually occurred, meaning there was less revenue overall in relationship to home office costs and that no replacement work was obtained.
         2) The under absorption was a direct result of the project.
3) The Contractor could have reasonably obtained specific replacement work that the alleged delay made impracticable.

b. Submit the following information supporting the claim additional costs:
   1) The previous five years audited financial statements that include as a minimum the following information:
      a) Summaries of actual home office overhead costs.
      b) Total revenues generated annually sorted by each project worked on during the year.
      c) The amount of gain/loss earned for each active project during each year.

   c. The amount will be calculated as shown below if additional payment for home office overheads is justified:
      1) No unabsorbed home office overheads will be reimbursed for the first ten calendar days of the delay-causing event.
      2) Calculate home office overhead costs from the eleventh calendar day of the delay-causing event through the events end if the project is between 0 and 90 percent complete.
      3) Use the following formula to calculate home office overhead costs:

\[
E = D \times \frac{0.03(A)}{C}
\]

Where:
- 0.03 = Allowed markup for home office overheads
- A = Original contract value
- C = Total contract duration in calendar days including approved time extensions
- D = The agreed upon number of calendar days the project is delayed due to the delay-causing event minus ten
- E = Total reimbursable amount for unabsorbed home office overhead

4) No home office overheads will be reimbursed if the delay occurs after the project is 90 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 according to 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 for the convenience of the Department or when the Contractor and Engineer are unable to negotiate an agreed upon price for changed or added work. Costs reimbursed according to this Section are considered full and complete compensation for the work performed.

B. Labor will be reimbursed at the actual cost of wages, benefits, burdens and other related expenses that are agreed to by the Engineer. A 15 percent markup will be paid on all labor expenses. This markup compensates the Contractor for field overheads, home office overheads, profit, and incidental costs.
   1. Provide daily field records showing the labor hours charged to the force account work. The Engineer must approve these records daily.
   2. Include certified accounting records verifying these costs or make them available upon request of the Engineer.

C. Materials installed and accepted by the Engineer as part of the force account work will be paid for at actual cost plus a 15 percent markup. The markup compensates the Contractor for field overheads, home office overheads, profit, and incidental costs.
   1. Provide daily field records showing the materials installed as part of the force account work. The Engineer must review and approve these records daily.
   2. Include copies of invoices and certified accounting records verifying these costs or make them available upon request of the Engineer.

D. Compensation for Equipment
   1. The Department will pay the lesser of the following:
      a. Actual cost of the equipment to the Contractor based on internal equipment billing rates or actual rental rates supported by rental agreements. Provide certified accounting records substantiating these costs. The rates cannot exceed the rate included in the contractor's original contract bid.
      b. Hourly rates for machinery or special equipment, excluding small tools, authorized by the Engineer. Hourly rental rates are determined by the monthly rental rate found in the Rental Rate Blue Book for Construction Equipment divided by 176. The total hourly rates have been computed from equipment costs currently in effect and do not include costs for operating personnel.
References

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

2) 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. The duration of allowable standby time must be approved in writing by the Engineer with a maximum of eight hours per day or 40 hours in a week.

3) The Department uses the shown capacity that is closest to the manufacturers when the manufacturer’s rated capacity falls between those shown in the Rental Rate Blue Book for Construction Equipment.

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. The Department allows hourly operating rate for equipment moved to the site under its own power. 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. 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. 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. 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. Such rentals must be supported by a cost analysis indicating the method used was the least expensive. 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.

2. The Department does not pay for pickup trucks used solely for transportation.
3. Provide daily field records showing the equipment hours charged to the force account work. The Engineer must review and approve these records daily.
4. Provide certified accounting records verifying these costs.

E. Subcontract work will be reimbursed in the same manner as the Contractor’s work is reimbursed as described above.
1. The Contractor will be allowed the following markups on force account work performed by subcontractors:
   a. 15 percent on first $75,000.
   b. 10 percent on amounts exceeding $75,000 up to $250,000.
   c. 7.5 percent on any amount in excess of $250,000.
2. Provide daily field records showing the subcontract labor, material, and equipment charged to the force account work. The Engineer must review and approve these records daily.
3. Provide certified accounting records verifying these costs.

1.12 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 according to 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:
   1. Retention for subcontracted work is paid upon satisfactory completion and acceptance by the Department. Refer to Section 01284.
   2. 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.
      a. The Department will waive the 30 day limit and pay advance payment for Pavement Marking Tape if the Pavement Marking Tape placement is delayed more than one week beyond the original CPM schedule date.
   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 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 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 as specified in 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.
   3. The consent of the Surety is required for the final estimate when a semi-final estimate is not processed.

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 invoked by the Contractor and remains in effect for the duration of the contract.

B. Abbreviations and Terms
      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.
   3. Fuel Factor (FF) – A combined diesel and gasoline usage factor established for purposes of calculating the Fuel Cost Adjustment.
      a. Table 1 shows the items of work eligible for adjustment.
   4. Fuel Cost Adjustment (FCA) – The fuel cost adjustment in dollars determined according to this article.
C. Determining FCA
1. FCA applies only to acceptable work performed on individual contract items in Table 1 with values of more than $100,000 based on original contract quantities, unless otherwise specified in Table 1.
2. FCA does not apply to work added by change order.
3. FCA may be positive or negative depending on the changes or differences between the BPf and the EPf.
4. Work performed after the expiration of contract time 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

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

When the EPf is more than 15 percent below the BPf

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

Where:

\[
\begin{align*}
Q & \quad \text{Quantity of acceptable work performed} \\
FF & \quad \text{Fuel factor for } Q \\
42 & \quad \text{Conversion of gallons of fuel per barrel of crude}
\end{align*}
\]

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**

<table>
<thead>
<tr>
<th>Item of Work</th>
<th>Quantity of Work (Q)</th>
<th>Fuel Factor (FF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Excavation, Borrow, Granular Borrow, Top Soil</td>
<td>Ton</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>0.45</td>
</tr>
<tr>
<td>Underdrain Granular Backfill</td>
<td>Cubic Yard</td>
<td>1.16</td>
</tr>
<tr>
<td>Untreated Base Course</td>
<td>Ton</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>1.63</td>
</tr>
<tr>
<td>Hot Mix Asphalt</td>
<td>Ton</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>7.00</td>
</tr>
<tr>
<td>Open Graded Surface Course</td>
<td>Ton</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>6.80</td>
</tr>
<tr>
<td>Stone Matrix Asphalt (SMA)</td>
<td>Ton</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>6.80</td>
</tr>
<tr>
<td>Warm Mix Asphalt (WMA)</td>
<td>Ton</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>6.80</td>
</tr>
<tr>
<td>All Other Asphalt Mix Products with Mix Design</td>
<td>Ton</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>Cubic Yard</td>
<td>6.80</td>
</tr>
<tr>
<td>Rotomilling</td>
<td>Sq Yd</td>
<td>0.03</td>
</tr>
<tr>
<td>Profile Rotomilling</td>
<td>Sq Yd</td>
<td></td>
</tr>
<tr>
<td>In-Place Cold Recycled Asphaltic Base</td>
<td>Sq Yd</td>
<td></td>
</tr>
<tr>
<td>Recycled Surface</td>
<td>Sq Yd</td>
<td></td>
</tr>
<tr>
<td>Chip Seal Coat</td>
<td>Square Yard</td>
<td>0.03</td>
</tr>
<tr>
<td>Portland Cement Concrete Pavement</td>
<td>Sq Yd-In</td>
<td>0.214</td>
</tr>
<tr>
<td>Lean Concrete Base Course</td>
<td>Sq Yd-In</td>
<td>0.048</td>
</tr>
<tr>
<td>Riprap</td>
<td>Cubic Yard</td>
<td>0.57</td>
</tr>
<tr>
<td>Bridges exceeding $500,000</td>
<td>$</td>
<td>0.038</td>
</tr>
<tr>
<td>Includes the following items:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Concrete, Piles, Peeling, Steel, Prestressed Concrete Members, and Structural Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 inch and larger pipe culvert – combined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>items exceeding $200,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 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.
B. The Department adjusts the price of asphalt materials for acceptable work performed on bid items that contain asphalt materials.

C. Abbreviations and Terms
   a. On the first Monday of each month, the Department determines the EPa using price values from the most recent Poten & Partners Asphalt Weekly Monitor and Argus Asphalt Report. The Department averages all values for the following, eliminating the single highest and single lowest values, before averaging.
   1) The high reported selling price (per ton) of typical non-modified paving grades of asphalt from the Asphalt Weekly Monitor.
      Arizona
      - Phoenix area
      - Flagstaff area
      - Tucson area
      Idaho
      - Boise area
      - Eastern markets
      - Northern markets
      Nevada
      - Las Vegas area
      - Reno area
      New Mexico
      - Eastern markets
      - Western markets
      Utah
      - Salt Lake City area
   2) The high reported wholesale asphalt price (per ton) from the Argus Asphalt Report for Rocky Mountain and West coast asphalt prices for:
      Arizona
      Colorado
      Idaho/East Washington
      Montana
      Nevada
      Utah
      Wyoming
   b. This average value is then averaged with values obtained in the same manner for the previous three weekly reports to establish the EPa.
c. The EPa remains in effect until the first Monday of the following month and is used for regular partial estimates closed before the first Monday of the following month.

2. Base Price for asphalt (BPa) – The contract base asphalt price, equal to the EPa in effect on the date of the contract bid opening or other date where prices are submitted for the establishment of a contract such as the proposal submittal date for a design build project.

3. Adjusted Base Price for asphalt (ABPa) is 115 percent of the BPa on the up side and 85 percent of the BPa on the down side. No price adjustment will be paid when the EPa is between 85 percent and 115 percent of the BPa.

4. Asphalt cost adjustment (ACA) – The asphalt cost adjustment in dollars determined according to this article.

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

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

F. Adjustment Formula

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

\[
ACA = \left(\frac{EPa - ABPa}{T}\right)
\]
No price adjustment will be paid when the EPa is between 85 percent and 115 percent of the BPa.

Where:

\[ T = \text{Quantity in ton of Asphalt Binder Materials used} \]

The Engineer determines T as follows:

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

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.

PART 2 PRODUCTS  Not Used

PART 3 EXECUTION  Not Used

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section applies to Federal-aid contracts only.
   1. Refer to Utah Code Title 15, Chapter 06 for State-funded contracts.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. Utah Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 SUBCONTRACTS

A. Include in the subcontract language a clause agreeing to pay all retainage owed to the subcontractor for satisfactory completion of the accepted work within 30 calendar days after receiving payment from the Department.
   1. A subcontractor’s work is considered satisfactorily complete when all work included in the subcontract is completed according to the requirements of the contract and documented as required by the Department. Refer to this Section, article 1.8, paragraph B.
      a. Partial work is considered to be satisfactorily completed when the Department accepts that portion of the work.

1.7 PROGRESS PAYMENTS

A. Pay subcontractors for satisfactory performance of subcontracted work no later than 30 calendar days after receiving payment from the Department.
   1. Enter the dates that payments are sent to the subcontractor into the UDOT PDBS Subcontractor Payment Screen within 30 calendar days of receiving payment from the Department.
   2. The Department considers the entry of payment dates into PDBS as an affidavit certifying prompt payment by the prime Contractor.
      a. The entry date is tied to the date the pay estimate is processed by the Department’s comptroller.
b. The entry will be flagged red, indicating failure to make prompt payment, if the entry date is more than 30 calendar days after the comptroller processing date.

1.8 RETAINED MONEY

A. Pay retained money owed to the subcontractor for satisfactory completion of the subcontracted work, as documented by the Department’s written acceptance, within 30 calendar days after receiving payment from the Department.

B. Require notification from the subcontractor when all subcontracted work is complete.
   1. Notify the Engineer in writing within two working days after notification from the subcontractor.
   2. The Engineer schedules and coordinates an inspection for acceptance of the work within three working days.
   3. The Engineer issues written notification when the work is considered to be satisfactorily complete and accepted.
      a. Acceptance of the work includes all requirements of the contract, agreement on pay quantities, and all documentation required by the Department.
   4. The Department releases an amount equal to the subcontractor’s retention upon acceptance of the work.

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

1.9 PAYMENT DELAY

A. Delay payment only for cause and document the reason in the comments area of the UDOT PDBS Subcontractor Payment Screen. This will serve as notification to the Department.
   1. Send written notification to the subcontractor.
   2. The prime contractor is considered non-compliant if no payment is made to the subcontractor and there are no comments in PDBS explaining why the subcontractor’s payment is being withheld for cause.
      a. The prime contractor is subject to the provisions in this Section, article 1.10.
   3. The Department may withhold the dollar amount of delayed payment, including retention, from future estimates.
B. Provide subcontractor 15 calendar days from the date of written notification to correct all deficiencies.
   1. Release payment upon receipt of documentation demonstrating correction of deficiencies within 15 calendar days.

C. Include language in the subcontract that provides for the use of appropriate alternative dispute resolution mechanisms to resolve payment disputes.
   1. The Department may hold disputed funds in escrow until the dispute is resolved.

1.10 FAILURE TO MAKE PROMPT PAYMENT

A. The Engineer will provide written notification to the Contractor upon determination of failure to make prompt payment.
   1. Make prompt payment within three working days of receiving written notification.

B. The Department considers failure to make prompt payment a contract violation for which the Contractor is subject to the following measures:
   1. Forfeit the privilege of bidding on Department projects until payment covered by this Section is made.
   2. Forfeit the privilege of having a subcontract to perform work or supply materials on Department projects until payment is made according to this Section.

C. The Department may consider additional measures up to and including debarment for repeated failure to make prompt payment.

D. The Department may employ other mechanisms consistent with this Section and applicable state and local law so payment is fully and promptly made.

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 length of a project.

1.2  RELATED SECTIONS

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

1.3  REFERENCES  Not Used

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used

1.6  PERFORMANCE REQUIREMENT

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

1.7  PIC RESPONSIBILITIES

A.  Establish a local public information office.  Office may be located within the Contractor’s regular office provided that the telephone number is a local call or toll-free number for project stakeholders.
   1.  Maintain established working hours and days.
   2.  Provide a telephone or cell phone with voice mail capability dedicated to project public information services.

B.  Maintain daily communication with the Engineer.

C.  Maintain and document weekly communications with Region Public Involvement Manager, affected residents, businesses, organizations, and public agencies such as local emergency services, public works, transit authorities, city offices, and other stakeholders.
D. Maintain telephone availability.
   1. Maximum 12 hour response time during project working hours.
   2. On-call status required during non-working hours.

E. Develop a database of stakeholders and stakeholder contact information including name, address, phone number, e-mail address, and fax number.

F. Establish method of producing and distributing printed fliers and e-mail information.

G. Organize, participate in, and document public and private meetings involving project when requested by the Engineer.

H. Refer to Section 00555.

1.8 PAYMENT PROCEDURES

A. Department makes:
   1. Partial payments for the pay item Public Information Services as the work progresses when the Contractor provides public information services according to this specification.
   2. Payments based on a percentage of project completion.

B. The Engineer and the Region Public Involvement Manager monitor and evaluate the Public Information Coordinator and all public information services. Failure to provide public information services according to this specification results in a weekly deduction of between $1,000 and $10,000.

PART 2 PRODUCTS

2.1 OFFICE SPACE AND EQUIPMENT – GENERAL

A. Office Space

B. Telephone Services

C. Labor and material required to perform the duties and responsibilities of this section.
PART 3      EXECUTION

3.1      ESTABLISH LOCAL PUBLIC INFORMATION SERVICES

A.      Provide office address and local or toll-free telephone number.
        1.      Establish and publish office hours, working days, telephone
                number, and e-mail address.
                a.      Answer all e-mail within 12 hours of receipt during business
                        hours.

B.      Provide voice mail service.
        1.      Update message with project information a minimum of once each
                week concerning the activities on the project.
        2.      Provide public information office hours.
        3.      Opportunity for caller to leave a recorded message.
        4.      Check voice mail a minimum of twice daily.
        5.      Document and respond to messages within 12 hours of receipt.

C.      Maintain a logbook.
        1.      Communication information.
                a.      Date, time
                b.      Contact information
                        1)      Name, phone number, address, and e-mail address
                c.      Description of inquiry or request
                d.      Response
                e.      Subsequent responses or actions taken during construction
        2.      Follow up all inquiries with a phone call, in writing, or with a meeting
                as required.
        3.      Document discussions, resolutions, and actions.
                a.      Provide weekly copies of logbook documentation to the
                        Engineer and Region Public Involvement Manager.

D.      Develop and maintain database of stakeholders and stakeholder contact
        information including name, address, phone number, e-mail address, and
        fax number.
        1.      Make database available for review by the Engineer and Region
                Public Involvement Manager at all times during the project
        2.      Deliver to the Region 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 before beginning construction and subsequently each week until the end of the project.
   1. Provide copies of all fliers, e-mail, or other materials containing project information to the Engineer and the Region Public Involvement Coordinator for review before distribution.
   2. Include the following information in the flier:
      a. Project name
      b. Description of work to be done including completion dates
      c. Work locations
      d. Lane restrictions and directions
      e. Traffic management plans or detours
      f. Work times and days of the week
      g. Impacts to access
      h. Schedule for coming week
      i. Name of the Contractor’s Public Information Coordinator, telephone number, and office hours of the Public Information Office.
3. Communicate construction changes to established weekly schedule to all affected stakeholders. Provide draft copy of changes to Engineer before distribution.

I. Provide telephone number to sign manufacturer or Traffic Control Maintainer for placement on Construction Zone Information Sign. Refer to TC Series Standard Drawings and Section 01554.

J. Provide telephone number to sign manufacturer or Traffic Control Maintainer for placement on a “Project Notification Sign” according to TC Series Standard Drawings with legend (text) determined in coordination with Region Public Involvement Manager.

K. Provide updates to the Engineer and Region Public Involvement Manager on project activities that affect traffic and access.

L. Forward all media inquiries, written and verbal, regarding the project or project activities to the Region Public Involvement Manager or the Department Communications Office.

END OF SECTION
SECTION 01355
ENVIRONMENTAL COMPLIANCE

PART 1      GENERAL

1.1      SECTION INCLUDES

A. Processes and guidance for compliance with federal and state environmental regulations and provisions of this Section.

1.2      RELATED SECTIONS       Not Used

1.3      REFERENCES

A. American National Standards Institute (ANSI)
B. State Department of Environmental Quality (DEQ) Regulations
C. Title 40, Code of Federal Regulations (CFR)
D. U.S. Environmental Protection Agency (EPA) Regulations
E. Utah Administrative Code

1.4      DEFINITIONS

A. Ephemeral Channel – A natural channel that flows as a result of a storm event.
B. Fugitive Dust – Small particles originating primarily from soil that are suspended in the air by the wind and by human activities.
C. Intermittent Stream – A stream that flows seasonally.
D. Noise Receptor – Any property where frequent human use occurs and where a lowered noise level would be of benefit.
E. Percussive Noise – Short bursts of noise including but not limited to blasting, pile driving, and jack-hammering.
F. Perennial Stream – A stream that has continuous flow during years of normal rainfall.
G. Sound Level – The average sound pressure level from all concurrent construction activities related to the project as measured with a sound level meter using the A-weighting network (ANSI S1.4). The standard notation is dB(A) or dBA.

1.5 SUBMITTALS

A. Submit a fugitive dust control plan to the Utah Division of Air Quality (DAQ) before construction. Refer to this Section, article 3.5.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 HAZARDOUS MATERIAL DISCOVERED DURING CONSTRUCTION

A. Immediately suspend work in the area if abnormal conditions are encountered or exposed during construction that indicates the presence of a hazardous material or 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, sludge, 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 for a link to a list of hazardous wastes.
   1. Notify the Engineer immediately after the discovery.
   2. Notify the DEQ according to R315.9 of Utah Administrative Rules. 24-hour phone number (801) 536-4123.
   3. The Engineer will 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 DEQ and the EPA regulations and requirements.

D. Dispose of hazardous material and toxic or hazardous waste under the direction of the Engineer according to the remediation plan and requirements and regulations of the DEQ and the EPA.
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 work required to dispose of these materials as “extra work.”

2. The Department will arrange for the disposal of waste materials requiring special procedures by certified personnel.

3.2 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 – Refer to [http://www.udot.utah.gov/go/standardsreferences](http://www.udot.utah.gov/go/standardsreferences):

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 gal
   b. Released to a water body

2. Notify the 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. Implement measures to minimize the spread of contaminants using spill kits or other appropriate methods in the event of a spill of hazardous materials.

C. Capture and dispose of the spilled materials under the direction of the Engineer according to the requirements of the DEQ and the EPA.

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

E. Pay for all required clean-up operations.

3.3 WATER RESOURCE PERMITS

A. Any work in or adjacent to a perennial or intermittent stream or river and some ephemeral channels requires a Regional General Permit 40 (stream alteration permit) issued by the Utah Department of Water Rights.

B. Conform to the general and special conditions of the permit if a permit has been obtained for this project.
C. Any work in wetlands requires a Clean Water Act, Section 404 wetland permit issued by the U.S. Army Corps of Engineers. Refer to the general and special conditions of the permit if a permit has been obtained for this project.

D. Any project that disturbs one or more acres of bare ground, vegetated, or un-paved surfaces requires a UPDES Permit (Storm Water General Permit for Construction Activities), Permit No. UTR300000.
   1. Prepare and submit a Notice of Intent (NOI) to the State of Utah Department of Environmental Quality (DEQ), Division of Water Quality (DWQ) along with a signed copy of the NOI to the Engineer before construction.
   2. Prepare and submit a Notice of Termination (NOT) to the DEQ DWQ with a signed copy of the NOT to the Engineer when disturbed areas have been permanently stabilized.
   3. NOI and NOT forms can be completed online at the DWQ Web site. Refer to http://www.udot.utah.gov/go/standardsreferences.

3.4 OPEN BURNING

A. Do not conduct open burning along highway right-of-way without approval orders from the DAQ.

3.5 FUGITIVE DUST

A. Prepare a fugitive dust control plan for any construction activity that could result in fugitive dust, including:
   1. Disturbing ¼ acre of ground surface or greater.
   2. Demolition activities including razing homes, buildings, or other structures.
   3. Material storage, hauling, or handling operations.
   4. Provide the Engineer documentation that a dust control plan was submitted to DAQ for these types of projects.

B. Minimize fugitive dust from construction activities using methods such as watering and chemical stabilization of potential fugitive dust sources or other methods approved by the DAQ.
   1. Do not exceed 10 percent opacity caused by fugitive dust at the project boundary and 20 percent within the project site. This requirement does not apply when wind speeds exceed 25 MPH and the operator is taking appropriate actions to control fugitive dust.
3. Use procedures similar to Method 9 to conduct opacity observations for intermittent and mobile sources.
   a. The requirement for observations to be made at 15 second intervals over a six minute period does not apply.

C. Minimize fugitive dust from material storage, handling, or hauling operations through the use of covers, stabilization, or other methods approved by the State Division of Air Quality.

3.6 NOISE CONTROL

A. Locate haul routes to minimize noise disturbances to noise receptors.

B. Take measures to avoid construction activities causing sound levels to exceed 95 dBA in daytime (7 a.m. - 9 p.m.) or 55 dBA in nighttime (9 p.m. - 7 a.m.) within 10 ft of the nearest receptor.

C. Schedule work to minimize noise disturbance on Sundays and State holidays in areas with noise receptors.

D. Percussive Noise
   1. Notify affected noise receptors and the local government authority (if applicable) at least two weeks in advance of any percussive noise activity.
   2. Provide documentation of coordination efforts to the Engineer.

3.7 ENVIRONMENTAL CLEARANCE BY THE CONTRACTOR

A. Obtain the following environmental clearances before starting any ground disturbing activity not previously cleared by the project such as wasting project-generated material at offsite locations, importing excavated borrow material from un-cleared sites, or locating equipment, storage areas, office sites, utility lines, or holding ponds.
   1. Cultural and Paleontological – Initiate consultation with a Department staff archeologist. Provide the Engineer documentation of clearance from a qualified archaeologist or paleontologist of historic, archaeological, and paleontological resources, and how each resource may be affected by the activities. The Department staff archeologist provides clearance to the Engineer through written notification.
   2. Threatened or Endangered Species – Provide the Engineer documentation of clearance from a qualified professional of any potential threatened or endangered or other species such as migratory birds, big game, state sensitive species, or fish that may be affected by the activities.
3. Wetlands – Provide the Engineer documentation of clearance from a qualified wetland specialist of the absence of wetlands.

4. Floodplains – Provide the Engineer documentation of clearance that the site is not within the 100 year floodplain.

5. Utah Pollutant Discharge Elimination System (UPDES) – Obtain a separate UPDES permit for storm water discharge from Utah Division of Water Quality (DWQ) when disturbing more than one acre of ground offsite.

B. 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.

C. Environmental clearances are required regardless of the property ownership.

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

A. 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 Department Region staff archaeologist who will assess the nature of the discovery and determine the necessary course of action.

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

E. 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 and dependent on the nature and condition of the discovery.
   2. The Engineer will provide written confirmation when work may resume in the area.

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), Bonded Wearing Course (BWC), 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

1.3 REFERENCES

A. Materials Manual of Instruction

1.4 DEFINITIONS

A. Category 1
   1. Pavement surfaces having two or more opportunities for improving the ride
   2. Portland Cement Concrete Paving

B. Category 2
   1. All other pavements incorporating single lift overlays

C. Opportunity to Improve Ride
   1. Placing gravel or treated base course, Open-Graded Surface Course (OGSC), Bonded Wearing Course (BWC), Stone Matrix Asphalt (SMA), rotomilling, cold recycling, hot-in-place recycling, or each lift of paving.
   2. Lane leveling is not considered an opportunity to improve the ride.

D. Pavement Section
   1. Each travel lane or median, 0.1 mile long, meeting the requirements specified in this Section, article 1.8, paragraph A. Each pavement section is laid out consecutively from the start of the project.
E. Wheel Path
   1. A continuous parallel line 2.5 ft inside the lane or median lines.

1.5 SUBMITTALS

A. Certifications for Profilographs, Profilers, and Operators. Refer to this Section, article 1.6, paragraph A.

B. Summary report of acceptance profile testing for the project. Refer to this Section, article 3.1, paragraph D2.

1.6 GENERAL REQUIREMENTS

A. Certify operators and equipment through the Department. Submit copies of certifications to the Engineer before performing acceptance testing according to the Materials Manual of Instruction.

B. Determine pavement smoothness using a California-type profilograph or profiler.

C. All work necessary to prepare the pavement for testing, including sweeping, is incidental to the work and is not measured for payment.
   1. Include all costs and resources for smoothness testing, preparation, and correction, including traffic control, temporary pavement markings, grinding or milling, disposal of waste material, and flush coat for ground areas in the surfacing bid items.

1.7 ACCEPTANCE

A. The Department evaluates longitudinal deviations for all roadways based on acceptance Profile Index (PI) traces performed by the Contractor.

B. Limit transverse pavement deviations to less than $\frac{1}{8}$ inch from the lower edge of a 10-foot straightedge.

C. Smoothness is evaluated before the placement of Thin Bonded Polymer Overlay, Microsurfacing, Slurry Seal, or Chip Seal Coat when applicable.

D. Limit profile deviations to those specified in Table 1.
   1. Determine the PI for each pavement section by taking the average of all profile traces.
      a. Perform a profile trace in each wheel path.
         1) Include profile trace deviations from bridge decks, approach slabs and transitions, 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 bridge decks, approach slabs and transitions, manholes, valves, and other facilities in the profile trace when the contract does not include adjustment or reconstruction of these facilities.

b. Analyze the profile using 0.2 inch blanking band.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Profile Deviation</strong></td>
</tr>
<tr>
<td><strong>Category</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
</tr>
</tbody>
</table>

1.8 INCENTIVE/DISINCENTIVE

A. Apply Incentive/Disincentive to Category 1 and 2 pavements longer than 1,000 ft in length, including:
1. All traffic lanes
2. Ramps
3. Medians 8 ft and wider
4. Turn lanes
5. Bridges and approach slabs with final riding surfaces placed as part of the contract

B. Do not apply Incentive/Disincentive to:
1. Pavements shorter than 1,000 ft
2. Shoulders
3. Medians narrower than 8 ft
4. Horizontal curves with a centerline curvature radius less than 900 ft and areas within the superelevation transitions to these short radius curves
5. Tapers
6. Surfaces within 15 ft of bridge decks and approach slabs not paved as part of the contract

C. The Department calculates the Incentive/Disincentive for HMA, OGSC, BWC and SMA (final riding surface) according to Table 2. Amounts are prorated for partial pavement sections based on length.
D. The Department calculates the Incentive for PCCP according to Table 3. Disincentive does not apply to PCCP. The disincentive for PCCP is grinding and finish work needed to meet the minimum requirements of this Section, paragraph 1.7.

Table 2

<table>
<thead>
<tr>
<th>Category</th>
<th>Incentive/Disincentive per Pavement Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$150 \times [(\text{Required in/mi}) - (\text{PI})]</td>
</tr>
<tr>
<td>2</td>
<td>$100 \times [(\text{Required in/mi}) - (\text{PI})]</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Category</th>
<th>Incentive per Pavement Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$200 \times [(\text{Required in/mi}) - (\text{PI})]</td>
</tr>
</tbody>
</table>

E. Incentive/Disincentive does not apply to the HMA surfaces on projects that include an OGSC, BWC, or SMA placed over the HMA surface.

F. Grinding on any non-PCCP pavement section exceeding 20 yd$^2$ does not qualify for incentive. Disincentive remains applicable for pavement sections where grinding exceeds 20 yd$^2$. The minimum disincentive for these pavement sections is $1,000 each.

G. Evaluate any ground, non-PCCP pavement section that has microsurfacing, chip seal, slurry seal, or other bituminous layer being placed as part of the contract for thickness acceptance after all grinding and before the placement of the finished riding surface. Refer to Section 02741 for HMA thickness acceptance.

H. Loss of incentive for the section will occur for any pavement section still requiring corrective work identified at the time of acceptance testing. Disincentives remain applicable and are based on the PI obtained at the time of acceptance testing.

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

PART 2 PRODUCTS  Not Used
PART 3 EXECUTION

3.1 PAVEMENT PROFILE CORRECTION

A. Construct finished pavement to meet the requirements of this section.

B. Perform preliminary profiling and roadway smoothness evaluation to identify any defects exceeding acceptance limits.
   1. Correct defects before performing acceptance testing.
      a. Measure and correct defects in HMA surface before the placement of the final OGSC, BWC, or SMA surface course.
      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 surface replacement as approved by the Engineer.
      c. Re-profile for correction verification before acceptance testing.
      d. Seal areas in BWC, OGSC, HMA, and SMA that have been ground with a flush coat application.
         1) Use a CSS-1h, CSS-1, CQS-1, or equivalent emulsion, approximately 40 percent residual asphalt.
         2) Apply the emulsion at 0.11 ± 0.01 gal/yd².

C. Notify the Engineer in writing after all corrective work has been performed and at least two working days before performing acceptance testing for pavement smoothness.
   1. Clearly define each of the pavement sections to be evaluated in the written notification.

D. Perform acceptance testing for smoothness according to this Section, article 1.7.
   1. Perform acceptance testing with Department certified profilers, profilographs, and operators.
   2. Submit a summary report to the Engineer within two working days that includes pavement section identification, trace results, PI summary, and bump location by pavement section.

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 Compliance

1.3 REFERENCES

A. UDOT Materials Manual of Instruction

B. UDOT Minimum Sampling and Testing Requirements

C. Code of Federal Regulations (CFR)

1.4 DEFINITIONS

A. Cost documentation for foreign steel or iron – Material invoices documenting the material cost to the Contractor from the Supplier as delivered to the site, not the Contractor’s bid price.

1.5 SUBMITTALS

A. Copies of test reports to the Engineer.

B. Certificates of Compliance – Refer to this Section, article 1.16, paragraph C.

C. Cost documentation – Refer to this Section, article 1.16, paragraph D2.

D. Provide the Engineer with a written release from the property owner indicating that all conditions of the agreement between the contractor and property owner are satisfied before contract completion. Refer to this Section, articles 1.8 and 1.9.

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 do not meet contract requirements.

D. The Department encourages the re-use of industrial byproducts that meet contract requirements.
   1. Use new materials for the work in cases where industrial byproducts do not meet contract requirements.

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

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

D. 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 project specific 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 the Department.
   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 the Engineer’s approval of the materials site plans before removing any materials.
   2. Meet the requirements established by Utah Division of Oil, Gas, and Mining and other agencies having jurisdiction over the operation of commercial material source sites.

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.
   1. 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.

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.
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 cost to the Department.

B. The Department uses the Minimum Sampling and Testing Requirements, Materials Manual of Instruction, and AASHTO or ASTM standards effective at the time of the work.

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

D. The Department may inspect, test, and reject materials at any time.
   1. Copies of any or all test results will be provided 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, to perform material sampling and testing.

1.11 CERTIFICATE OF COMPLIANCE

A. The Contract or the UDOT Materials Manual of Instruction designate manufactured materials and assemblies that can be incorporated in the work if accompanied by a manufacturer’s Certificate of Compliance that includes the following:
   1. Project number and description, location, and Contractor’s name
   2. Manufacturer’s name, along with the material source location and point of manufacture or assembly
   3. Identification of the party the material was sold or supplied to
   4. Quantity and lot identification or manufacturer’s identification of the certified materials or assemblies delivered to the project
   5. Reference to the particular section or requirement of the contract specifications fulfilled through certification along with test reports when applicable
6. Statement that the material or assemblies comply with the particular requirements of the contract cited above and signed by a manufacturer’s representative in a position to legally bind the manufacturer

B. Photocopies, faxes, and electronically submitted PDF files are acceptable.

C. The Department may sample and test materials or assemblies used on the basis of certificates of compliance and reject if determined not to meet contract requirements.

1.12 PLANT INSPECTION

A. The 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 cost 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. The 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 CFR Part 635.410, Buy America Requirements.
   1. Check the appropriate box on the bid proposal indicating the intent to use steel or iron or both of 100 percent domestic supply or with some foreign supply.
   2. The Department considers the bid a bid for furnishing domestic steel and iron if neither box is checked.
   3. The Department awards the Contract to the bidder who submits the lowest total contract bid based on furnishing domestic steel and iron unless the total contract bid exceeds the lowest total contract bid based on foreign steel and iron by more than 25 percent.

B. All products manufactured from steel and iron must be manufactured in the United States to be considered domestic.
   1. All manufacturing processes of the steel and iron material in a product such as smelting, rolling, extruding, machining, bending, grinding, drilling, and coating must occur within the United States.
2. Coating includes all processes that protect or enhance the value of the material to which the coating is applied. The material applied as a coating is not subject to Buy America.

C. Maintain Material Certifications of Compliance and submit to the Engineer prior to payment and incorporation of the materials into a project.
1. Include as a minimum the following information for Material Certifications of Compliance for Buy America:
   a. Signed mill test report.
   b. Signed certification by each Fabricator and Manufacturer that has handled the steel or iron product affirming that every process, including the application of a coating, performed on the steel or iron product has been carried out in the United States.
   c. Material descriptions, quantities, and means of material identification such as heat numbers, lot numbers, and other industry identification markings for each process the material underwent so the final product can be tracked through a step process from smelting to final product.
2. Include all steel or iron materials that can't be substantiated as being of domestic origin in cost documentation for foreign steel or iron.

D. The above requirement does not preclude a minimal use of foreign steel or iron, provided the cost of the steel or iron used does not exceed one tenth of one percent (0.1 percent) of the total contract amount or $2,500, whichever is greater.
1. The Engineer must pre-approve the use of all permanent foreign steel or iron on the project.
2. Provide satisfactory cost documentation to the Engineer prior to payment and incorporation of the materials into the project when foreign steel or iron is used as provided by this article.

E. Buy America requirements do not apply to temporary steel or iron materials, including materials left in place at the Contractor's convenience.

1.17 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 02744S – Stone Matrix Asphalt
   6. Section 02752 – Portland Cement Concrete Pavement
   7. Section 02785 – Chip Seal Coat
   8. Section 02786 – Open-Graded Surface Course
   9. Section 02787 – Bonded Wearing Course
   10. Section 03055 – Portland Cement Concrete
   11. Section 03310 – Structural Concrete

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress
B. Section 00727: Control of Work
C. Section 02056: Embankment, Borrow, and Backfill
D. Section 02721: Untreated Base Course
E. Section 02741: Hot Mix Asphalt
F. Section 02743: Hot Mix Asphalt – Bike and Pedestrian Paths
G. Section 02744S: Stone Matrix Asphalt
H. Section 02745: Asphalt Material
I. Section 02752: Portland Cement Concrete Pavement
J. Section 02785: Chip Seal Coat
K. Section 02786: Open-Graded Surface Course

L. Section 02787: Bonded Wearing Course

M. Section 03055: Portland Cement Concrete

N. Section 03310: Structural Concrete

1.3 REFERENCES

A. AASHTO R 35: Superpave Volumetric Design for Hot Mix Asphalt (HMA)

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

C. AASHTO T 193: The California Bearing Ratio

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 (HMA)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Engineering analysis within one week of receipt of test results or 24 hours before 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 a Department 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. The option to dispute the validity of the Department’s test results is waived if paired “t” testing is required by specification and is not performed.
C. Include the following items in the engineering analysis where applicable:
   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.

D. The Department immediately reviews the submittal when the 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.

E. The Department reviews the analysis to identify possible discrepancies that can be resolved through validation testing if merit is found. Validation testing may then be performed by the Department as follows:
   1. Department personnel begin repeat testing in the presence of a Contractor’s representative within 24 hours on the material remaining from the original Department test.
   2. Repeat test results are used to validate or invalidate original Department result.
      a. Validation test results may not be used instead of acceptance results.
      b. Base validation on results within two standard deviations of the original acceptance results. Use project acceptance samples to determine the standard deviation.
   3. Invalidated test results are removed from acceptance lot and the lot is reevaluated based on the reduced sample size.
   4. 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 specified price reduction, where applicable.

F. The Resident Engineer, Region Materials Engineer, and Region District 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.

G. The Department and Contractor immediately begin 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. A review of all equipment, procedures, and methods used for sampling, splitting, and testing.
   2. A review of the Department and Contractor's raw test data and calculations for documentation or calculation errors.
   3. Production and testing of additional correlation samples.
   4. Cross-witnessing of test procedures by Contractor Quality Control and Department personnel.
   5. Distribution of any other pertinent information.
   6. Discussion of other possible means for variation.

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.

H. 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.

I. 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) 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, District Engineer, and Resident Engineer determine 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
J. 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.

K. 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.

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

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

N. A review of the Contractor’s schedule and appropriate adjustments to contract time are required when errors are identified in the Department’s testing results. Refer to Section 00555. Time lost due to a rejected analysis is not credited to the contract time.

O. The Contractor may request that “reject material to be removed” be left in place at a reduced pay. Include an engineering analysis with the following items, where appropriate and any other additional items appropriate for the material in question in this request.
   1. Volumetric, durability, and long-term structural properties from one or more of the following tests:
      c. PG Asphalt Binder Tests – Refer to Section 02745.
      d. SuperPave Volumetric Properties – Refer to AASHTO R 35.
      e. California Bearing Ratio – Refer to AASHTO T 193.
      f. Obtaining and Testing Drilled Cores and Sawed Beams from Concrete Pavement and non-reinforced Portland Cement Concrete – Refer to AASHTO T 24. Samples from reinforced structures may be taken only as approved by the Engineer.
   2. Recommendation for a price adjustment based on expected long-term performance.

P. The response submitted to the contractor concludes this materials dispute resolution process. Continuing disputes must be addressed and escalated as outlined in Section 00727 and the UDOT and Utah AGC Partnering Field Guide.

Materials Dispute Resolution
01456 – 5 of 6

January 1, 2012
PART 2     PRODUCTS  Not Used

PART 3     EXECUTION  Not Used

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

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

1.2  RELATED SECTIONS

A. Section 00555: Prosecution and Progress
B. Section 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 02765: Pavement Marking Paint
G. Section 02890: Retroreflective Sheeting

1.3  REFERENCES

B. American National Standards Institute (ANSI)
C. Americans with Disabilities Act
E. International Safety Equipment Association (ISEA)
F. Manual on Uniform Traffic Control Devices (MUTCD), Current Edition
1.4 DEFINITIONS

A. Peak Hours – Refer to Section 00555 under Limitations of Operations. Peak hours are generally 6:30 a.m. to 9:00 a.m. and 3:30 p.m. to 7:00 p.m., Monday through Friday or as defined by the Region Traffic Engineer and communicated through the Engineer.

B. Traffic Slow Down – An isolated planned event where traffic on a highway is reduced in speed to provide a gap for work to proceed.
   1. Examples include the crossing of the highway with heavy equipment or the adjustment of traffic control devices.

1.5 SUBMITTALS

A. Three copies of the Traffic Control Plan to the Engineer no later than the fourth Wednesday following bid opening.
   1. 11 inches x 17 inches format prepared using CAD software.

B. Traffic Control Plan requirements
   1. Refer to this Section, article 1.8 paragraph G for required documentation.
   2. Refer to this Section, article 3.1 paragraph A for modified plan submittal requirements.

1.6 BIDDING REQUIREMENTS

A. The Contractor
   1. All plans must be signed and sealed by a professional engineer licensed in the State of Utah. The Department provides basemap CAD files in MicroStation format to the Contractor on a CD-ROM at no cost when available.
   2. All 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. Verify 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 1, 2 and 3 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. Use of uncoated reinforcement steel is acceptable for portable/temporary concrete barrier when barrier is stamped with the manufactured date “MM-DD-YY” and “WORK ZONE ONLY” with 2 x 2 inch numbers or alpha letters ¼ inch deep according to BA 1 Series Standard Drawings.
   b. Do not use Portable/Temporary pre-cast concrete barrier for permanent applications.

4. Category 3 – Crash Cushions and Truck Mounted Attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements. Refer to the Department Guidelines for Crash Cushions and Barrier End Treatments.

5. Category 4 – Arrow Board 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 according to Section 00727 and the following:

1. Refer to SN Series Standard Drawings for post mounted signs and TC Series Standard Drawings.

2. MUTCD Current Edition.
B. Follow the requirements and limitations identified in the Traffic Control Special Provision if included, Sections 00555, 00725, and 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 according to this Section, article 1.8, paragraphs H and I.

F. Provide concrete barrier or other positive protection for workers and all hazards such as bridge parapets, barrier blunt ends, poles, and large equipment to include but not limited to cranes and pile drivers when hazard is within AASHTO clear zone requirements for approach traffic. Refer to TC 3 Series Standard Drawings and Department Guidelines for Crash Cushions and Barrier End Treatments for acceptable construction zone crash cushions and end treatments.

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. Account 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. Identify and include all contract bid items and elements of work 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 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 according to the Americans with Disabilities Act and the MUTCD.

f. Clearly indicate the following:
   1) Proposed regulatory speed reductions in accordance to this Section, article 3.6.
   2) Tapers – length of taper, device spacing, lane or shoulder closures, amount of lane shift according to this Section, article 3.3, paragraph A.
   3) Length of buffer zone according to this Section, article 3.3, paragraph A.
   4) Device spacing used in tangents according to this Section, article 3.3, 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 items such as timing changes, phase changes.
   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 according to Section 01558 as directed by the Engineer.

I. Completely remove all existing traffic markings that conflict with the Traffic Control Plan according to 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) with the Department endorsement as a Traffic Control Technician. List of certifying agencies is available at http://www.udot.utah.gov/go/standardsreferences

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

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

1.10 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL

A. Implement and maintain traffic control according to 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 1.9 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, with 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 retroreflectorized sign.
   1. Refer to Section 02890
   2. MUTCD sign G20-4

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

2.2 FLAGGER EQUIPMENT AND CLOTHING

A. Refer to the Department’s Flagger Training Handbook.

B. Refer to TC Series Standard Drawings.

C. Safety Clothing

   1. Flagger vest and hard hat – Orange, red-orange, or fluorescent version of these colors.
      a. Wear safety apparel for daytime and nighttime activity meeting the requirements of ANSI/ISEA “American National Standard for High-Visibility Apparel and Headwear” or equivalent revisions and labeled as meeting the ANSI 107-2004 (or equivalent ANSI/ISEA publication year) standard performance for Class 2 risk exposure.
1) Considered for flagger wear for nighttime activity, safety apparel meeting the requirements of ANSI/ISEA “American National Standard for High-Visibility Apparel and Headwear” or equivalent revisions and labeled as meeting the ANSI 107-2004 or current ANSI/ISEA publication year, standard performance for Class 3 risk exposure.

b. Hard hat with 10 square inches of white or strong yellow-green retroreflective tape placed around the base of the hard hat and visible to traffic from all directions.

2.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Signs
1. Comply with this Section, article 1.7
2. Comply with Section 02890
3. Comply with TC Series Standard Drawings
4. Comply with SN Series Standard Drawings when using post mounted signs

B. Channelizing Devices
1. Comply with this Section, article 1.7
2. Comply with TC Series Standard Drawings
3. Comply with Section 02890

C. Precast Concrete Barrier
1. Comply with this Section, article 1.7
2. Comply with TC Series Standards Drawings
3. Use an approved construction zone attenuator or permanent style end sections, as listed in Department Guidelines for Crash Cushions & Barrier End Treatments.
   a. Use a construction zone attenuator when approach ends of temporary precast barrier are within the maximum AASHTO clear zone.
      1) Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements
      2) Refer to the CC Series Standard Drawings and manufacturer’s recommendations to install crash cushions.

D. Use properly rated truck-mounted attenuator for the posted speed limit prior to construction.
1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.
3. Do not use a truck-mounted attenuator (TMA) to protect blunt end for more than 72 hours.
2.4 ARROW BOARD

A. According to all standards as specified in the MUTCD, Section 6F.61 Arrow Boards.

B. 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. Submit a plan to the Engineer for review if a construction phase is proposed that is not covered by the Traffic Control Plan.
   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 Department Standard Specifications, Standard Drawings and MUTCD at no additional cost to the Department.
      a. Comply with this Section, article 1.6, paragraph A1.

3.2 FLAGGING

A. Flaggers must have a current Utah flagging certificate and must present proof of certification upon request by the Department.

3.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Use posted speed limit prior to construction to compute sign spacing, taper lengths, buffer zones, and construction clear zone.
   1. Use plastic drums or directional barricades for lane closure taper devices for speeds 50 mph and greater.
   2. Refer to the TC Series Standard Drawings for use of cones or tubular markers at night.

B. Use pre-construction posted speed during construction to compute the tangent spacing for channelizing devices.
C. Remove all traffic control from site of work when not required within 24 hours.
   1. Remove traffic control devices from the roadway a distance twice that of the Work Clear Zone if they will be used within 24 hours of the daily work stoppage and are not required for immediate traffic control. Refer to the TC Series Standard Drawings.
      a. Obtain written permission from property owner prior to storing traffic control devices on private property.
   2. Cover post mounted signs completely with an opaque and durable covering when not applicable.

3.4 ARROW BOARD

A. May substitute Type C units for Type B units. Refer to the TC Series Standard Drawings

B. Do not substitute Type B units for Type C units.

C. Remove Arrow Board from the site of work when not needed for the control of traffic within a four-hour period.

3.5 TRAFFIC SIGNALS

A. Use uniformed police officer when construction activities are impacting an operating signalized intersection.

B. Use of flaggers at traffic signals permitted when the signals have been turned to red flash mode or are inoperable.
   1. Control each approach by separate flaggers.
      a. Flaggers can control only two lanes of approach traffic.
         1) Third lane control permitted when left or right turn bays present.

C. The Department will make all changes to traffic signal operations.

3.6 CONSTRUCTION ZONE SPEED LIMIT REQUIREMENTS

A. Obtain approval for regulatory and advisory speed reductions through the 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.
3.7 LIMITATION OF OPERATIONS

A. Traffic Slow Down

1. Notify and obtain approval from the Department and law enforcement a minimum of 48 hours prior to slow down.

2. Use a Highway Patrol Trooper or other law enforcement officer in a marked vehicle with overhead flashing lights to conduct the slowdown.

3. Use the officer in the marked vehicle to slow down one or two lanes. Use, in any combination either, contractor-supplied vehicles equipped with overhead amber flashing lights or additional officers in marked vehicles at the rate of one vehicle per lane thereafter for all lanes of the highway to affect the traffic slow down.

4. Additional vehicles as described in this article may be used in the traffic slow down to supplement the law enforcement vehicle when required by the officer.

5. No traffic slow downs will be allowed during peak hours, holiday periods, or events defined by the Region Traffic Engineer.

6. The duration of any traffic slow down is not to exceed five minutes or as approved by the Region Traffic Engineer and communicated through the Engineer.

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
D. Section 02890: Retroreflective Sheeting

1.3 REFERENCES
A. ASTM D 4592: Preformed Retroreflective Pavement Marking Tape for Limited Service Life

1.4 DEFINITIONS    Not Used

1.5 SUBMITTALS
A. Manufacturer’s product data, specifications, and recommended installation instructions.

1.6 ACCEPTANCE
A. Pavement marking paint and glass beads accepted upon approval of the weights and analysis stated on the containers.

1.7 PAYMENT PROCEDURES
A. Temporary Pavement Markings
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made when there is no 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.

2.2 PAVEMENT MARKING TAPE

A. Refer to ASTM D 4592, Type I (Removable).

B. Minimum reflective values – Refer to ASTM D 4592.

2.3 TEMPORARY RAISED PAVEMENT MARKERS

A. Provide plastic raised pavement markers that have reflective material with clear covers as needed for the particular application.
   1. Supply marker body manufactured of polyurethane plastic in color specified for required type.
      a. Width 4 inches, height 2 inches, thickness 0.06 inches.
   2. Retroreflective sheeting to be at least 1 in² and according to Section 02890 for retroreflective sheeting requirements.
   3. Provide clear polyvinyl chloride covers attached to marker body with heavy duty staples when appropriate for the particular application or work operation.

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.
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.

3.2 PAVEMENT MARKING PAINT AND GLASS BEADS

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

B. Refer to Section 02765.

3.3 PAVEMENT MARKING TAPE

A. Apply pavement marking tape according to manufacturer’s directions.

B. Maintain or re-apply pavement marking tape to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.

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

D. Remove the tape immediately before paving.

3.4 TEMPORARY RAISED PAVEMENT MARKERS

A. Attach raised pavement marker according to manufacturer’s directions.

B. Space raised pavement markers as follows:
   1. Solid line On 10 ft centers
   2. Broken line Three on 5 ft centers spaced on a 40 ft cycle length.

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

D. Remove markers immediately before paving.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for controlling erosion and capturing sediment laden runoff from leaving the construction site and areas under the Contractor’s control.

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

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

1.2 RELATED SECTIONS

A. Section 02373: Riprap

B. Section 02376: Steep-Slope Erosion Control and Flexible Channel Liner

C. Section 02610: Pipe Culverts

D. Section 02613: Culvert End Sections

E. Section 02911: Wood Fiber Mulch

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specifications for Highway Applications

B. Storm Water Pollution Prevention Plan (SWPPP)

C. UDOT Sediment and Erosion Control Field Guide

D. Utah Storm Water General Permit for Construction Activities
1.4 DEFINITIONS

A. Check Dam – 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. Drop Inlet Barrier – A fiber roll or silt fence placed around a drop inlet that intercepts and traps sediment.

C. Fiber Roll – A tube-like structure of encased natural materials used to intercept and trap sediment in a sheet flow situation.

D. Gutter Inlet Barrier – A protective barrier placed around a gutter inlet that intercepts and traps sediment before it enters the inlet.

E. Pipe Inlet Barrier – A barrier protecting a pipe inlet that intercepts and traps sediment before it enters the pipe.

F. Refer to EN Series Standard Drawings.

G. Sediment Trap – An excavated basin, usually installed at low points on a construction site that intercepts and traps sediment.

H. Silt Fence – A geotextile fabric fence to intercept and trap sediment in a sheet flow situation.

I. Slope Drain – 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.

J. Stabilized Construction Entrance – A layer of rock placed at a construction site entrance/exit that removes mud from vehicle tires to prevent tracking onto a paved road.

K. Straw Bale Barrier – Straw bales placed end to end, used where a silt fence would fail. Install to intercept and trap sediment.

L. Temporary Berm – A ridge of compacted soil with or without a shallow ditch that diverts storm runoff from a slope to a controlled release point.

M. Temporary Environmental Fence – A visual barrier used to delineate and prevent encroachment on sensitive areas.
1.5 SUBMITTALS

A. A signed copy of the Notice of Intent to the Engineer before beginning any earth disturbing activities

B. Environmental Control Supervisor (ECS)
   1. Certification to the Engineer that the ECS selected for the project has completed and passed the ECS examination when the contract proposal includes a bid item for an ECS. Contact the UDOT Environmental Division for more information.

1.6 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. Work required by the ECS will be paid under that item when a bid item has been included in the contract for an ECS. Work listed in this Section will still need to be performed by the Contractor and paid under the individual erosion and sediment control Best Management Practices (BMP) when a bid item for an ECS is not included on the project.

C. 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. The damages assessed are increased to $1,000 per day if the contractor remains in non-compliance after three days and increased to $1,500 per day if the Contractor remains not in compliance after seven days.
   2. Any 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.

PART 2 PRODUCTS

2.1 MATERIALS

A. Check Dams
   1. Fiber Roll
      a. Use 12 inch diameter fiber roll selected from products included on the Department Approved Products List for Fiber Rolls.
b. Wood Stakes – 1 inch square by 18 inches long.
c. Channel Liner – Use products included on the Department Approved Products List for Channel Liners.

2. Stone
   a. Angular, well-graded, within 2 to 6 inches in diameter.

B. Silt Fence
   1. Silt Fence Fabric – Refer to AASHTO M 288, Table 6 – Temporary Silt Fence Property Requirements
   2. Wood Post – Nominal 2 inch square by 4 ft long.
   3. Fasteners – Staples, wire, zip ties, or nails sufficient to maintain fabric attachment to post.

C. Fiber Roll
   1. Use 12 inch diameter fiber roll selected from products included on the Department Approved Products List for Fiber Rolls.
   2. Wood Stakes – Nominal 2 inch square by 18 inches long.

D. Slope Drain
   1. Pipe Culverts – Refer to Section 02610.
   2. End Section – Refer to Section 02613.
   3. Loose Riprap – Refer to Section 02373.
   4. Wood Stakes – Nominal 2 inch square by 3 ft long.

E. Temporary Berm
   1. Existing Soil

F. Drop Inlet Barriers
   1. Fiber Roll
      a. Use 18 inch diameter fiber roll selected from products included on the Department Approved Products List for Fiber Rolls.
      b. Wood stakes – Nominal 2 inch square by 2 feet long.
   2. Stone – Angular, well-graded within 2 to 6 inch diameter.
   3. Silt Fence – Refer to AASHTO M 288, Table 6 – Temporary Silt Fence Property Requirements.
      a. Wood stud: 2 inches x 4 inches nominal.

G. Pipe Inlet Barrier
   1. Stone – Well-graded within 2 to 6 inch in diameter.
   2. Fiber Roll – Contact Engineer for currently approved products.
H. Curb Inlet Barrier
1. Fiber Roll – 9 inch minimum diameter selected from products included on the Department Approved Products List for Fiber Rolls.
2. Sand Bags – 14 inch x 26 inch, UV stabilized polypropylene bags, 50 lb capacity with attached ties.
3. Sand

I. Sediment Trap
1. Loose Riprap – Refer to Section 02373.

J. Stabilized Construction Entrance
1. Stone – 2 to 3 inch diameter.

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

L. Temporary Environmental Fence
1. Fence Fabric
   a. Polyethylene, high-density, UV stabilized
   b. Width, 4 ft minimum
   c. Color, Orange
2. Posts
   a. Wood Post – Nominal 2 inch square by 4 ft long.
   b. Fasteners – Staples, wire, zip ties, or nails sufficient to maintain fabric attachment to post.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete the Notice of Intent (NOI) form 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 if the project disturbs more than one acre of ground. NOI forms can be completed online at Division of Water Quality Web site. Refer to http://www.udot.utah.gov/go/standardsreferences.

B. Do not begin any earth-disturbing activity until the NOI form has been completed online and submitted to the Division of Water Quality.

C. Comply with the requirements of Storm Water General Permit for Construction Activities – Permit No. UTR100000. Refer to http://www.udot.utah.gov/go/standardsreferences
D. Follow the Storm Water Pollution Prevention Plan (SWPPP) provided for the project.

E. Do not start earth-disturbing activity until BMPs along the project perimeter and those protecting environmentally sensitive areas are installed.

F. Obtain written approval from the Engineer to change the SWPPP.

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

H. Maintain a copy of the prepared SWPPP on the project site at all times and attach the following items as they occur through project construction:
   1. Any changes made to the SWPPP
   2. Inspection forms

I. 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.

J. 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. Install additional erosion control measures as directed by the Engineer.

C. Follow installation procedures outlined in the EN Series Standard Drawings and the UDOT Sediment and Erosion Control Field Guide.

D. Provide or construct BMPs such as check dams, silt fence, slope drains, drop inlet barriers, sediment traps, and other sediment and 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 for stabilization measures.
   1. Install stabilization measures on all bare ground 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 fasteners.

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 a week upon beginning earth-disturbing activities and within 24 hours after any storm event greater than ½ inch. Conduct inspections at least once a month when construction activities are temporarily or seasonally shut down.
   1. Include the Engineer's ECS on all inspections.
   2. Complete a Division of Water Quality inspection form during 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, all 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.
      f. Sign the inspection form.

C. Accommodate inspections requested by regulatory agencies.

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 temporary sediment and erosion control devices as indicated below:
   1. Remove check dams in cut ditches when the areas draining to the cut ditch have been seeded and mulched or blanketed and the ditch has been permanently lined.
   2. Remove drop inlet and curb inlet protection when the areas draining to them have been stabilized.
   3. Remove silt fence and fiber rolls when the areas draining to them have been seeded and mulched or blanketed. Do not remove silt fence or fiber rolls if these devices are protecting a wetland or waterway.

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

3.6 PERMIT CLOSE-OUT

A. Obtain approval from Engineer through the Region Landscape Architect that all permit requirements for final close-out under the Contractor’s control have been met before terminating the permit.

B. Close-out the Storm Water General Permit for Construction Activities by submitting a Notice of Termination (NOT) form to the Division of Water Quality, along with a signed copy to the Engineer at the end of construction on projects where final stabilization requirements listed in the permit have been met.

C. Transfer the permit to the Department as directed by the Engineer if the project has not met the final stabilization requirements.

END OF SECTION
SECTION 01572

DUST CONTROL AND WATERING

PART 1  GENERAL

1.1  SECTION INCLUDES

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

1.2  RELATED SECTIONS  Not Used

1.3  REFERENCES  Not Used

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used

1.6  PAYMENT PROCEDURES

A.  The Department will not pay separately for furnishing or applying water used in:
   1.  Hot plant wet collectors
   2.  Areas around all hot mix asphalt and portland cement concrete 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 pre-wetting. 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.

B. 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.

END OF SECTION
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

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

B. Re-submittals may be required depending on completeness and correctness of the work.

C. Submit a statement before beginning work indicating all Department provided horizontal and vertical control has 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 before 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 are 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. Surveying and design data requirements:
1. Return all surveying and design data to the Engineer after project completion.
2. Provide a red-lined hard copy plan set showing as-constructed features denoting changes from the original design.
3. Provide an electronic copy of the red-lined 11 x 17 as-constructed plan, containing the “As-Built” stamp dated and signed by the Engineer, in a colored PDF format as follows:
   a. Resolution of not less than 400 dpi.
   b. Individual file sizes not greater than 10 megabytes.
   c. Group similar sheet types together into individual PDF files such as Summary Sheets grouped together in a single PDF file or Summary Sheets and Plan and Profile Sheets grouped together in a single PDF file.
   d. Provide electronic files on CD.

G. Survey Monuments
1. Refer to this Section, article 3.12, paragraph C3 for submittal of drawings and notes.

1.6 MEASUREMENT PROCEDURES

A. Directed Survey – Use a two-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 three-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:
   Two person survey crew $130 per hour
   Three person survey crew $155 per hour
   One person computation, CAD, or both $ 65 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 before directed survey work starts.

1.8 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 according to 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 cost 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 before starting 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 before 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

F. Contract Provision Disclaimer
   1. Provide a written request to the Engineer to obtain electronic data points.
   2. Electronic data points are available in Microstation or Inroads format only.
   3. Data points are prepared by the Department for its own purposes and not for the benefit of private individuals or businesses.
   4. Waive any claims that may result from the use of or reliance on the data points.
   5. Indemnify the Department and hold it harmless for any damages, costs, attorney 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 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 before 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>
<thead>
<tr>
<th>Description</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control points</td>
<td>± 0.01</td>
<td>± 0.01</td>
</tr>
<tr>
<td>Centerline points</td>
<td>± 0.03</td>
<td>± 0.02</td>
</tr>
<tr>
<td>Cross sections and slope stakes</td>
<td>± 0.10</td>
<td>± 0.10</td>
</tr>
<tr>
<td>Slope stake references</td>
<td>± 0.10</td>
<td>± 0.10</td>
</tr>
<tr>
<td>Culverts and Ditches</td>
<td>± 0.10</td>
<td>± 0.05</td>
</tr>
<tr>
<td>Minor drainage structures</td>
<td>± 0.10</td>
<td>± 0.03</td>
</tr>
<tr>
<td>Curb and gutter</td>
<td>± 0.02</td>
<td>± 0.02</td>
</tr>
<tr>
<td>Guardrail and concrete barrier</td>
<td>± 0.05</td>
<td>± 0.05</td>
</tr>
<tr>
<td>Retaining walls</td>
<td>± 0.05</td>
<td>± 0.01</td>
</tr>
<tr>
<td>Bridge substructure and overall</td>
<td>± 0.01</td>
<td>± 0.01</td>
</tr>
<tr>
<td>Bridge superstructure and overall</td>
<td>± 0.01</td>
<td>± 0.01</td>
</tr>
<tr>
<td>Environmental Control Limits</td>
<td>± 1.00</td>
<td>-----</td>
</tr>
<tr>
<td>Clearing and grubbing limits</td>
<td>± 1.00</td>
<td>-----</td>
</tr>
<tr>
<td>Right of Way Limits</td>
<td>± 0.02</td>
<td>-----</td>
</tr>
<tr>
<td>Roadway subgrade finish stakes</td>
<td>± 0.10</td>
<td>meet tolerance of</td>
</tr>
<tr>
<td>Roadway finish grade stakes</td>
<td>± 0.04</td>
<td>meet tolerance of</td>
</tr>
<tr>
<td>Signals and electrical</td>
<td>± 0.05</td>
<td>± 0.02</td>
</tr>
<tr>
<td>Striping</td>
<td>± 0.08</td>
<td>-----</td>
</tr>
<tr>
<td>Paving reference line</td>
<td>± 0.04</td>
<td>± 0.01</td>
</tr>
<tr>
<td>Milepost Sign</td>
<td>± 1.00</td>
<td>-----</td>
</tr>
</tbody>
</table>
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. Reduce the distance if staking distance is affected by line of sight.
   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. 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.

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. Provide a reference at a maximum spacing of 50 ft for storm sewers and waterlines. 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 before 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 before 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 before 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 to the Engineer showing references to section corners and quarter corners.

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 according to 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.
3.17 EXISTING MILEPOST SIGNS

A. Locate all existing milepost sign stations within the project limits.
   1. Contact the Engineer to determine any locations where a milepost sign was placed at a point other than the actual mile point due to prior physical limitations such as driveways, intersections, or bridge parapets, in coordination with Highway Referencing Specialist of the Asset Management Division.

B. Reestablish location of milepost signs before project completion if construction activities required removal of any existing milepost signs.
   1. Reset sign location at original station of existing sign.
      a. Exceptions
         1) Any prior physical limitations listed in this Section, article 3.17, paragraph A were removed during construction and no longer prevent installation of a sign at the actual mile point.
         2) Roadside conditions or newly constructed physical limitations would prevent reestablishment of any milepost sign within 3 ft of its original station.
      b. Contact the Engineer to determine how to proceed in either of these special cases listed in this Section, article 3.17, paragraph B1a, in consultation with the Highway Referencing Specialist.
   2. Establish an appropriate offset for each milepost sign to meet installation and clear zone requirements.

C. Contact the Highway Referencing Specialist through the Engineer to determine the preferred action for reestablishing the milepost signs where the alignment of the roadway was modified during construction to the extent that the new measured mile point locations of any milepost signs were shifted more than 10 ft from their original location.

END OF SECTION
SECTION 01741

FINAL CLEANUP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. 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 anything 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, and stumps.
   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 specified for finishing local material source sites including seeding and mulching. Refer to Section 01455.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Move or reset signs.
B. Move or reconstruct existing mailbox supports.

1.2  RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3  REFERENCES

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

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used

PART 2  PRODUCTS

2.1  CONCRETE

A. Refer to SN Series Standard Drawings.
B. Refer to Section 03055.

2.2  MAILBOX MOUNTING HARDWARE

A. Shelf, platform, and bracket.
B. Post – welded mechanical tubing. Refer to ASTM A 513.
C. Galvanize all hardware. Refer to AASHTO M 232
D. Refer to GW Series Standard Drawings.
PART 3 EXECUTION

3.1 MOVE SIGN

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

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

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

D. Reset sign following SN Series Standard Drawings.

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

3.2 MOVE MAILBOX

A. Furnish and install new posts, shelf, and brace. Firmly attach 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, and 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 02056: Embankment, Borrow, and Backfill
B.  Section 03055: Portland Cement Concrete

1.3  REFERENCES

A.  AASHTO M 105: Gray 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 – Refer to 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.

Reconstruct Catch Basin, Cleanout, Meter, Valve, Manhole, and Monument Boxes
3. Raise the frame and cover using adjustable extension rings.

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

3.2 LOWER BOXES

A. Remove the frame and portions of the existing walls.

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

C. Set the 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.
   1. Refer to Section 02056.

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

END OF SECTION
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 02075: Geotextiles

B. Section 02231: Site Clearing and Grubbing

C. Section 02317: Structural Excavation

D. Section 02912: Topsoil

E. 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. ASTM D 2487: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

G. UDOT Minimum Sampling and Testing Requirements
1.4 DEFINITIONS

A. Well-graded material – Material with a gradation having all particle sizes represented, with a smooth shaped grain-size distribution curve and coefficient of uniformity greater than four and a coefficient of curvature between one and three inclusive. Refer to ASTM D 2487.

1. Coefficient of uniformity \( C_u = \frac{D_{60}}{D_{10}} \)
2. Coefficient of curvature \( C_c = \frac{(D_{30})^2}{D_{10}D_{60}} \)
3. \( D_{xx} \) The diameter for which \( xx \) percent of the particles are finer.

1.5 SUBMITTALS

A. Provide the following before delivering material to the project:

1. Supplier and source of materials.
2. Gradation analysis. Refer to AASHTO T 27 and T 11.
3. Soil classification when applicable. Refer to AASHTO M 145.
4. Coefficient of uniformity and the coefficient of curvature when applicable. Refer to ASTM D 2487.
5. Maximum Dry Density and Optimum Moisture Determination

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is according to 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.
2. Maintain appropriate moisture for compaction during processing.

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.
   1. Do not include asphalt pavement materials.

2.2 BORROW

A. Classifications A-1-a through A-4. Refer to AASHTO M 145.

2.3 GRANULAR BORROW

A. Classification A-1-a. Refer to AASHTO M 145.
   B. Non-plastic, well-graded, 3 inch maximum.

2.4 GRANULAR BACKFILL BORROW

A. Classification A-1-a. Refer to AASHTO M 145.
   B. Non-plastic, well-graded, 2 inch maximum.

2.5 EMBANKMENT

A. Borrow or suitable roadway excavation materials excluding organic, frozen, or contaminated soils. Refer to this Section, article 2.1.

2.6 EMBANKMENT FOR BRIDGE

A. Granular Borrow

2.7 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             |
| No. 200             | 0 to 5              |

Embarkment, Borrow, and Backfill
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January 1, 2012
2.8 FLOWABLE FILL

A. Refer to Section 03575.

2.9 PIPE BEDDING AND BACKFILL

A. Pipe Foundation (As Required)
   1. Use Granular Backfill Borrow.
   2. Use Free-Draining Granular Backfill or other uniformly graded materials only with the approval of the engineer and only if enclosed with an appropriate separation geotextile. Refer to Section 02075.

B. Pipe Bedding and Backfill
   1. Use Granular Backfill Borrow or on-site material excluding unsuitable material.

C. Unsuitable material includes organic materials, frozen lumps, soils such as peat or bog, and over-saturated silts, clays, or sands whose water content prevents appropriate compaction.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete clearing, grubbing, 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.

C. Break and scarify all underlying road surfaces so that pieces do not exceed 3 ft² before placing embankment over an existing pavement that is outside the limits of removal or excavation shown on the plans.
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 items such as irrigation systems, sewers, and underdrainages.

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 the specified density. 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 1 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 the specified 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. Pipe Bedding and Backfill
   1. Refer to Section 02317 and DG Series Standard Drawings for excavation and over-excavation requirements.
   2. Place uniform layers of pipe backfill on both sides of the pipe.
   3. Use compaction equipment smaller than the trench width between the pipe and the trench wall. Fully compact the haunch areas. Hand-tamp areas where compaction equipment cannot compact the soil.

3.4 EMBANKMENT FOR BRIDGE PLACEMENT

A. Construct approach embankments from the original existing ground up with the specified material to the limits defined in this Section and according to DD Series Standard Drawings.
   1. Approach Embankments
      a. Place embankment beneath the bridge except riprap or other 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 locations as directed by the Engineer.

1.2 RELATED SECTIONS

A. Section 01571: Temporary Environmental Controls

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.

1.6 SAMPLING AND TESTING

A. Test each lot of geotextile before shipping and send test reports with the shipment to the project. Clearly label all rolls as part of the same production run.

1.7 PACKAGING, SHIPPING, AND STORING

A. Protect the geotextile from direct sunlight, chemicals, mud, dirt, and debris during shipment and storage. Replace any geotextile damaged or deteriorated during shipping, storage, or construction at no cost to the Department.

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

1.8 ACCEPTANCE

A. The Department accepts geotextile at installation if it does not have defects, rips, holes, flaws, deterioration, or damage.
   1. Remove rejected geotextile from the project.

PART 2 PRODUCTS

2.1 SILT FENCE GEOTEXTILE

A. Refer to Section 01571.

2.2 EROSION CONTROL GEOTEXTILE

A. Furnish according to AASHTO M 288.

2.3 DRAINAGE GEOTEXTILE

A. Furnish non-woven drainage geotextile according to AASHTO M 288 with in-situ soil designations as shown on the drawings or as indicated by the Engineer.

B. Notify the Engineer if soil conditions are different than shown on the drawings.

2.4 SEPARATION GEOTEXTILE

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

2.5 STABILIZATION GEOTEXTILE

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

2.6 WEED BARRIER GEOTEXTILE

A. Furnish woven, needle-punched, polypropylene, 5.0 oz, weed barrier geotextile designed for commercial use.
PART 3 EXECUTION

3.1 GENERAL

A. Place geotextile on areas that are smooth and free of projections or depressions. 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 at least a 6 inch 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 less. Do not turn vehicles on the first layer.

3.2 INSTALL SILT FENCE GEOTEXTILE

A. Refer to Section 01571.

3.3 INSTALL EROSION CONTROL GEOTEXTILE

A. Install at locations shown on the drawings.

B. Overlap the geotextile at least 2 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8 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 long, 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 at least 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 ft 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 at least 1 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8 for sewing requirements.

C. Repair – Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.

D. Place fill, beginning with the sheets overlapped, above subsequent sheets to hold geotextile in place.

E. Use pins 18 inches long to help secure the geotextile during installation.

3.6 INSTALL STABILIZATION GEOTEXTILE

A. Install Stabilization Geotextile at locations shown on the drawings or as designated by the Engineer.
B. Overlap the geotextile at least 2 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8 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 ft beyond the perimeter of the tear or damage.

E. Place fill to hold geotextile in place beginning with the sheets overlapped above subsequent sheets.

F. Use pins 18 inches long to help secure the geotextile during installation.

3.7 INSTALL WEED BARRIER GEOTEXTILE

A. Preparation
   1. Remove sharp objects, large stones, and undesirable vegetation.
   2. Cut an "X" over each plant and push geotextile under plant base if placing geotextile over an existing bed.
   3. Roll geotextile over soil and cut an "X" for each plant hole if placing over a new bed.
   4. Fold excess geotextile under and cover with specified landscaping materials.

B. Surface Cover
   1. Provide at least 4 inches of cover on all areas on the geotextile unless otherwise specified by the Engineer.
   2. Increase thickness of cover material over geotextile up to three times the diameter of the largest rock material based on the Engineer’s recommendations if using large landscape rock.
   3. Do not leave any portion of geotextile exposed to direct sunlight.

C. Repair
   1. Repair immediately if damaged.
   2. Remove the damaged area plus an additional 3 ft and apply geotextile patch.

D. Maintenance
   1. Maintain surfaces and supply additional landscape materials where necessary including areas affected by erosion.
3.8 SEW

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

END OF SECTION
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

1.4  DEFINITIONS

Not Used

1.5  SUBMITTALS

A. Include test reports and Manufacturer's Certificate of Compliance with the shipment to the job site.

1.6  PACKAGING, SHIPPING, HANDLING, AND STORING

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

1.7  PROTECTION

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

B. Replace at the Contractor's cost, 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 resistant to rotting, mildew, insects, chemicals, and ultraviolet (UV) light.
   1. Refer to AASHTO M 288, Paving Fabric Requirements.
   2. Meet the minimum average roll requirements when sampled and tested with the methods specified.

2.2  SOURCE QUALITY CONTROL

A. Perform tests before shipping for each individual shipment and lot of fabric.

PART 3  EXECUTION

3.1  PREPARATION

A. Prepare Pavement Surface
   1. Remove all dirt, water, oil, and foreign materials.
   2. Clean out and fill cracks wider than ¼ inch with sand and asphalt emulsion filler material.

B. Apply tack coat to the prepared surface at a rate of 0.25 to 0.30 gal/yd$^2$ 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:
      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
PART 1   GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing water meters as shown in 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 (AWWA) Standards

1.4 DEFINITIONS   Not Used

1.5 SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.

PART 2   PRODUCTS

2.1 WATER METERS AND ACCESSORIES

A. Refer to AWWA Standards.

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 inch diameter by 3 ft long
   3. Free standing crush factor of 3,000 lb
D. Meter Box Cover
   1. 12 inch minimum diameter lid with lock
   2. 20 inch minimum diameter ring constructed of cast iron

E. Pipe and Fittings
   1. Type K copper for sizes 2 inch and smaller.
   2. Ductile iron class 51 for sizes larger than 2 inch.

F. Aggregate
   1. Meet specifications for Free Draining Granular Backfill.
   2. Refer to Section 02056.

G. Corporation Stop and Service Saddle Clamp
   1. Supplied by the water system authority 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 for 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 to the depth determined by local authorities.

C. Install water meter according to manufacturer’s specifications.
   1. Place a 6 inch deep free draining granular backfill sump in the bottom of the meter box.
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
PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Remove, dispose of, or salvage buildings, fences, structures, pavements, concrete barrier, 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 items such as foundations, bridges, culverts, guardrail, concrete work, septic tanks, and trees.
   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 Compliance
   C. Section 02056: Embankment, Borrow, and Backfill
   D. Section 02705: Pavement Cutting
   E. Section 03055: Portland Cement Concrete
   F. Section 03575: Flowable Fill

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS
   A. Copies of disposal permits, agreements, or both.

1.6 PROJECT SITE CONDITIONS
   A. Protect adjacent structures and utilities and their contents that are designated to remain.
PART 2 PRODUCTS

2.1 CONCRETE

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

2.2 GRANULAR BORROW AND GRANULAR BACKFILL BORROW

A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with the Engineer.

B. Coordinate utility location according to Section 00727.
   1. Locate and protect all active utilities.
   2. Before beginning work:
      a. Notify Engineer
      b. Notify all affected utilities
      c. Have the utilities in the area located by Blue Stakes

C. Restore utility services disturbed by construction operations.

D. Disconnect water service by excavating to the corporation stop and turning it off. Disconnect the service line from the corporation stop.

E. 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 items such as existing septic tanks, cesspools, and leach lines.

G. All materials not designated for use or salvage becomes 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 according to 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 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.

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 will 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 according to Section 01355.

B. Break down and remove tank and appurtenances to at least 2 ft below the subgrade surface or finished ground lines.

C. Break the floor into pieces not over 3 ft² in area.

3.10 BURIED FUEL TANK DEMOLITION

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

3.11 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 at least 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 at least 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:
      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 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 AND PIPE CULVERT REMOVAL

A. Excavate all material necessary to permit removing items such as pipe, pipe culverts, end sections, and headwalls.

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 remaining manhole walls or catch basins with watertight concrete plug.

D. Obtain written approval from the Engineer to leave abandon pipe and pipe culverts in place.
   1. Completely fill all abandoned pipe and pipe culverts allowed to remain in place with flowable fill. Refer to Section 03575.

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 CONCRETE BARRIER REMOVAL

A. Precast
   1. Remove connection pins and concrete barrier including any stabilization pins.
   2. Dispose or salvage as required.
      a. Contact the Engineer for delivery location and coordination for salvaged barrier.

B. Cast-In-Place
   1. Saw cut the pavement at the front face of the cast-in-place barrier.
   2. Remove Portland Cement Concrete Pavement (PCCP) under barrier.
3.23 SALVAGE

A. Salvage designated equipment and materials.

B. All other materials become the property of the Contractor unless otherwise noted.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove existing asphalt surfacing materials from deck and approach slabs.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 REMOVAL EQUIPMENT

A. Use equipment capable of removing the full depth of asphalt on the deck and the approach slabs without damaging the underlying concrete surfaces 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, or concrete surfaces for partial-depth removal.

PART 3 EXECUTION

3.1 FULL DEPTH REMOVAL

A. Remove asphalt as indicated in the plans.

B. Remove any existing waterproofing membrane from the deck and concrete approach slabs.

C. Use equipment that weighs less than 22 tons.
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. Asphalt surfacing material removed becomes the property of the Contractor.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. Clear – Remove and dispose of trees, stumps, logs, limbs, sticks, vegetation, debris, and other material on the natural ground surface.

B. Grub – Remove and dispose of roots, buried logs, debris, organic matter, and other deleterious materials under the ground surface.

1.5 SUBMITTALS

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

1.6 PAYMENT PROCEDURES

A. Site Clearing and Grubbing when no bid item is included in the proposal:
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.
PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 VEGETATION REMOVAL

A. Grub the areas 2 ft below natural ground, within the limits of clearing, of all stumps, roots, buried logs, and all other underground obstructions.
B. Stumps, roots, and non-perishable solid objects may remain in cleared areas where the embankment is:
   1. 2.0 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.

D. Inside the Right-of-Way
   1. Bury material at locations specified by or acceptable to the Engineer.
   2. Use material to widen embankments and flatten embankment side slopes as approved by the Engineer.
   3. Cover disposed material with at least 2.0 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 02316
ROADWAY EXCAVATION

PART 1  GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES

A. National Fire Protection Association (NFPA) Codes and Standards
B. OSHA Construction Standards
1.4 DEFINITIONS
A. Rock – Material that cannot be excavated and removed without blasting, chipping, cutting, or ripping.

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

1.6 ACCEPTANCE AND PAYMENT PROCEDURES
A. Payment is plan quantity by the cubic yard. Make no adjustment to plan quantities if staked quantities differ by 5 percent or less.

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 according to Section 01721.
   2. Evaluate the “plan quantities” to “staked quantities” by individual cuts or balances as determined by the Engineer to provide the necessary accuracy.
   3. Do not begin excavation of any cut sections that the Contractor determines to differ from plan quantities by more than 5 percent until the calculations and plots have been submitted, reviewed, and approved by the Engineer. No payments, partial or final, will be made until submissions are provided and approved.

C. Approved quantities become the adjusted plan quantities and are paid at the original unit bid price when the Engineer determines the staked quantities differ from plan quantities by more than 5 percent.

D. Payment includes excavation, removal, transportation, and disposal when existing pavement is included in Roadway Excavation plan quantity.

PART 2 PRODUCTS
2.1 MATERIALS FOR OVER-EXCAVATED AREAS
A. Refer to Section 02056.
B. Geotextile Fabric – Refer to Section 02075.
2.2 USE OF ON-SITE MATERIALS
   A. Refer to Section 00725.

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

PART 3 EXECUTION

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

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

3.3 TOPSOIL
   A. Remove topsoil according to Section 02912.

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

3.5 EXCAVATION – STANDARD PROCEDURES
   A. Finish excavation to reasonably smooth and uniform surface.
B. Provide and maintain satisfactory access to roads, streets, and adjacent property during all phases of construction according to the Traffic Control Plan.

C. Remove material in all cut sections to the depth shown. Scarify to an 8 inch depth and backfill according 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 depth greater than 1 ft below subgrade will not be measured or paid for.

3.7 ROCK REMOVAL – EXPLOSIVE METHOD

A. Comply with OSHA Constructions Standards 1926 Subpart U - Blasting and the Use of Explosives.


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 according to all applicable rules and regulations and as follows:
   1. Inside the right-of-way as embankment, subject to the approval of the Engineer. Refer to Section 02056.
   2. Outside the right-of-way subject to the approval of the Engineer. Refer to Section 01355.

END OF SECTION
SECTION 02317

STRUCTURAL EXCAVATION

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 specified 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 on 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 cost 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. Refer to Section 02056.

3.2 SURFACE DITCH EXCAVATION
A. Construct the ditch along the contour of the ground.

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

END OF SECTION
SECTION 02372
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. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
D. ASTM A 116: Metallic-Coated, Steel Woven Wire Fence Fabric
E. 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. Hog rings – 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. Selvages of the basket structures – The galvanized thicker perimeter and edge 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 larger than 10 inches in size.
   3. Retain 95 percent or more of the stone on a square screen having openings with areas 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 AASHTO T 96.
   5. Maximum 16 percent weighted loss when subjected to five cycles of sodium sulfate. Refer to AASHTO T 104.

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. Furnish a wire coated with polyvinyl chloride (PVC) with a nominal thickness of 0.022 inches and not 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 9.

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 oz/ft$^2$ 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 are allowed. Refer to 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 according to AASHTO M 288. Refer to Section 02075 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. Obtain 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 so 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, lids, ends, and sides into modular units.
   1. Securely selvage 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 so 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 to achieve alignment and finish 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 including the vertical reinforced edges and the top selvages.
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. Use a loading frame to support the wire fabric while placing rocks if necessary.
   3. Hand place stone fill on exposed vertical faces as necessary to develop a satisfactory face graduation and prevent loss of smaller stone fill through mesh openings.

G. Insert connecting wires in the cells of baskets deeper than 1 ft in the following manner:
   1. Baskets 3 ft deep – uniformly fill adjacent cells first with stone to a height of 12 inches.
   2. Place one connecting wire in the longitudinal direction and one connecting wire in the transverse direction securing them to the opposite faces of each cell by looping them around a junction point in the mesh openings. Twist the ends of the wires to prevent loosening of connecting wires and bulging of the module walls.
   3. Fill the baskets with an additional 12 inches of stone and tie the two additional 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 so 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, place two connecting wires, one in each direction, at 9 inches from the base and secure the lid 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.
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 50 percent of the stone to be at least \( \frac{2}{3} \) times, but not more than 1\( \frac{1}{2} \) times, the specified thickness of the riprap layer. Not more than 10 percent of the rock will have a dimension of less than one-tenth the indicated thickness of the riprap.

E. Hand-placed riprap – Stones not less than 3 inches in thickness, with 75 percent of stones being at least \( \frac{1}{3} \) of a cubic foot in volume.

2.2 ACCESSORIES

A. Furnish stabilization/separation Geotextile according to 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. Obtain 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 so 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 un-segregated, 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 RIPRAPH

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 RIPRAPH

A. Place loose riprap conforming to this Section, article 3.2 where indicated on the plans.

B. Compact properly placed loose riprap to create an un-segregated, 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 RIPRAPH

A. Place loose riprap according to this Section, article 3.2 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 high.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials requirements and procedures for furnishing, transporting, and installing grouted riprap and all related materials.

1.2 RELATED SECTIONS

A. Section 02075: Geotextiles
B. Section 02373: Riprap
C. 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 180: Moisture Density Relations of Soils Using a 10 lb Rammer and an 18 inch Drop

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. In writing, at the preconstruction conference:
   1. Document the source, gradation, wear, and soundness for riprap. Refer to Section 02373.
   2. Grout mix-design.
   3. Riprap Rock samples for quality assurance testing before use.

B. Riprap Source
   1. Provide written certification verifying the quality of riprap existing at the industrial source. Refer to this Section, article 1.6 paragraph B3.
2. Provide historic results on rock reactivity or petrographic analysis of the proposed materials for riprap. Refer to this Section, article 1.6 paragraph B.

C. Grout
1. Submit a grout mix design for a mix that readily flows into the open spaces between the stones of the riprap gradation used. Refer to this Section, article 2.2.

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. Reduce or revise sample panel size according to the resident engineer directions for small quantities less than 20 ft².
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 throughout the project.
3. Remove sample panel upon completion and acceptance of riprap installation. The Engineer may allow the sample panel to be integrated into the accepted work.

B. Riprap Source
1. Set up riprap source location inspection meeting with the Engineer and source material owner before delivering materials to project site.
2. Identify stock piling procedure.
3. 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 use history of quarry aggregates in commercial concrete mix designs.

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 stockpile 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. See Section 02373.

B. Stone Gradation
   1. Provide stones for grouted riprap of 1½ to 2 ft thick that meet the gradation requirements detailed in Table 1.

<table>
<thead>
<tr>
<th>Equivalent Diameter (Feet)</th>
<th>Weight</th>
<th>Percent Larger Than Given Stone Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.25</td>
<td>½ ton</td>
<td>0 - 5</td>
</tr>
<tr>
<td>1.75</td>
<td>¼ ton</td>
<td>50 - 100</td>
</tr>
<tr>
<td>1.25</td>
<td>200 lb</td>
<td>- - -</td>
</tr>
<tr>
<td>1.00</td>
<td>75 lb</td>
<td>95 - 100</td>
</tr>
</tbody>
</table>

C. 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 3,000 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. Add 1½ pounds of fiber mesh or equivalent per cubic yard of grout.
6. Do not use calcium chloride admixtures.

2.3 ACCESSORIES

A. Cement, pozzolan, aggregates, water, air-entraining admixtures and other admixtures. Refer to Section 03055.

B. Use products to clean rock surfaces that are known to be compatible with cementitious grouts. Use according to manufacturer’s instructions.

2.4 BEDDING MATERIALS

A. Conform to AASHTO M 288 for geotextile layer. Refer to Section 02075.

B. Provide a class of geotextile that meets the requirements for strength detailed in Table 1 of AASHTO M 288 that is appropriate for the installation methods used. Refer to Section 02075.

C. Provide a geotextile that meets the requirements for subsurface drainage detailed in Table 2 of AASHTO M 288 that is appropriate for the in-situ soils encountered. Refer to Section 02075.

D. Use imported free-draining bedding aggregate material consisting of sand, gravel, or crushed stone following the gradation in Table 2. 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 and Table 2 requirements.

<table>
<thead>
<tr>
<th>U.S. Standard Sieve Size</th>
<th>Percent by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½ - inch</td>
<td>100</td>
</tr>
<tr>
<td>¾ - inch</td>
<td>20 - 90</td>
</tr>
<tr>
<td>⅜ - inch</td>
<td>- - -</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 20</td>
</tr>
<tr>
<td>No. 100</td>
<td>- - -</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 3</td>
</tr>
</tbody>
</table>

Table 2

Grouted Riprap
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January 1, 2012
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, 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 according to AASHTO T 99 or to a 70 percent relative maximum density according to 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 cost to the owner.

E. Repair damaged geotextile by placing a geotextile patch, extending 3 ft 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 to 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, grapple device, or by 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, 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 more than 10 percent above the finished design grade 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 ft on center at the toes of slopes.
F. Form all outer edges and the top of grouted riprap where construction terminates so the surface of the work is embedded and even with adjacent slope or ground.

3.4 RIPRAPH GROUTING

A. Do not place grout mix when the daily minimum temperature is less than 40 degrees F.
   1. Maintain a 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 to 90 degrees F for a minimum of 24 hours before placing grout 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 grout compaction and density.

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 to 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 with 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
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion control products applied to steep slopes and roadside ditches.

1.2 RELATED SECTIONS

A. Section 02922: Seed, Turf Seed, and Turf Sod

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. Steep-Slope Erosion Control – Material typically applied on slopes steeper than 2:1 to prevent soil erosion and protect the seedbed.
   1. Erosion Control Blanket – Machine-produced fabric consisting of elongated wood or a combination of coconut fibers and straw bounded together by a top and bottom net to provide functional longevity of 18 months.
   2. Hydraulically Applied Medium – A blended medium consisting of natural and synthetic fibers and bonding agents to provide functional longevity of 18 months.

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. Submit manufacturer’s product data and installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original weather-resistant factory labeled packages showing the name of the manufacturer and product description.
PART 2 PRODUCTS

2.1 STEEP-SLOPE EROSION CONTROL
A. Select from UDOT’s Approved Products List for Steep-Slope Erosion Control Products.

2.2 FLEXIBLE CHANNEL LINERS
A. Select from UDOT’s Approved Products List for Flexible Channel Liners.

2.3 STAPLES
A. Use staples for anchoring erosion control blankets or flexible channel liners as recommended by the blanket or liner manufacturer.

PART 3 EXECUTION

3.1 PREPARATION
A. Complete all required grading, topsoil placement, and seeding in areas to receive erosion control blanket, hydraulically applied medium, or flexible channel liner before placing the product. Verify the Engineer has provided written approval of seed incorporation. Refer to Section 02922.

B. Apply the blanket, medium, or liner within 24 hours after seeding or before precipitation falls. Replace eroded material, rework the soil, and reseed before installing the blanket, medium, or liner if a precipitation event occurs creating soil erosion.

3.2 INSTALLATION
A. General
1. Minimize disturbance of the prepared seedbed when installing blankets or liners or applying the medium.

B. Erosion Control Blankets and Flexible Channel Liners
1. 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 or liner during installation.
2. Install channel liner to allow runoff to flow directly to the centerline of ditch, not undermining or bypassing the lined ditch.
3. Key-in and staple the blanket or liner using manufacturer’s specifications. Staple requirements vary according to the steepness and length of the slope.

4. Place additional staples in areas such as swales, base of humps, against rock outcrops, and as required achieving maximum contact between the blanket and the soil.

C. Hydraulically Applied Medium
   1. Apply at a rate of 3,500 lbs. per acre.
   2. Mix water and medium in a hydroseeder following the product manufacturer’s instructions. Do not include seed in the slurry.
   3. Spray slurry on prepared slopes in multiple directions to provide 100 percent coverage of the soil surface. Areas not meeting 100 percent coverage will be rejected.
   4. Apply slurry to cover all disturbed areas.
   5. Avoid overspray onto pavements, barriers, walls, and signs and remove any overspray from these surfaces before the slurry dries.

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 on the Department Web site for each proposed hammer and pile/structure combination. Refer to http://www.udot.utah.gov/go/standardsreferences. The form is also at the end of this Section.

1. Provide all data in the form necessary to perform a pile driving wave equation analysis together with a preliminary schedule for driving.

2. The Engineer will provide within 14 calendar days of receiving 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.

2.2 STEEL HP SECTION PILES

A. Refer to AASHTO M 270 for Grade 36 or 50 steel, according to the plans.

2.3 PORTLAND CEMENT CONCRETE

A. Class A(AE) concrete – Refer to Section 03055.

2.4 REINFORCING STEEL

A. Meet AASHTO M 31, Grade 60.

B. Refer to Section 03211 for requirements.

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, according to this Section, article 1.5, 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 according to this Section, article 1.5, 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, article 1.5, 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 according to 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
   1. Fits the top of pile and provides full bearing.
   2. Drive cap to have a machined surface to fully engage the end of the pipe for pipe piles.

H. Hammer
   1. 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 begins on the project and at least five working days before piles are 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 according to ASTM D 4945 for each foundation (abutment, bent, or pier foundation). The Department performs this test using pile driving analysis (PDA) equipment on driving 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 gauges or provide a platform at least 4 ft square with a 4 ft high safety rail equipped to be raised to the top of the pile located in the leads to allow personnel to safely attach and remove gauges.
   3. Begin installation of dynamic analysis gauges 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 pile 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 re-strike PDA test on the pile after a sufficient time period (24 or more hours after the initial driving of the pile).
   1. Do not perform re-strikes 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 the hammer away from bent/abutment area or if driving conditions otherwise change.
   1. The Department may require testing additional piles and reestabishing 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 according to 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. Receive approval from the Engineer that these criteria have been met 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.

Driven Piles
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January 1, 2012
F. Notify the Department of water collecting in open pipe piles so 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 items such as chutes and pipes used as aids in placing concrete so concrete does not separate and flows freely without being pushed or shoveled.

G. Place concrete in pipe shell to the base without contacting either the rebar cage or the pipe wall through a tremie or drop chute.
H. 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.

I. Do not vibrate concrete that has taken initial set.

J. Vibrate concrete again after inserting cage to eliminate voids around the cage if rebar cage is inserted after concrete has been placed.

K. Place the rebar cage into the driven pipe pile when the concrete reaches the planned bottom elevation of the rebar for piles larger than 16 inches in diameter.
   1. Support the rebar cage from the top so it remains within 2 inches of the required vertical location until the concrete reaches the top of the pile.

L. Secure rebar cage in position until concrete is set.

M. Provide lighting to the work site if concrete placement is to occur after daylight hours so all operations are plainly visible.

N. 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 either:
            a) A 50 percent pay factor
            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>
<thead>
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<th>Pay Factor</th>
<th>Plumb % deviation from 2.0%</th>
<th>Plan Location inch deviation from 6 inch</th>
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<tr>
<td>1.00</td>
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<td>0.00 to 0.75</td>
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<tr>
<td>0.90</td>
<td>0.41 to 0.80</td>
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<td>2.26 to 3.00</td>
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<tr>
<td>0.50</td>
<td>1.61 to 2.00</td>
<td>3.01 to 3.75</td>
</tr>
<tr>
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<td>2.01 to 2.40</td>
<td>3.76 to 4.50</td>
</tr>
<tr>
<td>0.10</td>
<td>2.41 to 3.00</td>
<td>4.51 to 6.00</td>
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<tr>
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<td>&gt; 3.00</td>
<td>&gt; 6.00</td>
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</tbody>
</table>

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

END OF SECTION
### Sheet # __________

#### Pile and Driving Equipment Data

**Project No:**

**Project Name:**

**County:**

**Drawing No:**

**General Contractor:**

**Pile Driving Contractor/Subcontractor:**

**(Piles driven by, foreman):**

**Date Submitted:**

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<th>Hammer Components</th>
<th>Hammer</th>
<th>Ram</th>
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<td>Ram Length: ________(ft)</td>
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<td></td>
<td>Manufacturer’s Maximum Rated Energy: ________(k-ft)</td>
<td>(for diesel hammers)</td>
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<td></td>
<td>Stroke at Maximum Rated Energy: ______(ft)</td>
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<td></td>
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<tr>
<td></td>
<td>Range in Operating Stroke: _____ to _____(ft)</td>
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<tr>
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</tr>
<tr>
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<tr>
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<td>(psi)</td>
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<th>Drive Head</th>
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<td>Bonnet</td>
<td></td>
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<tr>
<td>Anvil Block</td>
<td></td>
</tr>
<tr>
<td>Drive Head</td>
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</table>

| Pile Cushion | Material: __________ Area: __________ |
|--------------|--------------------------------|--------|
| (Only for Concrete or Timber Piles) | No. of Sheets: __________ Thickness/Sheet: __________ (in) | |
| | Total Thickness of Pile Cushion: __________ | |
| | Mod. of Elasticity - E: __________ | (psi) |
| | Coeff. of Restitution - e: __________ | |

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<td>Tip Treatment/Plate Description:</td>
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*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. Proposed remedial action for approval if the reinforcing steel and concrete cannot be removed. Refer to this Section, article 1.6.
B. Procedure to place concrete under water. Refer to this Section, article 3.5 paragraph A.

1.6  QUALITY ASSURANCE
A. Shaft installed unsatisfactorily 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. 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 what is 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 what is 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) according to Section 03055.
   4. Keep slump between 4 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.

C. Uncased Holes
1. Drill uncased (dry, non-caving) holes in a continuous operation without interruption.

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 so the vertical alignment of the shaft excavation does not vary from the plan alignment by more than 0.25 inches per foot of depth.

C. Install the drilled shaft so the top of the reinforcing steel cage is no more than 2 inches above or below the plan elevation.

3.3 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 uncased (dry, non-caving) holes immediately after drilling and in a continuous manner. Fill cased drilled holes within 24 hours after drilling.

B. Use a tremie or spout to prevent concrete from striking the steel-reinforcing cage. Do not allow the free-fall of concrete to exceed 5 ft.
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. Obtain 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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 immediately determined.
   2. Prevent the end of the pipe from becoming plugged with soil from the bottom of the hole.

F. Begin pumping the concrete immediately after setting the reinforcing cage and 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 so the minimum 5 ft penetration is maintained.
3.6 FIELD QUALITY CONTROL

A. Do the following if the pipe plugs, equipment breaks down 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
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 LRFD Bridge Design and Construction Specifications

S. ASTM A 849: Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

T. ASTM C 828: Low Pressure Air Test of Vitrified Clay Pipe Lines

U. ASTM C 924: Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

V. ASTM C 969: Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Sewer Lines

W. ASTM C 1103: Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
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, manholes, 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. Progress Payments can be made for one or more sample units or segments of sample units of pipe in advance of the Final Acceptance testing criteria detailed below at the request of the Contractor and with the concurrence of the Engineer. Progress payments will only be made after certification by the Contractor that all of the following elements meet the requirements of this specification for each sample unit or segments of sample units submitted for payment.
   a. Horizontal and vertical alignment deviations
   b. Barrel distortion
   c. Damage to the pipe
   d. Joints
   e. Coating integrity
f. Provide a digital picture with a format and resolution quality acceptable to the Engineer of the pipe barrel condition at each end of each pipe sample unit or segments of sample units submitted for Progress payments.

2. Final acceptance of pipes will be according to the criteria outlined in this section. Perform the acceptance testing or use the services of a Department approved third party testing company.

B. Requirements

1. Horizontal and vertical alignment deviations.
2. Remove and reinstall all pipes that exceed the alignment tolerances shown in Table 1.

<table>
<thead>
<tr>
<th>Design Grade</th>
<th>Horizontal Deviation</th>
<th>Vertical Deviation *</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1%</td>
<td>Horizontal joint deflections not to exceed industry standards</td>
<td>1 1/2</td>
</tr>
<tr>
<td>≤ 1%</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>&lt; 0.5%</td>
<td></td>
<td>± 0.5</td>
</tr>
</tbody>
</table>

* Increase tolerance by 50 percent for cross culverts.

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 than 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 before placing the roadway pavement.

<table>
<thead>
<tr>
<th>Pipe Category and Size</th>
<th>Visual</th>
<th>Physical</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sight</td>
<td>Video</td>
<td>Mandrel</td>
</tr>
<tr>
<td>Cross Culverts ≤ 48-inch dia.</td>
<td>X*</td>
<td>X*</td>
<td>When visual shows non compliance with criteria in this section</td>
</tr>
<tr>
<td>Cross Culverts &gt; 48-inch dia.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Storm Drains/Irrigation Pipes ≤ 48-inch dia.</td>
<td>X*</td>
<td>X*</td>
<td>When visual test shows non compliance with criteria in this section</td>
</tr>
<tr>
<td>Storm Drains/Irrigation Pipe &gt; 48-inch dia.</td>
<td>X</td>
<td>X</td>
<td>When visual test shows non compliance with criteria in this section</td>
</tr>
</tbody>
</table>

* 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) Individual joints – Test according to ASTM C 1103.
   2) Concrete pipe – Test according to 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>
<thead>
<tr>
<th>Nominal Pipe Diameter (Inches)</th>
<th>Maximum Leakage Allowed (Gal/hr/100 ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>4.5</td>
</tr>
<tr>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>30</td>
<td>7.5</td>
</tr>
<tr>
<td>36</td>
<td>9</td>
</tr>
<tr>
<td>42</td>
<td>10.5</td>
</tr>
<tr>
<td>48</td>
<td>12</td>
</tr>
</tbody>
</table>

D. Quality Assurance
   1. Repair or replace damaged or improperly installed pipes in a sample unit at the direction of the Engineer.
   2. Repair pipes that fail the Joint Test in this Section, Article 1.6 paragraph C and according to manufacturer’s recommendations 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

<table>
<thead>
<tr>
<th>Amount of Deflection (%)</th>
<th>Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 5</td>
<td>100% of the Unit Bid Price</td>
</tr>
<tr>
<td>5.1 to 9.9</td>
<td>75% of the Unit Bid Price</td>
</tr>
<tr>
<td>10 or greater</td>
<td>Remove and Replace</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Pipe Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrugated Pipe and Pipe Arch</th>
<th>Pipe Type</th>
<th>Pipe Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M 36</td>
<td>M 36</td>
</tr>
<tr>
<td></td>
<td>Polymetric Coating 0 μm (inside)/250 μm (outside) M 245 &amp; M 246 ASTM A 849 or Aluminized Type II Steel M 274 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polymetric Coating 250 μm (inside)/250 μm (outside) M 245 &amp; M 246 ASTM A 849</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

|                               | M 196     | M 196       |
|                               | M 197     |             |
|                               | N/A       | N/A         |

|                               | M 196     | M 197       |
|                               | M 196     |             |
|                               | M 197     |             |
|                               | N/A       | N/A         |

|                               | M 294     | M 294       |
|                               | ASTM D 3350 | ASTM D 3350 |
|                               | M 294     |             |
|                               | ASTM D 3350 |             |
|                               | N/A       | N/A         |

Pipe, Pipe-Arch, Structural Plate Pipe, And Structural Pipe Arch

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January 1, 2012
# Smooth-Lined Pipe and Pipe Arch

<table>
<thead>
<tr>
<th>Description</th>
<th>M 36</th>
<th>M 36</th>
<th>M 36</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete lined corrugated steel pipe (Use Type V cement. Refer to Section 03055)</td>
<td>M 294</td>
<td>M 294</td>
<td>M 294</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter</td>
<td>M 304</td>
<td>M 304</td>
<td>M 304</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Smooth lined Polyvinyl chloride (PVC) pipe</td>
<td>M 307</td>
<td>M 307</td>
<td>M 307</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spiral rib steel pipe and pipe arch</td>
<td>M 36</td>
<td>M 36</td>
<td>M 36</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Reinforced concrete pipe</td>
<td>M 170</td>
<td>M 170</td>
<td>M 170</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-reinforced concrete pipe</td>
<td>M 86</td>
<td>M 86</td>
<td>M 86</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Elliptical reinforced concrete pipe</td>
<td>M 207</td>
<td>M 207</td>
<td>M 207</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Structural Plate Pipe and Pipe Arch

<table>
<thead>
<tr>
<th>Description</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>M 167</th>
<th>M 243</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural steel plate pipe and pipe arch</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>M 167</td>
<td>M 243</td>
</tr>
<tr>
<td>Aluminum alloy structural plate pipe and pipe arch</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>M 219</td>
<td>M 219</td>
</tr>
</tbody>
</table>

### 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.

Pipe, Pipe-Arch, Structural Plate Pipe, And Structural Pipe Arch

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January 1, 2012
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 required.

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 Department 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. Refer to AASHTO M 198.

C. Metal Pipe
1. Refer to AASHTO LRFD Bridge Design and Construction Specifications 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-roll 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. Refer 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. Refer to 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 LRFD Bridge Design and Construction Specifications.
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. Refer to 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 – Refer to DG Series Standard Drawings.

Embarkment – 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. Clearly mark 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 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 gauge 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 that 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
   B. Section 03055: Portland Cement Concrete

1.3 REFERENCES Not Used

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.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Use concrete or galvanized metal end sections on all pipe or pipe arch. Refer to Section 03055.
   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 re-lay 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. Re-lay according to Section 02610.

E. Salvage as directed.
3.2 RE-LAY CULVERT END SECTION

A. Re-lay 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
A. Manufacturer's Certificate of Compliance
B. Supplier and source for backfill
C. Sieve Analysis

PART 2 PRODUCTS

2.1 PIPE
A. Corrugated Polyethylene Drainage Pipe. Refer to 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 **FREE-DRAINING 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 and compact 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. Refer to AASHTO T 99, Method C.

**END OF SECTION**
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, Pipe-Arch, Structural Plate Pipe, and Structural Pipe Arch

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03575: Flowable Fill

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Structural Steel for Bridges

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. Coated reinforcing steel. Refer to Section 03211.

C. Structural Steel
   1. Refer to AASHTO M 270, Grade 36.
   2. Galvanize after fabrication. Refer to AASHTO M 111.
PART 3  EXECUTION

3.1  PREPARATION

A.  Location
1. Adjust catch basin location for better drainage performance where necessary as directed by the Engineer.

B.  Concrete Removal
1. Make saw cuts 1 inch deep to define the work areas.
2. Remove concrete using 90 lb class, hand-operated jackhammers or smaller.

C.  Reinforcing Steel
1. Cut steel encountered during concrete removal operations so that the final catch basin opening is unencumbered as shown on the plans.
2. Expose a minimum of 10 inches of reinforcing steel in both the bottom and upper mats of the existing approach slab on at least three sides of the new catch basin location.

D.  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.
2. Tie the new catch basin reinforcing steel to the exposed reinforcing steel of the existing approach slab.

B.  Provide for proper outlet connection to the pipe in the side of the box. Refer to Section 02610.

C.  Fill excavated voids not occupied by the new catch basin with flowable fill. Refer to Section 03575.

END OF SECTION
SECTION 02625

APPROACH SLAB DRAIN FRAME MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing 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: Structural Steel for Bridges

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Use structural steel plates according to AASHTO M 270, Grade 36.

B. Galvanize the frame riser after fabrication as specified. Refer to AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

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

A. Construct the frame riser according to the plan design.

B. Place a new frame riser before placing Hot Mix Asphalt (HMA) or asphalt surfacing. Hand compact the HMA and asphalt surfacing and slope the asphalt surfacing in the areas surrounding the frame of the drain as shown in the plans.

C. Position the grate properly to receive the water flow. Line up grate ribs with water flow for square or rectangular frames.

3.3 CLEANING

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

END OF SECTION
SECTION 02626

DECK DRAIN MODIFICATION OR CLOSURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing a frame riser to raise the existing drain grate to match the grade of the asphalt surfacing.

B. Materials and procedures for closing an existing deck drain.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Structural Steel for Bridges

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Galvanize the frame riser after fabrication as specified. Refer to AASHTO M 111.

B. Use structural steel plates according to AASHTO M 270, Grade 36.

PART 3 EXECUTION

3.1 PREPARATION

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

A. Deck Drain Modification
   1. Construct the frame riser according to the plan design.
   2. Place a new frame riser before placing Hot Mix Asphalt (HMA) or asphalt surfacing. Hand compact the HMA and asphalt surfacing and slope the asphalt surfacing in the areas surrounding the frame of the drain as shown in the plans.
   3. Position the grate properly to receive the water flow. Line up grate ribs with water flow for square or rectangular frames.
   4. Properly secure the extended pipes to the satisfaction of the Engineer.

B. Deck Drain Closure
   1. Close the deck drains as shown in the plans under the Deck Drain Closure Detail before placing new HMA or asphalt surfacing.

3.3 CLEANING

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

END OF SECTION
SECTION 02633

CONCRETE DRAINAGE STRUCTURES

PART 1  GENERAL

1.1  SECTION INCLUDES

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

1.2  RELATED SECTIONS

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

1.3  REFERENCES

A. AASHTO M 198: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
B. AASHTO M 199: Precast Reinforced Concrete Manhole Sections
C. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D. AASHTO M 235: Epoxy Resin Adhesives
E. AASHTO M 315: Joints for Concrete Pipes and Manholes Using Rubber Gaskets


G. ASTM C 361: Reinforced Concrete Low-Head Pressure Pipe

H. ASTM C 443: Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

I. ASTM C 478: Precast Reinforced Concrete Manhole Sections

J. ASTM C 857: Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

K. ASTM C 858: Underground Precast Concrete Utility Structures

L. ASTM C 891: Installation of Underground Precast Concrete Utility Structures

M. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

N. ASTM C 1244: Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

O. UDOT Quality Management Plans

1.4 DEFINITIONS

A. Catch Basin/Drop Inlet – A structure accepting drainage from gutters or medians or other channels and discharging the water through a conduit. Refer to the CB and DB Series Standard Drawings for shape and dimensions of Standard Catch Basins.

B. Inlet – A grated surface connection to a closed conduit such as a storm drain. A structure at the upstream end of a cross culvert. The upstream end of any structure through which water may flow.

C. Manhole (access hole) – A circular structure for access and joining pipes. Refer to the CB Series Standard Drawings for the Standard Detail for a Manhole.

1.5 SUBMITTALS

A. Concrete mix design for approval according to Section 03055 or 03056.
B. Precast Structures
   1. Provide verification the structures are furnished by a Department pre-qualified precast supplier.
   2. Submit a Certificate of Compliance from Department Central Materials upon delivery to the project.

C. Repair Procedure
   1. Submit to the Engineer for approval before performing any repairs. Refer to this Section, article 1.6, paragraph B.

1.6 ACCEPTANCE

A. Select and construct or install cast-in-place precast drainage structures according to this Section.
   1. Cast in place construction.
   2. Precast construction.
      a. Field verify the fit and function at structure locations before manufacturing.
      b. The Department will not reimburse the Contractor for precast structures that do not fit existing field conditions.

B. Repair or replace any structure that has the following:
   1. Fractures or cracks passing through the wall except for a single end crack that does not exceed the thickness of the precast unit.
   2. Defects showing improper proportioning, mixing, or molding.
   3. Honeycombing and open texture.
   4. Damaged or cracked ends that prevent joining manhole or inlets grade rings and sections.
   5. Any continuous crack with a surface width of 0.01 inch or more that extends more than 12 inches anywhere on the wall.
   6. Limit cracks or fractures for grade rings or similar structures. Refer to ASTM C 478.

C. Precast Structures
   1. Furnish precast drainage structures according to the CB Series Standard Drawings.
      a. Pre-qualify the supplier according to the UDOT Quality Management Plan – Precast/Prestressed Concrete Structures.
      b. Furnish precast structures that are plumb and square within 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. Test according to this Section, article 3.3 when directed by the Engineer.

PART 2 PRODUCTS

2.1 CONCRETE

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

B. Dry cast – Submit mix design for approval.
   1. Minimum cement content 470 lb/yd$^3$
   2. Maximum water/cementitious ratio 0.40

C. Self-Consolidating Concrete – Refer to Section 03055.

2.2 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

2.3 STRUCTURAL CONCRETE

A. Refer to Section 03310.

2.4 JOINTS AND SEALERS

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

2.5 WATERSTOPS

A. Refer to Section 03152 for materials requirements.

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

2.6 NON-SHRINK GROUT

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

2.7 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 according to 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 according to AASHTO M 198 requirements.

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

2.12 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 according to Section 02056.
   2. Add as needed, a sand-leveling course no greater than 2 inches in depth to the backfill material. Excavate the area to the appropriate depth to accommodate the backfill and leveling course, when used.

3.2 INSTALLATION

A. Manholes
   1. Furnish precast concrete manholes according to ASTM C 478 and use self-centering watertight joints that meet ASTM C 443. Refer to CB Series Standard Drawings.

B. Grade Rings/Catch Basin Grade Sections
   1. Furnish according to ASTM C 478 with anchor bolt-holes as shown on the CB Series Standard Drawings.

C. Precast Inlets and Boxes
   1. Furnish structures according to CB Series Standard Drawings.
      a. Attach and secure all inserts at the place of manufacture such as wall sleeves, gaskets or piping, sumps, steps, access hatches, and any other inserts as shown on CB Series Standard Drawings.
   2. Manufacture structures according to applicable requirements of ASTM C 858 and as modified by this Section.
      a. Meet AASHTO M 199 and ASTM C 857 requirements.
   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. Refer to ASTM C 891. Comply with manufacturer installation guidelines.
   a. Inspect precast drainage structures for defects before lowering into excavation.
   b. Clean mating surfaces of all foreign materials such as dirt, mud, and stones and apply proper joint sealing material where applicable.
   c. Assemble all joints tightly.
   d. Use care when joining precast elements in cold weather. Do not force joints together with mechanical equipment.
   e. Sufficiently warm all sealing materials to flow without causing damage to precast joint elements.
6. Furnish structures with appropriate openings for connecting pipe.
   a. Cast or cut structure openings. Do not expose reinforcing steel or reduce reinforcing steel covering at openings.
   b. Do not modify precast units in the field by cutting or enlarging holes or by making any other changes without the manufacturer’s and Engineer’s approval.
   c. Modify precast units only according to manufacturer requirements.
7. Do not place precast drainage structure in excavation that has water and frozen surfaces.
8. Plug lift insert recesses with a 1:1 sand to cement grout mix. Finish flush with top, bottom, or both surfaces of concrete.

3.3 TESTING

A. Conduct either a vacuum test or ex-filtration test to verify the drainage structures are watertight at the direction of the Engineer upon failure of the visual inspection referenced in this Section, article 1.6. 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 before backfilling.
   a. Form a seal between the vacuum base and the manhole rim/precast structure cover. Secure pipe plugs to prevent movement while the vacuum is drawn.
   b. Draw a vacuum of 10 inches of mercury (Hg). Record the time for the vacuum to drop to 9 inches.
c. Passing drop rates for the time to drop to 9 inches are:

<table>
<thead>
<tr>
<th>Diameter/Width</th>
<th>Time to Drop 1 inch Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 4 ft</td>
<td>30 seconds</td>
</tr>
<tr>
<td>4 ft and larger</td>
<td>40 seconds</td>
</tr>
</tbody>
</table>

d. Make necessary repairs if the structure fails the test. Repairs and repair procedures must be acceptable to the Engineer.

e. Disassemble the manhole and replace the gaskets if preformed plastic gaskets are pulled out during the vacuum test.

C. Ex-filtration Test – Follow test procedure ASTM C 1244 as modified below:
1. Plug all pipes leading into or out of the precast structure for a watertight seal.
2. Fill precast structure with water to a level 3-4 inches below the casting rim or lid.
3. Let the water stand for two hours before beginning the test to allow absorption into the precast structure.
4. Place additional water to bring the water level back to 3-4 inches below the rim or lid after the two hour stabilization.
5. Test for at least two hours and verify the leakage is less than shown on table 1.

<table>
<thead>
<tr>
<th>Water Depth (measured from invert to water level)</th>
<th>Allowable water drop per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Horizontal Internal Dimension</td>
</tr>
<tr>
<td></td>
<td>4 ft. *</td>
</tr>
<tr>
<td>Feet</td>
<td>(gals)</td>
</tr>
<tr>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>6</td>
<td>2.4</td>
</tr>
<tr>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>12</td>
<td>4.8</td>
</tr>
<tr>
<td>14</td>
<td>5.6</td>
</tr>
<tr>
<td>16</td>
<td>6.4</td>
</tr>
<tr>
<td>18</td>
<td>7.2</td>
</tr>
<tr>
<td>20**</td>
<td>8.0</td>
</tr>
</tbody>
</table>

* Adjust volume loss proportionally for different size not shown

** Provide an engineering analysis for equivalent ex-filtration rates for depths greater than 20 feet.
D. The Department will reimburse the Contractor for the actual cost of each test required by the Engineer to meet vacuum or ex-filtration requirements, not to exceed $500 per test.

END OF SECTION
SECTION 02635
GRATES, 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
F. AWS D1.1

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 MATERIALS
A. Structural Steel – Refer to Section 05120.
   1. Refer to AASHTO M 270.
   2. Hot-dip galvanize structural steel after fabrication. Refer to AASHTO M 111.
B. Cast Grey Iron – Refer to AASHTO M 105.

C. Ductile Iron – Refer to ASTM A 536.

D. Precast Grade Ring – Refer to AASHTO M 199.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as specified by the manufacturer and the following standard specifications:

<table>
<thead>
<tr>
<th>Item To Be Installed</th>
<th>Standard Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Diversion Box Hinged Lid (Solid Cover Plate)</td>
<td>DB 2E, 2F</td>
</tr>
<tr>
<td>Type A Details Type I Plan and Type II Plan</td>
<td></td>
</tr>
<tr>
<td>Standard Diversion Box Hinged Lid Solid Cover Type B and C</td>
<td>DB 2G, 2H</td>
</tr>
<tr>
<td>Standard Diversion Box Hinged Lid Solid Cover Type C</td>
<td>DB 2H</td>
</tr>
<tr>
<td>Open Curb Shallow Catch Basin</td>
<td>CB 4</td>
</tr>
<tr>
<td>Manhole Frame and Grated Cover</td>
<td>GF 1</td>
</tr>
<tr>
<td>Manhole Frame and Solid Cover</td>
<td>GF 2</td>
</tr>
<tr>
<td>Rectangular Grate and Frame (Standard Grating)</td>
<td>GF 3</td>
</tr>
<tr>
<td>Directional Grate and Frame (Bicycle-Safe Grating)</td>
<td>GF 4</td>
</tr>
<tr>
<td>Solid Cover and Frame</td>
<td>GF 5</td>
</tr>
<tr>
<td>Manhole Steps</td>
<td>GF 6</td>
</tr>
</tbody>
</table>

B. Fabricate according to AWS D1.1

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

A. Concrete mix design for Engineer’s Approval
B. Hot and cold weather plan
C. Manufacturer’s product data, specifications, and recommended application instructions for concrete curing compound.

1.6 ACCEPTANCE

A. Concrete-lined ditch may be accepted at a reduced price when the concrete strength is below what is 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
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material and procedures for fabricating and installing single-cell precast concrete box culverts, multi-cell precast concrete box culverts, precast conventionally reinforced concrete three-sided culvert structures, and secondary elements such as cutoff walls, aprons, footings, floor slabs, headwalls, and wingwalls.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill
B. Section 02317: Structural Excavation
C. Section 03055: Portland Cement Concrete
D. Section 03211: Reinforcing Steel and Welded Wire
E. Section 03310: Structural Concrete
F. Section 03390: Concrete Curing
G. Section 03575: Flowable Fill
H. Section 07105: Waterproofing Membrane

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
C. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
D. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing

Precast Concrete Box and Three-Sided Culvert Structures
1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from...
responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings

1. Detailed fabrication and installation drawings for approval of all fabricated materials and cast-in-place elements that are included in this item of work and are not detailed in the contract plans.
   a. Include all details not provided in the contract documents for the construction and erection of the members included in this item of work.
   b. Detail all phases of construction including layout, joint details, lifting devices, casting methods, construction placement, and details of any cast-in-place elements included in this item of work.
   c. Note proposed transportation methods.
   d. Include inventory and operating load ratings in a table on the first sheet of the drawings for structures with spans greater than 20 ft. Refer to this Section, article 2.9 for requirements.
   e. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah and include supporting engineering calculations for the following:
      1) Special designs of precast concrete box culverts for sizes and loads other than those shown in Table 1 of ASTM C 1577.
      2) Precast three-sided culvert structures.
      3) Lifting devices.
      4) Structural members and ancillary appurtenances designed by the fabricator.
      5) Connections between precast and cast-in-place members and appurtenances.
      6) Load ratings.
      7) Any other means and methods that require an engineer’s design.
   f. Do not begin work before receiving approval of the shop detail drawings. The Department rejects units fabricated before shop drawing approval.

2. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
3) State Structure Number
4) Contractor, Fabricator, or Erector Name
5) Contractor, Fabricator, or Erector Drawing Number
6) Contractor, Fabricator, or Erector Sheet Number
b. Revise and resubmit drawings when directed by the Engineer.
c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower left corner of each sheet.

3. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.

4. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings are submitted.

5. Do not deviate from the approved drawings unless authorized in writing. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Mix Design
   1. To the Engineer for approval. Refer to this Section, article 2.1 paragraph B.

C. Structural Non-Shrink Grout
   2. The proposed method for forming grout voids and installing the non-shrink grout including the sequence and equipment for the grouting operation for review at least 14 days before work begins.
Obtain approval before beginning placement of structural non-shrink grout.

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 according to Section 03055.

B. The Department rejects any elements fabricated before receiving written approval or any elements that deviate from the approved drawings. The Contractor is responsible for costs incurred due to faulty detailing or fabrication.

PART 2 PRODUCTS

2.1 CONCRETE

A. Wet Cast Concrete – Class AA(AE). Refer to Section 03055.

B. Dry Cast Concrete
   1. Minimum cement content $470 \text{ lb/yd}^3$ of concrete
   2. Maximum water/cement ratio 0.40

C. Flowable Bedding Concrete – Use flowable fill according to Section 03575.

2.2 REINFORCING STEEL AND WELDED WIRE

A. Coated – Refer to Section 03211.

2.3 JOINT SEALANT

A. Refer to ASTM C 990.

B. Use a flexible butyl rubber material with a minimum cross-section of $\frac{3}{4} \times 1\frac{1}{2}$ inches as a joint sealant for box culverts.

2.4 JOINT WRAP

A. Refer to ASTM C 877.
2.5 WATERPROOFING MEMBRANE

A. Refer to Section 07105.

2.6 STRUCTURAL NON-SHRINK GROUT

A. Use gray, non-shrink grout containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.

B. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.

C. Meet all the requirements of AASHTO T 160 with the exception that the Contractor-supplied cube molds will remain intact with a top firmly attached throughout the curing period.

D. Mix structural non-shrink grout just before use according to the manufacturer’s instructions.

E. Refer to Table 1 for additional structural non-shrink grout requirements.

<table>
<thead>
<tr>
<th>*Properties</th>
<th>Requirements</th>
<th>ASTM</th>
<th>AASHTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated Weathering:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tested Medium</td>
<td>&lt;3% White Utah Road Salt</td>
<td></td>
<td>T 161</td>
</tr>
<tr>
<td>Accepted Weight Loss</td>
<td>&lt;15% @ 300 Cycles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>&gt;3,000 psi @ 24 hours</td>
<td></td>
<td>T 106</td>
</tr>
<tr>
<td></td>
<td>&gt;5,000 psi @ 7 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accepted Bond Strength</td>
<td>&gt;1,000 psi @ 24 Hours</td>
<td>C 882 as modified by C 928 8.5</td>
<td></td>
</tr>
<tr>
<td>Length Change</td>
<td>No expansion after 7 days</td>
<td></td>
<td>T 160</td>
</tr>
</tbody>
</table>

* Certified test results from a private AASHTO accredited testing laboratory are acceptable.

2.7 LIFTING DEVICES

A. Use lifting devices that can support the required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements of the PCI Design Handbook.

B. Galvanize according to AASHTO M 111.
2.8 GROUTED SPLICE COUPLERS

A. Refer to Section 03211.

2.9 MANUFACTURE

A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for precast concrete box and three-sided culverts according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Precast Concrete Box Culverts
   1. Refer to ASTM C 1577.
   2. Special designs for sizes and loads other than those shown in Table 1 of ASTM C 1577 require approval by the Engineer.
   3. Prepare special designs according to AASHTO LRFD Bridge Design Specifications, Section 12.
   4. Provide 1 inch minimum concrete cover to reinforcing steel bars.
   5. Provide minimum concrete cover to reinforcement where welded wire fabric is used, equal to the greater of three times the diameter of the wire or 1 inch.
   6. Provide 2 inch minimum concrete cover to the reinforcing steel in the top of the top slab of box sections covered with less than 2 ft of fill for all types of reinforcement.
   7. Provide tongue and groove ends or equivalent to transfer shear between sections at all joints.
   8. Design and form section ends so that the sections can be laid together to make a continuous line of box sections compatible with the permissible variations in Section 11 of ASTM C 1577.

C. Precast Concrete Three-Sided Structures
   1. Refer to ASTM C 1504 with the following exceptions:
      a. Design the structure according to AASHTO LRFD Bridge Design Specifications, Section 12.
      b. Design for HL-93 live loading.
   2. Provide a maximum longitudinal wire spacing of 8 inches for welded wire. Provide a circumferential wire spacing not greater than 4 inches or less than 2 inches.
   3. Provide minimum concrete cover to welded wire fabric equal to the greater of three times the diameter of the wire or 1 inch.
   4. Provide 2 inch minimum concrete cover to all reinforcing steel in the top of the top slab for three-sided structures covered by less than 2 ft of fill.
D. Do not locate horizontal and vertical changes in alignment greater than 10 degrees at a joint between precast segments of a precast concrete box culvert unless otherwise approved by the Engineer.

E. Permanently mark each precast unit with date of casting and supplier identification.

F. Cast the Department structure number into the top and exposed faces of the headwall at each end of the structure as shown in the plans.

G. Provide the number and type of lifting devices required to support the vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements of the PCI Design Handbook.
   1. Use a maximum diameter of 3 inches when lifting holes are used. Locate holes to avoid interference with the reinforcing steel.

H. Load rate all precast concrete box culverts and precast concrete three-sided structures with spans greater than 20 ft according to the AASHTO Manual for Bridge Evaluation and Department Structures Design Memoranda.
   1. Measure span length along roadway centerline.

I. Concrete Curing – Refer to Section 03390.

2.10 QUALITY ASSURANCE

A. Precast Elements
   1. Prevent cracking or damage of precast elements during shipping, handling, and storage.
   2. Replace defects and breakage of precast elements.
      a. Members that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review or rejection.
      b. Obtain approval before performing repairs.
      c. Repair work must reestablish the elements’ structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
      d. Determine the cause when damage occurs and take corrective action.
      e. Failure to take corrective action, leading to similar repetitive damage, can be cause for rejection of the damaged element.
      f. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.
g. Full depth cracking and breakage greater than 1 ft are cause for rejection.

3. Document all test results. The quality control file will contain at least the following information:
   a. Element identification
   b. Date and time of cast
   c. Concrete cylinder test results
   d. Quantity of used concrete and the batch printout
   e. Form-stripping date and repairs if applicable
   f. Location/number of blockouts and lifting inserts
   g. Temperature and moisture of curing period
   h. Lifting device details, requirements, and inserts

PART 3 EXECUTION

3.1 PREPARATION

A. Excavating, Trenching, Bedding, and Backfill
   1. Refer to Section 02317.

B. Scarify moisture condition and compact the top 8 inches of the excavated ground surface to at least 90 percent of the maximum laboratory density.

3.2 BEDDING AND BACKFILL

A. Over excavate the material under the box location according to Section 02317 to a minimum depth of 6 inches.
   1. Replace over excavated material with granular backfill borrow or free draining granular backfill as specified in Section 02056.
   2. Provide a minimum bedding of 6 inches of granular backfill borrow or free draining granular backfill.
   3. Limit the soil gradation for granular backfill borrow used as bedding under precast members to 100 percent passing the ¾ inch sieve.
   4. Modify the soil gradation for free draining granular backfill used as bedding under precast members to 100 percent passing the ¾ inch sieve and no more than 10 percent passing the No. 4 sieve.

B. Level and compact bedding material to provide uniform support of the structure along its entire supported width and length.

C. Backfill structure with granular backfill borrow as specified in Section 02056 and as shown in the plans.

D. Refer to project plans for excavation, bedding, and backfill requirements where a three-sided culvert structure is placed on a footing.
E. Backfill the gap between multiple single cell culverts with flowable fill.

3.3 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 ft each side.

D. Lay precast elements starting at the downstream end.

E. Carefully lower precast elements into the trench with suitable equipment to prevent damage.

F. Remove all dirt and foreign material from joints. 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.
   4. Maintain the joint material at 70 degrees F or greater during placement.

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. Pull box culvert sections together to ½ inch joint gap spacing measured face to face of adjoining concrete surfaces with the joint gap being uniform on all sides of the box culvert.
   1. Use appropriate pulling devices to avoid misalignment and damage to box sections.
   2. The Engineer may approve up to a ¾ inch joint gap spacing in cases where it is necessary to adjust the total length of a box culvert run.
   3. Reject box sections when the installation tolerance cannot be met due to casting variations.
4. Prevent soil from being forced into the joint as the box sections are placed.

J. Do not disturb previously completed joints during laying operation.

K. Do not lay precast elements when water is in the trench.

L. Place three-sided structure sections against previous sections as tightly as possible while maintaining alignment.
   1. Follow manufacturer’s installation recommendations.
   2. Do not exceed joint tolerances in the stamped drawings.

M. Apply joint wrap to the top slab and side walls at all joints.
   1. Clean top and sides of concrete surface at joints before placing joint wrap.
   2. Use a minimum width of 2 ft centered on the joint.

N. Install precast cutoff walls, aprons, wingwalls, and headwalls, as follows:
   1. Establish working points, working lines, and benchmark elevations before placing elements.
   2. Clean bonding surfaces between elements of debris, dust, and rust before connecting elements to achieve the required bonding between protruding bars and elements.
   3. Place cut-off wall and apron elements as shown in the plans.
      a. Adjust the final location of the cut-off wall or apron elements if actual joint gaps cause the final location to vary.
      b. Adjust the height of each apron element by means of leveling devices or shims.
   4. Lift apron segments using lifting devices as shown on the approved fabrication and installation working drawings.
   5. Set elements in the proper horizontal location. Check for proper alignment and grade within specified tolerances.
   6. Adjust vertical leveling devices before full release of the apron from the crane to reduce the amount of torque required to turn the bolts in the leveling devices. Check for proper grade within specified tolerances.
   7. Place or pump bedding concrete or grout into voids and pockets as shown in the plans.

3.4 STEEL REINFORCEMENT

A. Refer to Section 03211.
3.5 **JOINTS**

A. Mechanically connect the exterior sections 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 ft.
   2. Galvanize all plates, shapes, and hardware.

B. Connect three-sided precast concrete structures to the footing, pedestal, or slab 2 ft from the outermost exterior edge of the structure at all four corners of the structure with a galvanized rigid mechanical connection.
   1. Locate the connection on the interior face of the segment to allow for future inspection.

3.6 **LIFTING HOLES AND DEVICES**

A. Plug lifting holes and lifting device recesses with structural non-shrink grout. Finish flush with all concrete surfaces.

3.7 **CAST-IN-PLACE CONCRETE**

A. Refer to Section 03310.

B. 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.

3.8 **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.

3.9 **MINIMUM LENGTH**

A. Do not use precast segments less than 5 ft in lay length.

3.10 **WATERPROOFING MEMBRANE**

A. Apply a waterproofing membrane to the top slab and side walls of all concrete box culverts and three-sided structures for the full length of the structures. Refer to Section 07105.

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 pavement 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. 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. Documentation from the manufacturer verifying that the curing compound is a wax-base product. Refer to Section 03390.

C. 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:

   \[ x_{avg} = \frac{\sum x}{n} \]

   Where:
   \( x \) = Determined length of core
   \( n \) = Number of cores (1 per sublot =12,000 ft\(^2\))
   \( x_{avg} \) = Average length for entire project (lot)

   4. Include all cores less than 3½ inches in \( x_{avg} \) determination and also have a price adjustment under sublot. Refer to Table 1 for Payment Reductions for Thickness.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Pay Factor (Project)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{x} \geq 3.75 ) inch</td>
<td>1.00</td>
</tr>
<tr>
<td>3.50 inch &lt; ( \bar{x} &lt; 3.75 ) inch</td>
<td>0.90</td>
</tr>
<tr>
<td>3.00 inch &lt; ( \bar{x} &lt; 3.50 ) inch</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**Table 1**

<table>
<thead>
<tr>
<th>Pay Factor (Sublot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublot, 3.00 inch &lt; ( x &lt; 3.50 ) inch</td>
</tr>
<tr>
<td>Sublots, ( x &lt; 3 ) inch</td>
</tr>
</tbody>
</table>
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 specified 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

<table>
<thead>
<tr>
<th>Aggregate - Lean Concrete Base Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job-Mix Gradation Band</td>
</tr>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>1½ inch</td>
</tr>
<tr>
<td>1 inch</td>
</tr>
<tr>
<td>¾ inch</td>
</tr>
<tr>
<td>⅜ inch</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 50</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>
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 according to Table 3.

<table>
<thead>
<tr>
<th>Slump (inches)</th>
<th>Air Content (percent)</th>
<th>Minimum Cement Content (lbs/cu yd)</th>
<th>Minimum Design Compressive Strength (psi @ 7days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2½ ± 1½</td>
<td>4.5 ± 1.5</td>
<td>255</td>
<td>750</td>
</tr>
</tbody>
</table>

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 ¾ 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 ft² 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. Trucks hauling portland cement concrete for pavement will be allowed after 72 hours provided that hauling does not cause damage
   2. Legal loads may be hauled after seven days.
   3. Reduce the load or refrain from hauling if damage occurs.

B. Repair all damage at no 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 T 335: Determining the Percent of Fracture in Coarse Aggregate

K. UDOT Minimum Sampling and Testing Requirements
1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Written report for approval for each aggregate class and source, a minimum of five working days before placement. Include the following:
   1. Aggregate suitability. Refer to this Section, Part 2.
   2. Name of supplier and location of source.
   3. Maximum Dry Density and Optimum Moisture Content and associated test result data. Refer to AASHTO T 180, Method D.
   4. Job mix gradation including single values for each sieve size, No. 4 and finer. The target values must be within the gradation limits of Table 2.

B. Job-mix gradation changes
   1. Refer to this Section, article 3.1.

1.6 ACCEPTANCE

A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. Type I Placement – Pavement Section
   1. Use Class A aggregate, Table 1.
   2. The Engineer takes random samples from the grade and tests for moisture, gradation, and laboratory density and performs in-place density determinations.
   3. Meet gradation limits and applicable tolerances of Table 2 for each gradation test. Evaluate each subplot separately and do not average with other sublots.
   4. Meet minimum density test average of 97 percent of maximum laboratory density with no test less than 94 percent.

C. Type II Placement – Incidental includes placement for Curb, Curb and Gutter, Driveways, Pedestrian Access Ramps, Sidewalk, Waterways, Flatwork, and other items of work in the contract to which UTBC is included and not measured or paid for separately.
   1. Use Class A aggregate, Table 1.
   2. The Engineer takes random samples from the grade and tests for moisture, gradation, and laboratory density and performs in-place density determinations.
   3. Meet gradation limits and applicable tolerances of Table 2 for each gradation test. Each subplot will be evaluated separately and not averaged with other sublots.
   4. Meet minimum density test average of 95 percent of maximum laboratory density with no test less than 92 percent.
D. Type III Placement – Shoulder
   1. Use Class A or B aggregate, Table 1.
   2. Adjust moisture content before compaction.

E. Material not meeting the gradation requirements may be allowed to remain in-place at the discretion of the Engineer provided density requirements are met. Additional lots may not be placed until the deficiencies are addressed and corrected.

F. Correct material that does not meet the specified criteria by scarifying, placing additional material, re-mixing, reshaping, and re-compacting when 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, according to Table 1.

Table 1

<table>
<thead>
<tr>
<th>Aggregate Properties</th>
<th>Aggregate Class</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Rodded Unit Weight</td>
<td>Aggregate Class</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>75 lb/ft³</td>
<td>AASHTO T 19</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>AASHTO T 19</td>
<td></td>
</tr>
<tr>
<td>Liquid Limit/Plastic Index</td>
<td>Non-plastic</td>
<td>PI ≤ 6</td>
<td>AASHTO T 89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AASHTO 90</td>
</tr>
<tr>
<td>Aggregate Wear</td>
<td>Not to exceed 50 percent</td>
<td>AASHTO T 96</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>Table 2</td>
<td>AASHTO T 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AASHTO T 27</td>
<td></td>
</tr>
<tr>
<td>CBR with a 10 lb surcharge measured at 0.20 inch penetration</td>
<td>70% Minimum</td>
<td>N/A</td>
<td>AASHTO T 193</td>
</tr>
<tr>
<td>Two Fractured Faces</td>
<td>50% Min</td>
<td>N/A</td>
<td>AASHTO T 335</td>
</tr>
</tbody>
</table>
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
<table>
<thead>
<tr>
<th>Gradation Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>1½ inch</td>
</tr>
<tr>
<td>1 inch</td>
</tr>
<tr>
<td>¾ inch</td>
</tr>
<tr>
<td>½ inch</td>
</tr>
<tr>
<td>¼ inch</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 16</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

Percent passing based on total aggregate (dry weight) and fine and coarse aggregate with approximately the same bulk specific gravities.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mixing – Provide moisture content of ± 2 percent of optimum at the time of placement. Refer to AASHTO T 180, Method D and AASHTO T 255.

B. Procedures for Changing the Job-Mix Gradation
   1. Submit changes in writing 24 hours before placement for approval by the Engineer.

C. Placing – Place in layers of uniform thickness and compact each layer to a thickness not to exceed a 6 inch depth. Do not place on any frozen surface. Refer to Section 01572.

D. Finishing – Uniform line and grade with surface deviations no more than ¾ inch in 10 ft in any direction.
   1. Profile Tolerance – Correct any profile deviations greater than ¾ 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 ¾ 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
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-surfacing mixture that can be 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: Mineral Filler for Bituminous Paving Mixtures
B. AASHTO M 85: Portland Cement
C. AASHTO M 208: Cationic Emulsified Asphalt
D. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregate
E. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
F. AASHTO T 49: Penetration of Bituminous Materials
G. AASHTO T 53: Softening Point of Bitumen
H. AASHTO T 59: Testing Emulsified Asphalts
I. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
J. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
K. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
L. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
M. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
N. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
O. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
P. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer
Q. ASTM D 6372: Testing and Construction of Micro-Surfacing
R. ASTM D 7405: Multiple Stress Creep and Recovery (MSCR) of Asphalt Binder Using a Dynamic Shear Rheometer
S. ASTM D 7497: Modified Emulsion Residue by Evaporation
T. International Slurry Seal Association (ISSA) Specifications and Guidelines
U. UDOT Minimum Sampling and Testing Requirements
V. UDOT Quality Management Plans

1.4 DEFINITIONS

1.5 SUBMITTALS

A. Provide the mix design to the Engineer 10 days before beginning construction.
   1. Refer to this Section, article 2.6.

B. Provide the Engineer with the following for asphalt/polymer emulsion with job-mix design.
   1. Test report that meets the requirements of this Section, article 2.1.
   2. Certificate of analysis and compliance from the manufacturer for each batch.
   3. Target gradation for combined aggregate and mineral filler.
4. Verification the asphalt/polymer emulsion supplier adheres to UDOT Quality Management Plan Section 508 Asphalt Emulsion.

C. Provide test reports for mineral aggregate.
   1. Refer to this Section, article 2.2.

D. Provide Manufacturer’s Certificate of Compliance for Mineral Filler.
   1. Refer to this Section, article 2.3.

E. Provide calibration documentation for each mixing unit including an individual calibration for each material at various settings that corresponds to the machines’ metering devices.

F. 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 4.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material according to UDOT Minimum Sampling and Testing Requirements.

B. Department will assess price adjustments based on the average daily application rate of aggregate and emulsion residue per lot.
   1. A lot is defined as one day’s production.
   2. Use the computerized monitoring system from the paver for the aggregate and emulsion totals per lot.
   3. Obtain square yards from the Contractors Daily Report, verified by the Engineer.
   4. Pay Factor = PF_{rate} (Table 1) x PF_{residue} (Table 2)

C. Application rate pay factor (PF_{rate}) is based on application rate of dry aggregate.
   1. Aggregate application target rate is 25 lbs/yd^{2}

<table>
<thead>
<tr>
<th>Average Application Rate (lbs/yd^{2})</th>
<th>PF_{rate}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 25.0</td>
<td>1.0</td>
</tr>
<tr>
<td>20.0 to 24.9</td>
<td>(Avg. Rate ÷ 25)</td>
</tr>
<tr>
<td>Less than 20.0</td>
<td>Reapplication with option to remove</td>
</tr>
</tbody>
</table>
D. Emulsion residue pay factor ($PF_{\text{residue}}$) is based on the residue of the emulsion placed each lot.
1. Target Value = Residual asphalt target value for emulsion based on the mix design.
2. Emulsion residue = Based on the Certificate of Compliance from the Emulsion Supplier.

<table>
<thead>
<tr>
<th>Pay Factor Emulsion Residue Content</th>
<th>( PF_{\text{residue}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Emulsion Residue %</td>
<td>( PF_{\text{residue}} )</td>
</tr>
<tr>
<td>Target Value less than ±0.6%</td>
<td>1.0</td>
</tr>
<tr>
<td>Target Value ± 0.61% to Target Value ± 1.00%</td>
<td>0.8</td>
</tr>
<tr>
<td>Greater than 1% of Target Value</td>
<td>Reapplication with option to remove</td>
</tr>
</tbody>
</table>

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

A. Use a quick-set polymer-modified asphalt emulsion manufactured specifically for micro-surfacing.
   1. Refer to AASHTO M 208 grade CQS-1 h (cationic) emulsified asphalt. Delete settlement and cement mixing test requirements.

B. Mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process.
   1. Obtain certification from the asphalt emulsion manufacturer that the emulsion contains at least 3.0 percent polymer solids based on the weight of asphalt (asphalt residual).

C. Refer to Table 3 for Modified Emulsion Residue.
Table 3

<table>
<thead>
<tr>
<th>Modified Emulsion Residue By Distillation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Method</strong></td>
</tr>
<tr>
<td>AASHTO T 49</td>
</tr>
<tr>
<td>AASHTO T 53</td>
</tr>
<tr>
<td>AASHTO T 59-modified (a)</td>
</tr>
<tr>
<td>AASHTO T 316</td>
</tr>
</tbody>
</table>

**Modified Emulsion Residue By Evaporation, ASTM D 7497 (b)**

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO T 315 (b)</td>
<td>Original DSR, G* at 58° C, kPa</td>
<td>7 - 14</td>
</tr>
<tr>
<td>AASHTO T 315 (b)</td>
<td>Original DSR, G* at 64° C, kPa</td>
<td>4 - 8</td>
</tr>
<tr>
<td>AASHTO T 315 (b)</td>
<td>Original DSR, Phase Angle, δ, at 58° C</td>
<td>75 Max.</td>
</tr>
<tr>
<td>ASTM D 7405 (b)</td>
<td>Multiple Stress Creep Recovery (MSCR) at 64° C, % recovery at 3.2 kPa stress level</td>
<td>25 Min.</td>
</tr>
</tbody>
</table>

(a) Modified distillation procedure – Heat emulsion residue to 177 ± 5° C and maintain that temperature for 20 min. Perform the distillation within 60 ± 15 min.

(b) Do not reheat on completion of evaporation. Complete residue testing within 48 hr of performing the evaporation procedure. Pull small specimens from the evaporation sample for rheological testing and ball by hand using gloves that will not affect the residue such as nitrile gloves.

D. Formulate the polymer modified emulsified asphalt so that when the paving mixture is applied with relative humidity at not more than 50 percent and the ambient air temperature of at least 75 degrees F, the paving mixture will sufficiently cure so that traffic can be allowed in one hour.

2.2 MINERAL AGGREGATE

A. Use 100 percent crushed mineral aggregates, clean and free from organic matter or other detrimental substances that meet the following requirements:

1. Maximum clay lumps and friable particles of 2 percent for coarse and fine aggregates. Refer to AASHTO T 112.
2. Maximum weighted sodium sulfate soundness loss of 15 percent. Refer to AASHTO T 104.
3. Maximum loss by abrasion of 30 percent. Refer to AASHTO T 96.
4. Sand equivalent of 60 or greater. Refer to AASHTO T 176.
5. Minimum polishing value of 31. Refer to AASHTO T 278 and T 279.
   a. Perform tests on aggregate before crushing.
   b. Predominantly limestone or dolomite aggregates will not be accepted.
B. Establish a job mix or target gradation within the gradation band as specified in Table 4.
   1. Base the mix design on the target gradation.
   2. Verify the percent passing each sieve does not vary by more than the stockpile tolerance and still remains within the gradation band. Refer to AASHTO T 11 and AASHTO T 27.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Job Mix Gradation Target Band</th>
<th>Stockpile Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>⅜</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>#4</td>
<td>70-90</td>
<td>±5</td>
</tr>
<tr>
<td>#8</td>
<td>45-70</td>
<td>±5</td>
</tr>
<tr>
<td>#16</td>
<td>28-50</td>
<td>±5</td>
</tr>
<tr>
<td>#30</td>
<td>19-34</td>
<td>±5</td>
</tr>
<tr>
<td>#50</td>
<td>12-25</td>
<td>±4</td>
</tr>
<tr>
<td>#100</td>
<td>7-18</td>
<td>±3</td>
</tr>
<tr>
<td>#200</td>
<td>5-15</td>
<td>±2</td>
</tr>
</tbody>
</table>

Percent passing based on total aggregate (dry weight) and fine and coarse aggregate with approximately the same bulk specific gravities.

2.3 MINERAL FILLER

A. Use one of the following for Mineral Filler. Refer to AASHTO M 17.
   1. Non-air entrained Type I/II portland cement. Refer to AASHTO M 85.
   2. Hydrated lime, free from lumps or foreign matter. Refer to Section 02746.

B. Determine the amount of mineral filler needed through the laboratory mix design.
   1. Verify the amount of mineral filler used is between 0.5 percent and 2.0 percent by the weight of dry aggregate.
   2. Adjust the percentage of mineral filler ± 0.5 percent as necessary for better consistency or to optimize set times with Engineer’s approval.

2.4 WATER

A. Use potable water free from harmful salts, reactive chemicals, and any other contaminants.
2.5 ADDITIVES

A. Use additives as required to accelerate or retard the break-set of the micro-surfacing mix, to improve the resulting finished surface, or to increase adhesion.
   1. Determine the initial additive quantities from the mix design for the micro-surfacing mix or individual materials.
   2. Use additives compatible with the other components of the mix.

2.6 JOB-MIX DESIGN

A. Design according to ASTM D 6372.
   1. Show each ingredient amount meets the following:
      a. Residual asphalt cement content, 7.0 percent minimum by dry total weight of aggregate.
      b. Aggregate gradation (target) within the job-mix gradation design limits in Table 4.
      c. Mineral filler, percentage by total dry weight of aggregate.
      d. Polymer modifier 3.0 percent minimum polymer solids based on the residual asphalt content certified by emulsion supplier.
   2. Identify the optimum emulsion content as a percentage of the dry weight of aggregate to meet Table 5 requirements.
   3. Identify additives as determined by design testing to control mix set times and cohesion.
      a. Provide acceptable limits for additives.
   4. Conform to the ISSA A143 specifications listed in Table 5.
   5. Use the same materials and aggregate gradation to be used on the project.
Table 5

<table>
<thead>
<tr>
<th>ISSA Test No.</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSA TB-139</td>
<td>Wet Cohesion</td>
<td>12 kg-cm Minimum</td>
</tr>
<tr>
<td></td>
<td>@ 30 Minutes Minimum (Set)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>@ 60 Minutes Minimum (Traffic)</td>
<td>20 kg-cm Minimum or Near Spin</td>
</tr>
<tr>
<td>ISSA TB-109</td>
<td>Excess Asphalt by LWT Sand Abrasion</td>
<td>50 g/ft² Maximum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(538 g/m² Maximum)</td>
</tr>
<tr>
<td>ISSA TB-114</td>
<td>Wet Stripping</td>
<td>Pass (90% Minimum)</td>
</tr>
<tr>
<td>*ISSA TB-100</td>
<td>Wet-Track Abrasion Loss</td>
<td>50 g/ft² (538 g/m²) Maximum</td>
</tr>
<tr>
<td></td>
<td>One-hour Soak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Six-day Soak</td>
<td>75 g/ft² (807 g/m²) Maximum</td>
</tr>
<tr>
<td>ISSA TB-147</td>
<td>Lateral Displacement</td>
<td>5% Maximum</td>
</tr>
<tr>
<td>ISSA TB-144</td>
<td>Classification Compatibility</td>
<td>11 Grade Points Minimum (AAA, BAA)</td>
</tr>
<tr>
<td>ISSA TB-113</td>
<td>Mix Time @ 77° F (25° C)</td>
<td>Controllable to 120 Seconds Minimum</td>
</tr>
</tbody>
</table>

* Perform the wet track abrasion test under laboratory conditions as a component of the mix design process.

2.7 EQUIPMENT

A. Use mixing equipment specifically designed and manufactured to mix and place micro-surfacing.
   1. Mix the material by an automatically sequenced, self-propelled micro-surfacing mixing machine with a continuous flow revolving multi-blade double shafted mixing unit that:
      a. Accurately delivers and proportions the aggregate, emulsified asphalt, mineral filler, controls setting additive, and water.
      b. Discharges the mixed product on a continuous flow basis.
   2. Use a machine with sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls.
   3. Use a machine capable of self-loading materials while continuing to place micro-surfacing.
   4. Verify that the operator has full control of the forward and reverse speed during applications of the micro-surfacing material.
      a. Use original manufacturer designed equipment for the self-loading device, opposite side driver stations, and forward and reverse speed controls.

B. Use a machine with a hydraulically adjustable (while applying mixture) type spreader box with a positive screed adjustment for yield control and a positive adjustment for the joint matcher.
C. Equip the micro-surfacing spreader box with the following:
   1. Ribbon flights mounted on an adjustable shaft to continually agitate
      and distribute the materials throughout the box.
   2. Curb bumpers and replaceable runners with at least 5 ft long end
      runners.
   3. A sufficient walkway to provide access to either side of the
      spreader box without walking through the freshly placed material.
      a. Verify that the equipment provides sufficient turbulence to
         prevent the mix from setting in the box or causing excessive
         side buildup or lumps.
   4. Flexible seals in contact with the road, front and rear, to prevent the
      loss of the mixture from the box.
   5. A secondary strike-off located approximately 2 to 3 ft behind the
      primary strike-off to minimize transverse corrugations and to
      improve surface texture.
      a. Verify that the secondary strike-off has elevation and width
         adjustments similar to the primary strike-off and a pivot point
         that can be tilted for texturing or raised completely off the
         surface.
      b. Verify that the secondary strike-off has the same
         adjustments as the spreader box.
   6. Ability to side shift the box to compensate for variations in the
      pavement geometry.
   7. Capability of applying micro-surfacing mixture in variable widths up
      to 15 ft.

D. Use a rut filling spreader box specifically designed to fill ruts with an
   average depth greater than ½ inch. Ruts greater than ½ inch deep require
   multiple passes to restore the cross section.

E. Use a computerized material monitoring system with integrated material
   control devices such that the amount of each material can be determined
   at any time.
   1. Calibrate each material control device before each mix application
      and as often thereafter as deemed necessary by the Engineer.
   2. Use a monitoring system capable of recording, displaying, and
      printing the following information:
      a. Individual sensor counts for emulsion, aggregate, mineral
         filler, water, and additive.
      b. Aggregate, emulsion, and mineral filler output in pounds per
         minute.
      c. Percentages of emulsion, mineral filler, water, and additive.
      d. Cumulative totals of aggregate, emulsion, mineral filler,
         water, and additive.
      e. Scale factor for all materials.
F. Verify the daily totals from the computerized monitoring system for the aggregate and the daily total from the scalping screen weighing system are within 2 percent.

G. Calibrate each mixing unit in the presence of the Engineer before construction.
   1. Do not use any machine until calibration has been completed.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Do not apply micro-surfacing during rain when road surface moisture is present or during other adverse weather conditions.

B. Do not apply micro-surfacing if either the pavement or air temperature is below 50 degrees F.

C. Do not apply micro-surfacing when the temperature is projected below 37 degrees F within 48 hours of placing micro-surfacing.

D. Cease micro-surfacing operations when the weather or other conditions prolong opening road surface to traffic beyond two hours.

E. Remove and replace the micro-surfacing if any of the following occurs:
   1. Lumping, balling, or unmixed aggregates.
   2. Separation of the coarse aggregate from the emulsion and fines.
   3. Excessive breaking of emulsion inside the spreader box.
   4. Streaking caused by oversized aggregate.
   5. Flushing or excessively rich areas appearing in the micro-surfacing after two hours from the time of placement.
   6. Any measurable rutting, shoving, or other evidence of premature deformation when exposed to traffic.

F. Keep traffic off roadway surface until the micro-surfacing has cured.
   1. Allow for additional curing time at locations such as driveways, intersections, and where sharp turning movements may take place or where vehicles may accelerate quickly.

3.2 STOCKPILE

A. Construct individual 500-ton stockpiles of micro-surfacing aggregates.
   1. Engineer will approve stockpiles at least one and at most seven days before use.
2. Combining, altering, or moving 500-ton stockpiles may require re-approval by the Engineer before use.

B. Notify the Engineer at least seven calendar days before micro-surfacing placement in order for the initial stockpiles to be sampled and tested for acceptance.

C. Obtain the Engineer’s written acceptance of a stockpile before its use for micro-surfacing.

D. Provide stockpile Quality Control information to the Engineer for every 500 tons of aggregates to include the following:
   1. Aggregate gradation meeting job-mix formula tolerances according to Table 4.
   2. Sand Equivalency refer to AASHTO T 176.

E. Be capable of determining aggregate moisture within 10 minutes at all times.

F. Rework or remove material not meeting specifications from the stockpile area. Identify stockpiles that will be reworked.

G. The Department will retest corrected material for acceptance.

3.3 PREPARATION

A. Clean the pavement surface of all dirt, sand, dust, oil, and other objectionable material immediately before applying micro-surfacing.

B. Allow un-sealed cracks to dry thoroughly before applying micro-surfacing when using water to clean the road surface.

C. Cover manholes, valve boxes, drop inlets, and other service utility entrances before surfacing.

D. Protect all structures, including items such as guardrail, guideposts, concrete barriers, drains, and parapet walls.

3.4 APPLICATION

A. Pre-wet the pavement surface as required due to local conditions by fogging ahead of the micro-surfacing box.
   1. Do not create standing water on the pavement in front of the micro-surfacing box.
B. Place micro-surfacing mix that meets the job-mix design.
   1. Control the ingredient proportions with metering or measuring devices on the micro-surfacing equipment.
      a. Use readings from the metering or measuring devices to determine compliance with limits stated in the approved job-mix design.
   2. Limit any increase or decrease in the amount of mineral filler added to the mix during production to ± 1 percent of the job-mix design.
   3. Limit the set-control agent to ± 1 percent of the job-mix design.
   4. Verify that the emulsion submitted with the job-mix design is the same emulsion used throughout the project.
   5. Verify that emulsion content is ±1 percent of the job-mix design.
      a. Engineer may require a new job-mix design and re-approval of the micro-surfacing if large disparities occur.
      b. Calculate the percent emulsion on the daily electronic printout from the calibrated paver for emulsion and aggregate quantities.

C. Produce a mixture according to the mix design and the quality control tolerances.
   1. Maintain quality control documentation and make available to the Engineer upon request or at completion of daily work.
   2. Randomly calculate the percent asphalt content of the mixture from the equipment computer display readings at least three times daily.
   3. Randomly calculate the yield of the aggregate being placed from the equipment computer display readings at least three times daily.
   4. Maintain a daily report and log sheet containing the following information:
      a. Aggregate used, ton (dry)
      b. Micro-Surfacing emulsion used, ton
      c. Bituminous materials for tack coat used, if specified, ton
      d. Mineral Filler used, lbs
      e. Water used in mixture, gallons
      f. Additive used in mixture, gallons
      g. Surface area completed (square yards)
      h. Surface area application rate (dry lbs aggregate per square yard)
      i. Percentage of emulsified asphalt based on dry aggregate

D. Pass the mineral aggregate over a vibratory scalping screen before transfer to the micro-surfacing mixing machine to remove oversize material.
   1. Verify that the screening unit is capable of providing weigh tickets for each load of material.
E. Carry a sufficient amount of micro-surfacing in all parts of the spreader box so that full width and complete coverage is obtained with no streaks or narrow spots.
   1. Avoid overloading the spreader box.
   2. Do not spray water directly into the spreader box during the application of micro-surfacing under any circumstances.

F. Apply micro-surfacing of proper consistency at a minimum rate of 25 lbs/yd$^2$ based on the dry weight of aggregate for each lot.
   1. Provide to the Engineer the square yards for each lot.
   2. Calculate the aggregate application rate using the daily tickets from the screening unit and daily electronic printout from the calibrated paver.

G. Apply micro-surfacing for rut filling.
   1. Apply micro-surfacing as a scratch-coat pass using a steel or high density strike-off when required to fill ruts less than ½ inch deep or as directed by the Engineer.
   2. Make multiple passes with the rut filling spreader box for ruts greater than ½ inch deep or as directed by the Engineer.
   3. Allow 24-hour cure time after filling ruts, before placing additional micro-surfacing layer.

H. Do not apply water to freshly placed micro-surfacing.

3.5 TEST STRIP

A. Construct a test strip at least 500 ft long on the roadway before initial placement.
   1. Verify initial set is achieved within 30 minutes and the surface shows no signs of distress when exposed to traffic after curing for 2 hours.
   2. Remove and replace or repair at the Engineer’s approval, at no cost to the Department, if the test strip does not meet the conditions stated above.

B. Make necessary adjustments if test strip does not perform as required.
   1. Obtain approval from the Engineer before 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. Verify that the depth of each micro-surfacing course does not exceed twice the maximum aggregate size.
1. Not required when using a rut filling spreader box.

B. Verify that the finished longitudinal and transverse joints are neat and uniform.
   1. Construct longitudinal joints within 6 inches of the lane lines where possible.
   2. Verify that overlap of micro-surfacing at any joint does not exceed 6 inches.
   3. Repair the joints if any of the following conditions exist:
      a. Build-up of material at the joints.
      b. Uncovered areas at the joints.
      c. Longitudinal and transverse joints with more than ¼ inch vertical space between the surface and a 4 ft straightedge placed perpendicular to the joint.
   4. Verify that the edges of the micro-surfacing follow the centerline, lane lines, shoulder lines, and curb lines.
   5. Repair the edges if they vary more than 6 inches.
   6. Use methods approved by the Engineer to correct deficiencies.
      a. Verify that the repaired surfaces are dense with a uniform texture.
      b. Repair sections with surface irregularities the same width as the existing pass of micro surfacing.
      c. Small areas of patching are not permitted.

C. Verify that the finished micro-surfacing has a uniform texture free of scratches, tears, and other surface irregularities.
   1. Repair the surface, at Contractor’s expense, if any of the following conditions exist:
      a. More than one surface irregularity ¼ inch or wider and 10 ft or longer in any 100 ft section.
      b. More than three surface irregularities ½ inch or wider and more than 6 inches long in any 100 ft section.
      c. Any surface irregularity 1 inch or wider and more than 4 inches long.
      d. Any tire track damage to the fresh micro-surfacing.
      e. Slick spots or any area of bleeding (surface flushing).

D. Place micro-surfacing adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge.
   1. Do not allow over-lap in these areas.

E. Maintain neat construction lines at all locations.

F. Place micro-surfacing at side streets and intersections out to right-of-way line including around radii where applicable.
G. Use hand squeegees to spread micro-surfacing in areas where micro-surfacing machine cannot operate.
1. Lightly dampen areas before mix placement.
2. Provide complete and uniform coverage.
3. Avoid unsightly appearance from handwork.
4. Use the same type of finish in hand worked areas as applied by the spreader box.

H. Use construction paper or comparable products so that beginning and ending joint lines from each construction pass are straight and neat.

END OF SECTION
SECTION 02741

HOT MIX ASPHALT (HMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. 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 01452: Pavement Smoothness
B. Section 01456: Materials Dispute Resolution
C. Section 02742S: Project Specific Surfacing Requirements
D. Section 02745: Asphalt Material
E. Section 02746: Hydrated Lime
F. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO M 323: Superpave Volumetric Mix Design
B. AASHTO R 35: Superpave Volumetric Design for Hot-Mix Asphalt (HMA)
C. AASHTO T 19: Bulk Density ("Unit Weight") and Voids in Aggregate
D. AASHTO T 89: Determining the Liquid Limit of Soils
E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
F. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
1.4 DEFINITIONS

A. Lot – The number of tons of HMA placed in a Production Day.

B. Minor Target Change – A change from the verified mix design gradation target on a maximum of two sieves with the following limitations.
   1. The maximum allowable change in the target gradation on the #8 or any coarser sieve is limited to 3 percent passing per sieve.
   2. The maximum allowable change in the target gradation on the #16 or #50 sieves is 2 percent passing per sieve.
   3. The maximum allowable change in the target gradation on the #200 sieve is 0.5 percent passing.
   4. No target change may violate the mix design requirements in this section.

C. Production Day – A 24 hour period in which HMA is being placed.
D. RAP – Recycled Asphalt Pavement. Crushed or milled asphalt materials that have been removed from pavements. Aggregates contained in these materials are required to meet Table 5 except sand equivalent.

E. Thin Overlay Pavement – An overlay where the sum of the thickness of the HMA lifts is less than two inches.

1.5 SUBMITTALS

A. Mix design at least 10 working days before paving according to the UDOT Materials Manual of Instruction 960.

B. Verification that hydrated lime meets the requirements of Section 02746.

C. Verification that asphalt binder meets the requirements of Section 02745.

D. Changes in job mix design
   1. Submit a written request for any proposed change in the job-mix gradation.
      a. Allow at least 12 hours for approval before incorporating a minor target change into production.
      b. Allow at least six working days for verification and approval of any other change.
   2. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Department acceptance test results or Contractor QC test data or both are acceptable.
   3. Submit samples according to the UDOT Materials Manual of Instruction 960 for a volumetric mix design verification for anything other than approved minor target changes. This includes changes in the aggregate source, asphalt binder source, or asphalt binder grade.

E. Corrective action plan according to this Section, articles 3.3 paragraph B and 3.4 paragraph A4b.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. Gradation and asphalt binder content
   1. The Engineer evaluates a lot on the test results of four samples with the following exceptions:
a. Compute incentive/disincentive using the test results from three samples if only three samples can be taken for the production day.
b. Combine test results with the next day of production if at least three random samples cannot be taken. Take one sample for each 500 tons, or portion thereof, from the following day’s production.
c. Add the lot to the previous day’s production for the final day’s production if three random samples cannot be taken.
d. The lot may be increased to include up to three production days when agreed upon in advance by both the Contractor and the Engineer when less than 900 tons are anticipated per production day.

2. Evaluate the lot using the number of tests “n” in Table 3.

3. The Engineer informs the Contractor of the time and place of sampling not more than 15 minutes before sampling.

C. Density and Thickness
1. Contractor obtains cores within two contract days after the pavement is placed. Refer to UDOT Materials Manual of Instruction 984.
   a. The Engineer marks coring location for in-place 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 is 93.5 percent of Theoretical Maximum Specific Gravity except for thin overlay pavements.
   b. The target for in-place density is 92.5 percent of Theoretical Maximum Specific Gravity for Thin overlay pavement projects.
   c. Use the average of the Theoretical Maximum Specific Gravity tests for each lot.
   d. Acceptance for in-place density may be based on establishing a rolling pattern for items such as bridge decks, utility work, traffic signals, detours, lane leveling, driveways, other handwork, or small projects with plan quantities less than 500 tons.
3. Thickness Requirements
   a. The Department accepts a lot for thickness when:
      1) The average thickness is not more than ½ inch greater or ¼ inch less than the total design 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 overlay pavement consists of checking thickness regularly with a depth probe during placement and taking corrective action as necessary.

D. The Department applies Incentives/Disincentives for Gradation/Asphalt Content, In-Place Density, and Longitudinal Joint Density. The Engineer computes Incentive/Disincentive for each lot. Refer to Section 01452 for smoothness requirements.
   1. Compute incentive/disincentive for Gradation/Asphalt Binder and In-place Density according to Table 1.
   2. Base the incentive/disincentive on Percent within Limit (PT) computation using Tables 2, 3, and 4.
   3. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content incentive/disincentive.
   4. Use Tables 2, 3, and 4 to determine PT for in-place density.
   5. Meet PT of 88 or greater for in-place density or the Department does not pay incentives on gradation/asphalt binder content.
   6. Incentive for Joint Density is $0.20 per linear foot of longitudinal joint for each lift when the average of all joint densities is above 91 percent of Theoretical Maximum Specific Gravity for the lot.
7. The following work is not eligible for incentive:
   a. Items such as utility work, traffic signals, detours, lane leveling, and driveways.
   b. Small projects with plan quantities of HMA less than 500 tons.

8. The Department will reject the lot if the PT is less than 60 percent.

E. The Department rejects lots:
   1. If the PT for any individual measurement listed in Table 2 is less than 60 percent.
   2. The Engineer may accept a reject lot. Refer to Section 01456.
      a. A $25 per ton price reduction will be assessed.
      b. The lot will not be eligible for any incentive.

F. The Engineer may elect to accept material on visual inspection for work such as utility work, traffic signals, detours, lane leveling, and driveways, other hand work, or small projects with plan quantities less than 500 tons.
   1. Lots accepted on visual inspection are not eligible for Incentive/Disincentive.
   2. The Engineer reserves the option of conducting any acceptance tests necessary to determine that the material and workmanship meets the project requirements.
   3. Acceptance for density may be based on establishing and maintaining a roller pattern to obtain maximum density without over-stressing the pavement.

Table 1

<table>
<thead>
<tr>
<th>PT Based on Min. Four Samples</th>
<th>Incentive/Disincentive (Dollars/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 99</td>
<td>1.50</td>
</tr>
<tr>
<td>96-99</td>
<td>1.00</td>
</tr>
<tr>
<td>92-95</td>
<td>0.60</td>
</tr>
<tr>
<td>88-91</td>
<td>0.00</td>
</tr>
<tr>
<td>84-87</td>
<td>-0.26</td>
</tr>
<tr>
<td>80-83</td>
<td>-0.60</td>
</tr>
<tr>
<td>76-79</td>
<td>-0.93</td>
</tr>
<tr>
<td>72-75</td>
<td>-1.27</td>
</tr>
<tr>
<td>68-71</td>
<td>-1.60</td>
</tr>
<tr>
<td>64-67</td>
<td>-1.93</td>
</tr>
<tr>
<td>60-63</td>
<td>-2.27</td>
</tr>
<tr>
<td>&lt;60</td>
<td>Reject</td>
</tr>
</tbody>
</table>
Table 2
Upper and Lower Limit Determination

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UL and LL</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>Target Value ± 6.0%</td>
</tr>
<tr>
<td>No. 8 sieve</td>
<td>Target Value ± 5.0%</td>
</tr>
<tr>
<td>No.50 sieve</td>
<td>Target Value ± 3.0%</td>
</tr>
<tr>
<td>No. 200 sieve</td>
<td>Target Value ± 2.0%</td>
</tr>
<tr>
<td>Asphalt Binder Content</td>
<td>Target Value ± 0.35%</td>
</tr>
<tr>
<td>Density</td>
<td>Lower Limit Target Value - 2.0% Upper Limit Target Value + 3.0%</td>
</tr>
<tr>
<td>PU/PL</td>
<td>n=3</td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>100</td>
<td>1.16</td>
</tr>
<tr>
<td>99</td>
<td>1.16</td>
</tr>
<tr>
<td>98</td>
<td>1.15</td>
</tr>
<tr>
<td>97</td>
<td>1.15</td>
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<tr>
<td>96</td>
<td>1.15</td>
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<tr>
<td>95</td>
<td>1.14</td>
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<tr>
<td>94</td>
<td>1.13</td>
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<tr>
<td>93</td>
<td>1.12</td>
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<td>92</td>
<td>1.11</td>
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<tr>
<td>91</td>
<td>1.10</td>
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<tr>
<td>90</td>
<td>1.09</td>
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<tr>
<td>89</td>
<td>1.08</td>
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<td>88</td>
<td>1.07</td>
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<td>87</td>
<td>1.06</td>
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<td>86</td>
<td>1.05</td>
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<td>85</td>
<td>1.03</td>
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<tr>
<td>84</td>
<td>1.02</td>
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<td>83</td>
<td>1.00</td>
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<tr>
<td>82</td>
<td>0.98</td>
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<tr>
<td>81</td>
<td>0.96</td>
</tr>
<tr>
<td>80</td>
<td>0.94</td>
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<tr>
<td>79</td>
<td>0.92</td>
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<tr>
<td>78</td>
<td>0.89</td>
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<tr>
<td>77</td>
<td>0.87</td>
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<td>76</td>
<td>0.84</td>
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<tr>
<td>75</td>
<td>0.82</td>
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<tr>
<td>74</td>
<td>0.79</td>
</tr>
<tr>
<td>73</td>
<td>0.77</td>
</tr>
<tr>
<td>72</td>
<td>0.74</td>
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<tr>
<td>71</td>
<td>0.71</td>
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<tr>
<td>70</td>
<td>0.68</td>
</tr>
<tr>
<td>69</td>
<td>0.65</td>
</tr>
<tr>
<td>68</td>
<td>0.62</td>
</tr>
<tr>
<td>67</td>
<td>0.59</td>
</tr>
<tr>
<td>66</td>
<td>0.56</td>
</tr>
<tr>
<td>65</td>
<td>0.53</td>
</tr>
<tr>
<td>64</td>
<td>0.49</td>
</tr>
<tr>
<td>63</td>
<td>0.46</td>
</tr>
<tr>
<td>62</td>
<td>0.43</td>
</tr>
<tr>
<td>61</td>
<td>0.39</td>
</tr>
<tr>
<td>60</td>
<td>0.36</td>
</tr>
<tr>
<td>&lt;60</td>
<td>≤ 0.35</td>
</tr>
</tbody>
</table>

Enter table in the appropriate “number of tests” column and round down to the nearest value.
### Table 4

**Definitions, Abbreviations, and Formulas for Acceptance**

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Value (TV)</td>
<td>The target values for gradation and asphalt binder content are given in the Contractor’s volumetric mix design. See this Section, article 1.6 for density target values.</td>
</tr>
<tr>
<td>Average (AVE)</td>
<td>The sum of the lot’s test results for a measured characteristic divided by the number of test results—the arithmetic mean.</td>
</tr>
<tr>
<td>Sample Standard Deviations</td>
<td>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.</td>
</tr>
<tr>
<td>Upper Limit (UL)</td>
<td>The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 2)</td>
</tr>
<tr>
<td>Lower Limit (LL)</td>
<td>The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 2)</td>
</tr>
<tr>
<td>Upper Quality Index (QU)</td>
<td>QU = (UL - AVE)/s</td>
</tr>
<tr>
<td>Lower Quality Index (QL)</td>
<td>QL = (AVE - LL)/s</td>
</tr>
<tr>
<td>Percentage of Lot Within UL (PU)</td>
<td>Determined by entering Table 3 with QU.</td>
</tr>
<tr>
<td>Percentage of Lot Within LL (PL)</td>
<td>Determined by entering Table 3 with QL.</td>
</tr>
<tr>
<td>Total Percentage of Lot Within UL and LL (PT)</td>
<td>PT = (PU + PL) – 100</td>
</tr>
<tr>
<td>Incentive/Disincentive</td>
<td>Determined by entering Table 1 with PT or PL.</td>
</tr>
</tbody>
</table>

All values for AVE, s, QU, and QL will be calculated to at least four decimal places and carried through all further calculations. Rounding to lower accuracy is not allowed.

### 1.7 DISPUTE RESOLUTION

A. Refer to Section 01456 when disputing the validity of the Department’s acceptance tests.

B. The option to dispute the validity of the Department’s test results is waived if the paired “t” testing described in this Section, article 3.4 is not performed.
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>
<thead>
<tr>
<th>Table 5 Aggregate Properties – HMA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Method</strong></td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>One Fractured Face</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Two Fractured Face</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
</tr>
<tr>
<td>Flakiness Index</td>
</tr>
<tr>
<td>(Based on ⅜ inch sieve and above)</td>
</tr>
<tr>
<td>L.A. Wear</td>
</tr>
<tr>
<td>Sand Equivalent</td>
</tr>
<tr>
<td>(Pre-wet method)</td>
</tr>
<tr>
<td>Plasticity Index</td>
</tr>
<tr>
<td>Unit Weight</td>
</tr>
<tr>
<td>Soundness (sodium sulfate)</td>
</tr>
<tr>
<td>Clay Lumps and Friable Particles</td>
</tr>
<tr>
<td>Natural Fines</td>
</tr>
</tbody>
</table>
C. Meet gradation requirements in Table 6.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1 inch</th>
<th>¾ inch</th>
<th>½ inch</th>
<th>⅜ inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Sieves</td>
<td>1½ inch</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 inch</td>
<td>90.0 - 100.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>¾ inch</td>
<td>&lt;90</td>
<td>90.0 - 100.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>½ inch</td>
<td>&lt;90</td>
<td>90.0 - 100.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>⅛ inch</td>
<td>&lt;90</td>
<td>&lt;90</td>
<td>90.0 - 100.0</td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
<td></td>
<td>&lt;90</td>
</tr>
<tr>
<td>No. 8</td>
<td>19.0 - 45.0</td>
<td>23.0 - 49.0</td>
<td>28.0 - 58.0</td>
<td>32.0 - 67.0</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0 - 7.0</td>
<td>2.0 - 8.0</td>
<td>2.0 - 10.0</td>
<td>2.0 - 10.0</td>
</tr>
</tbody>
</table>

2.3 HYDRATED LIME

A. Meet the requirements of Section 02746.

2.4 RECLAIMED ASPHALT PAVEMENT (RAP) (OPTIONAL)

A. Do not adjust the asphalt binder grade when RAP content is not more than 15 percent by total weight of the hot mix and RAP asphalt binder content is not more than 15 percent of the total asphalt binder content by weight.

B. Adjust asphalt binder grade according to AASHTO M 323 when RAP asphalt binder content is between 15 to 25 percent of the asphalt binder weight.
   1. Select one grade softer than the grade specified. Do not select any grades lower than PG XX-34.
   2. Provide test reports indicating that the PG grade and quantity of the recovered asphalt binder is consistent throughout the stockpile.
   3. Limit RAP to 25 percent of the total weight of the hot mix and RAP binder to 25 percent of the total binder.

C. RAP aggregate is required to meet Table 5 with exception of Sand Equivalent. Refer to AASHTO T 176.

2.5 WARM MIX

A. Meet all design requirements of Hot Mix Asphalt.
2.6 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. Refer to the UDOT Materials Manual of Instruction 960.
   1. Do not begin paving until verification is complete.
   2. The Resident Engineer and Region Materials Engineer will provide written verification of the field volumetric mix design.

C. Mix Design Changes
   1. The Department may allow up to two minor target changes per project without penalty to contractor. The Department charges $1,000 for each additional minor target change.
   2. The Department allows up to two volumetric mix design verifications, (including field verifications), per project. The Department charges $3,000 for each additional laboratory or field verification required. This includes all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.
   3. The Resident Engineer and Region Materials Engineer will review each change and provide written notice of approval or rejection of each mix design change.

<table>
<thead>
<tr>
<th>20 Years Design ESALS (Million)</th>
<th>Compaction Parameters</th>
<th>Voids Filled with Asphalt (VFA) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N_{initial} /% of G_{mm} *</td>
<td>N_{design} /% of G_{mm} *</td>
</tr>
<tr>
<td>0.3</td>
<td>6/ ≤ 91.5</td>
<td>50/96.5</td>
</tr>
<tr>
<td>0.3 to &lt;3</td>
<td>7/ ≤ 90.5</td>
<td>75/96.5</td>
</tr>
<tr>
<td>3 to &lt; 30</td>
<td>8/ ≤ 89</td>
<td>100/96.5</td>
</tr>
<tr>
<td>≥ 30</td>
<td>9/ ≤ 89</td>
<td>125/96.5</td>
</tr>
</tbody>
</table>

* G_{mm}: Theoretical maximum specific gravity of mix. Refer to AASHTO T 209.
** 67 percent specified lower limit VFA for 1-inch nominal maximum size mixture.
Table 8

<table>
<thead>
<tr>
<th>Volumetric Design Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA design mixing and compaction temperatures</td>
</tr>
<tr>
<td>Dust Proportion Range</td>
</tr>
</tbody>
</table>
| Voids in Mineral Aggregate (VMA) at $N_{\text{design}}$ AASHTO R 35.9.2 using $G_{\text{sb}}$ at SSD. Equation based on percent of total mix. | 12.5% - 13.5% for 1 inch  
13.5% - 14.5% for $\frac{3}{4}$ inch  
14.5% - 15.5% for $\frac{1}{2}$ inch  
15.5% - 16.5% for $\frac{3}{4}$ inch |
| Hamburg Wheel Tracker UDOT MOI 990 | 75 Design Gyrations and Greater Maximum 10 mm impression at 20,000 passes.  
Less than 75 Design Gyrations Maximum 10 mm impression at 10,000 passes |

2.7 PRIME COAT/TACK COAT

A. Refer to Section 02748.

PART 3 EXECUTION

3.1 HMA

A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight.  
1. May be verified by AASHTO T 255.  
2. Adjust burners to avoid damage or soot contamination of the aggregate.

B. Treat aggregate with hydrated lime. Refer to Section 02746.  
1. Method A or B  
2. The Department applies a deduction for mix produced by a non-certified supplier to cover the costs of inspection. The deduction is applied according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

C. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.  
1. May be verified by AASHTO T 195.  
2. Discontinue operation and make necessary corrections if material is not properly coated.
D. Maintain temperature of the HMA between the limits identified on the Volumetric Mix Design Verification Letter for mixing and compacting.
   1. The Department rejects materials heated over the identified limits.
   2. Remove all material rejected by the Department for overheating.

### 3.2 HMA PLANT

A. Provide
   1. Positive means to determine the moisture content of aggregate.
   2. Positive means to sample all material components.
   3. Sensors to measure the temperature of the HMA at discharge.
   4. The ability to maintain mix discharge temperature according to the mix design.

B. Asphalt Binder Storage Tanks
   1. Provide a positive means for separating and identifying asphalt grades when multiple products are used in mix production.
   2. Provide a positive means of sampling the asphalt binder. Accept a common sampling point where multiple products are used in mix production.

### 3.3 CEASE PRODUCTION

A. Cease production when any two out of three consecutive lots meet one of the following criteria:
   1. A net disincentive
   2. Air voids at N\textsubscript{des} averaged for each lot are less than 2.5 or greater than 4.75 percent
   3. VMA at N\textsubscript{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. Address the specific issues contributing to the cease production directive. The Engineer must approve the revised plan before production continues.

C. The Engineer may require a new mix design.

D. The Engineer may require Hamburg Wheel-Track testing for up to 5 lots after the cease production order.
   1. Sample to be taken randomly from behind the paver for up to 5 lots after the cease production order.
   2. Failure to meet the requirements of Table 8 results in rejection of the lot.
3.4 LABORATORY CORRELATION

A. Perform split-sample, paired $t$-testing with the Department based on project quality control testing using Department LQP qualified lab.
   1. Perform split-sample, paired $t$ analysis on all mix acceptance tests and tests related to volumetric properties.
   2. Perform paired $t$ analysis as defined in the UDOT Materials Manual of Instruction, Appendix C.
   3. Continue paired $t$-testing until at least two consecutive production days meet $\alpha = 0.05$ for a two tailed distribution.
   4. Resolve discrepancies in lab results within the first five production days.
      a. Cease production if two consecutive days in the first five days cannot be achieved.
      b. Submit a corrective action plan to the Engineer before production continues indicating the changes in procedures that will be implemented to correct the deficiencies. Both Contractor and Department labs must make paired $t$ test results available within 24 hours of sampling.

3.5 SURFACE PREPARATION

A. Locate, reference, and protect all utility covers, monuments, curb and gutter, and other components affected by the paving operations.

B. Remove all moisture, dirt, sand, leaves, and other objectionable material from the prepared surface before placing the tack coat and mix.

C. Complete spot leveling before placing pavement courses.
   1. Place, spread, and compact leveling mix on portions of the existing surface.
   2. Fill and compact any localized potholes more than 1 inch deep.
   3. Allow compacted mix to cool sufficiently to below 150 degrees F to provide a stable structural platform before placing additional lifts of HMA.

D. Apply tack coat to all paved surfaces before applying a leveling course or pavement lift as required in Section 02748.

E. Allow sufficient cure time for prime coat/tack coat before placing HMA.
3.6 SURFACE PLACEMENT

A. Provide a compactable sloped edge adjacent to the next lane to be paved when full-width or Echelon paving is impractical and more than one pass is required.
   1. Coat edge with tack coat according to Section 02748 at a residual rate of 0.05 gal/yd$^2$.
   2. Echelon paving is the preferred method for constructing a longitudinal joint.
   3. Refer to Section 01554 and DD and TC Series Standard Drawings for pavement edge slope required to safely maintain traffic.

B. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.

C. 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.

3.7 COMPACTION

A. Use a small compactor or vibratory roller at structures in addition to normal rolling.

B. Operate in a transverse direction next to the back wall and approach slab.
3.8 LIMITATIONS

A. Do not place on frozen base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.

B. Use a release agent that does not dissolve asphalt and is 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.

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 209: Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt Paving Mixtures

L. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

M. AASHTO T 308: Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven

N. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate

O. UDOT Materials Manual of Instruction (MOI)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Design data sheet – Refer to this Section, article 1.6, paragraph A.

1.6 ACCEPTANCE

A. Certify that the mix meets the gradation requirements of Table 2, aggregate gradation and asphalt binder requirements from the Job Mix Design Requirements. Refer to AASHTO T 30 and T 308.

PART 2 PRODUCTS

2.1 ASPHALT MATERIALS

A. Use the following asphalt materials:
   2. Flush Coat – CQS-1, CSS-1 or SS-1.

2.2 AGGREGATE

A. Refer to Section 02745 and Section 02741 excluding Aggregate Properties Table.

B. Use Table 1 following for Aggregate Properties.
Table 1

Aggregate Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test Method</th>
<th>Test Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Fractured Face</td>
<td>AASHTO T 335</td>
<td>N/A</td>
</tr>
<tr>
<td>Two Fractured Face</td>
<td>AASHTO T 335</td>
<td>90% Min.</td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
<td>AASHTO T 304</td>
<td>45 Min.</td>
</tr>
<tr>
<td>Flakiness Index</td>
<td>MOI 933</td>
<td>17% Max.</td>
</tr>
<tr>
<td></td>
<td>Based on ⅜ inch and above</td>
<td></td>
</tr>
<tr>
<td>L.A. Wear</td>
<td>AASHTO T 96</td>
<td>35% Max.</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>AASHTO T 176</td>
<td>45 Min.</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>AASHTO T 89 and T 90</td>
<td>0</td>
</tr>
<tr>
<td>Unit Weight</td>
<td>AASHTO T 19</td>
<td>75 lb/ft³ Min.</td>
</tr>
<tr>
<td>Soundness Loss</td>
<td>AASHTO T 104 – Sodium Sulfate</td>
<td>16% Max. loss with five cycles</td>
</tr>
<tr>
<td>Deleterious Materials</td>
<td>AASHTO T 112</td>
<td>2% Max.</td>
</tr>
<tr>
<td>Natural Fines</td>
<td>---</td>
<td>10% Max.</td>
</tr>
</tbody>
</table>

C. Meet gradation in Table 2.

Table 2

Aggregate Gradations
Percent Passing by Dry Weight of Aggregate
AASHTO T 11 and AASHTO T 27

<table>
<thead>
<tr>
<th>Control Sieve</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ inch</td>
<td>100.0</td>
</tr>
<tr>
<td>⅜ inch</td>
<td>90.0 - 100.0</td>
</tr>
<tr>
<td># 4</td>
<td>&lt; 90.0</td>
</tr>
<tr>
<td># 8</td>
<td>32.0 - 67.0</td>
</tr>
<tr>
<td>#200</td>
<td>2.0 - 10.0</td>
</tr>
</tbody>
</table>

2.3 HYDRATED LIME

A. Use at least one percent hydrated lime.

B. Refer to Section 02746.
2.4 VOLUMETRIC DESIGN REQUIREMENTS

A. Perform Superpave Volumetric Mix Design according to UDOT Materials Manual of Instruction 960 and the following:
   1. Incorporate hydrated lime into all designs. Refer to Section 02746.
   2. Comply with Table 3.

B. The Department Region Materials Lab verifies the Volumetric Mix Design. Refer to UDOT Materials Manual of Instruction 960.
   1. Do not begin paving until verification is complete.
   2. The Region Materials Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design or from a previous mix design.
   3. The Region Materials Engineer reserves the right to verify any mix design submitted.

Table 3

<table>
<thead>
<tr>
<th>Compaction Stage</th>
<th>Number of Gyrations (N)</th>
<th>% of G_{mm} (AASHTO T 209)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>5</td>
<td>≤ 91.5</td>
</tr>
<tr>
<td>Design</td>
<td>50</td>
<td>≥ 98.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>75</td>
<td>≤ 100.0</td>
</tr>
</tbody>
</table>

PART 3 EXECUTION

3.1 HMA

A. Refer to Section 02741, Part 3.

3.2 SURFACE PREPARATION

A. Refer to Section 02741, Part 3.

   B. Refer to Section 02748.

3.3 COMPACTION

A. Establish a rolling pattern to obtain maximum density without overstressing the pavement.
3.4 ASPHALT EMULSION

A. Apply the flush coat at a uniform rate of 0.10 gal/yd² undiluted emulsion or 0.15 gal/yd² 2:1 diluted emulsion. Diluted emulsion 2:1 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: Cutback Asphalt (Rapid-Curing Type)
B. AASHTO M 82: Cutback Asphalt (Medium-Curing Type)
C. AASHTO M 140: Emulsified Asphalt
D. AASHTO M 208: Cationic Emulsified Asphalt
E. AASHTO M 226: Viscosity Graded Asphalt Cement
F. AASHTO M 282: Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements
G. AASHTO M 320: Performance Graded Asphalt Binder
H. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
I. AASHTO T 44: Solubility of Bituminous Materials
J. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup
K. AASHTO T 49: Penetration of Bituminous Materials
L. AASHTO T 50: Float Test for Bituminous Materials
M. AASHTO T 51: Ductility of Bituminous Materials
N. AASHTO T 59: Emulsified Asphalt
O. AASHTO T 201: Kinematic Viscosity of Asphalts (Bitumens)
P. AASHTO T 228: Specific Gravity of Semi-Solid Asphalt Materials

Q. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)

R. AASHTO T 300: Force Ductility of Asphalt Materials

S. AASHTO T 301: Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer

T. AASHTO T 313: Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)

U. AASHTO T 314: Determining the Fracture Properties of Asphalt Binder in Direct Tension

V. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

W. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer


Y. ASTM D 2007: Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum Derived Oils by the Clay Gel Absorption Chromatographic Method

Z. ASTM D 2026: Cutback Asphalt (Slow Curing Type)

AA. ASTM D 4402: Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer

BB. ASTM D 5329: Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

CC. ASTM D 5801: Toughness and Tenacity of Bituminous Materials

DD. California Test Methods

EE. UDOT Materials Manual of Instruction

FF. UDOT Minimum Sampling and Testing Requirements
GG. UDOT Quality Management Plan

1.4 DEFINITIONS

1.5 SUBMITTALS

A. 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 ACCEPTANCE

A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Each shipment of asphalt material must:
1. Be uniform in appearance and consistency.
2. Show no foaming when heated to the specified loading temperature.

B. Do not supply shipments contaminated with other asphalt types or grades than those specified.

1.8 GRADE OF MATERIAL

A. The Engineer determines the grade of material to be used based on the supply source designated by the Contractor when the bid proposal lists more than one grade of asphalt material.
1.9 PAYMENT PROCEDURES

A. Price adjustments for asphalt binder and liquid asphalt including chip-seal emulsions and cut-backs.
   1. 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. Department PGAB management plan governs price reductions or removal of material where the binder does not meet 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 Quality Management Plan Section 509, Asphalt Binder.

B. Refer to AASHTO M 320 for all PGABs having algebraic differences less than 92 degrees between the high and low design temperatures.

C. Refer to AASHTO M 320 modified by Tables 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**

<table>
<thead>
<tr>
<th><strong>Original Binder</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 58° C, G*, kPa</td>
<td>1.30 Min.</td>
<td></td>
</tr>
<tr>
<td>@ 58° C, phase angle, degrees</td>
<td>74.0 Max.</td>
<td></td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 135° C, Pa.s</td>
<td>3 Max.</td>
<td></td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 °C</td>
<td>260 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T 240</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 58° C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>65 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 16° C, kPa</td>
<td>5,000 Max.</td>
<td></td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -24° C, S, MPa</td>
<td>300 Max.</td>
<td></td>
</tr>
<tr>
<td>@ -24° C, m-value</td>
<td>0.300 Min.</td>
<td></td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -24° C, Failure Strain, %</td>
<td>1.5 Min.</td>
<td></td>
</tr>
<tr>
<td>@ -24° C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
<td></td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th><strong>Original Binder</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 64° C, G*, kPa</td>
<td>1.30 Min.</td>
<td></td>
</tr>
<tr>
<td>@ 64° C, phase angle, degrees</td>
<td>74.0 Max.</td>
<td></td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 135° C, Pa.s</td>
<td>3 Max.</td>
<td></td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 °C</td>
<td>260 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T 240</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 64° C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>65 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 22° C, kPa</td>
<td>5,000 Max.</td>
<td></td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -18° C, S, MPa</td>
<td>300 Max.</td>
<td></td>
</tr>
<tr>
<td>@ -18° C, m-value</td>
<td>0.300 Min.</td>
<td></td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -18° C, Failure Strain, %</td>
<td>1.5 Min.</td>
<td></td>
</tr>
<tr>
<td>@ -18° C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
<td></td>
</tr>
</tbody>
</table>

(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

**Original Binder**

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Value</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 64°C, G*, kPa</td>
<td>1.30 Min.</td>
<td></td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 64°C, phase angle, degrees</td>
<td>71.0 Max.</td>
<td></td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 °C</td>
<td>3 Max.</td>
<td></td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T-240</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 64°C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>70 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 19°C, kPa</td>
<td>5,000 Max.</td>
<td></td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -24°C, S, MPa</td>
<td>300 Max.</td>
<td></td>
</tr>
<tr>
<td>@ -24°C, m-value</td>
<td>0.300 Min.</td>
<td></td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -24°C, Failure Strain, %</td>
<td>1.5 Min.</td>
<td></td>
</tr>
<tr>
<td>@ -24°C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
<td></td>
</tr>
</tbody>
</table>

(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

**Original Binder**

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Value</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70°C, G*, kPa</td>
<td>1.30 Min.</td>
<td></td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 70°C, phase angle, degrees</td>
<td>74.0 Max.</td>
<td></td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 °C</td>
<td>3 Max.</td>
<td></td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T 240</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70°C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>65 Min.</td>
<td></td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 28°C, kPa</td>
<td>5,000 Max.</td>
<td></td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -12°C, S, MPa</td>
<td>300 Max.</td>
<td></td>
</tr>
<tr>
<td>@ -12°C, m-value</td>
<td>0.300 Min.</td>
<td></td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -12°C, Failure Strain, %</td>
<td>1.5 Min.</td>
<td></td>
</tr>
<tr>
<td>@ -12°C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
<td></td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th>Original Binder</th>
<th>PG70-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70° C, G*, kPa</td>
<td>1.30 Min.</td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 70° C, phase angle, degrees</td>
<td>71.0 Max.</td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 @ 135° C, Pa.s</td>
<td>3 Max.</td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T 240</strong></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70° C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>70 Min.</td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</strong></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 25° C, kPa</td>
<td>5,000 Max.</td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -18° C, S, MPa</td>
<td>300 Max.</td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -18° C, Failure Strain, % @ -18° C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th>Original Binder</th>
<th>PG70-34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70° C, G*, kPa</td>
<td>1.30 Min.</td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316 @ 70° C, phase angle, degrees</td>
<td>71.0 Max.</td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48 @ 135° C, Pa.s</td>
<td>3 Max.</td>
</tr>
<tr>
<td><strong>RTFO Residue, AASHTO T 240</strong></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 70° C, G*/sinδ, kPa</td>
<td>2.20 Min.</td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a) %</td>
<td>75 Min.</td>
</tr>
<tr>
<td><strong>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</strong></td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315 @ 22° C, kPa</td>
<td>5,000 Max.</td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313 @ -24° C, S, MPa</td>
<td>300 Max.</td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314 @ -24° C, Failure Strain, % @ -24° C, Failure Stress (b), MPa</td>
<td>4.0 Min.</td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th>Original Binder</th>
<th>PG76-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 76°C, G*, kPa</td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316</td>
<td>@ 76°C, phase angle, degrees</td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48</td>
<td>@ 135°C, Pa.s</td>
</tr>
<tr>
<td>RTFO Residue, AASHTO T 240</td>
<td>°C</td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 76°C, G*/sinδ, kPa</td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a)</td>
<td>%</td>
</tr>
<tr>
<td>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 31°C, kPa</td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313</td>
<td>@ -12°C, S, MPa</td>
</tr>
<tr>
<td></td>
<td>@ -12°C, m-value</td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314</td>
<td>@ -12°C, Failure Strain, %</td>
</tr>
<tr>
<td></td>
<td>@ -12°C, Failure Stress (b), MPa</td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th>Original Binder</th>
<th>PG76-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 76°C, G*, kPa</td>
</tr>
<tr>
<td>Rotational Viscometer, AASHTO T 316</td>
<td>@ 76°C, phase angle, degrees</td>
</tr>
<tr>
<td>Flash Point, AASHTO T 48</td>
<td>@ 135°C, Pa.s</td>
</tr>
<tr>
<td>RTFO Residue, AASHTO T 240</td>
<td>°C</td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 76°C, G*/sinδ, kPa</td>
</tr>
<tr>
<td>Elastic Recovery, AASHTO T 301 mod (a)</td>
<td>%</td>
</tr>
<tr>
<td>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</td>
<td></td>
</tr>
<tr>
<td>Dynamic Shear Rheometer, AASHTO T 315</td>
<td>@ 28°C, kPa</td>
</tr>
<tr>
<td>Bending Beam Rheometer, AASHTO T 313</td>
<td>@ -18°C, S, MPa</td>
</tr>
<tr>
<td></td>
<td>@ -18°C, m-value</td>
</tr>
<tr>
<td>Direct Tension Test, AASHTO T 314</td>
<td>@ -18°C, Failure Strain, %</td>
</tr>
<tr>
<td></td>
<td>@ -18°C, Failure Stress (b), MPa</td>
</tr>
</tbody>
</table>

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.
2.2 ASPHALTIC CEMENT, LIQUID ASPHALTS, AND REJUVENATING AGENTS

A. Refer to AASHTO M 226, Table 2 with the following modifications:
   1. Delete and replace ductility at 77 degrees F (25 degrees C) with ductility at 39.2 degrees F (4 degrees C) using the values specified below.

   \[
   \begin{array}{cccc}
   \text{AC - 2.5} & \text{AC - 5} & \text{AC - 10} & \text{AC - 20} \\
   50+ & 25+ & 15+ & 5+ \\
   \end{array}
   \]

B. Cationic and Anionic Emulsified Asphalt
   1. All standard Slow Setting (SS, CSS), Quick Setting (QS, CQS) Medium Setting (MS, CMS), and Rapid Setting (RS, CRS) grades including all High-Float designations (HF).
   2. Supply under the Approved Supplier Certification System (ASC).
   3. Refer to and meet AASHTO M 208 and M 140.

C. Meet the requirements of one of these tables:
   1. Table 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 specification ASTM D 2026 for slow curing (SC).
   2. Refer to specification AASHTO M 82 for medium curing (MC).
   3. Refer to specification AASHTO M 81 for rapid curing (RC).

E. Meet the requirements for Emulsified Asphalt Pavement Rejuvenating Agent:
   1. Table 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**

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF, 140° F (60° C), s</td>
<td>AASHTO T 59</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>(Project-site Acceptance/Rejection Limits)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settlement (a) 5 days, percent</td>
<td>AASHTO T 59</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Storage Stability Test (b) 1 d, 24 h, percent</td>
<td>AASHTO T 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosucinate, percent</td>
<td>AASHTO T 59</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>AASHTO T 59</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>AASHTO T 59</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td><strong>Distillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Residue (d), percent</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residue from Distillation Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100 g, 5 s, dmm</td>
<td>AASHTO T 49</td>
<td>80</td>
<td>150</td>
</tr>
<tr>
<td>Ductility, 39,2° F (4° C), 5 cm/min, cm</td>
<td>AASHTO T 51</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Toughness, lb-in</td>
<td>ASTM D 5801</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Tenacity, lb-in</td>
<td>ASTM D 5801</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>97.5</td>
<td></td>
</tr>
</tbody>
</table>

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 five 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 ± 5° F (177 ± 3° C) maximum temperature to be held for 15 minutes.

Modify the asphalt cement before emulsification.
### Table 10

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF, 122° F (50° C), s</td>
<td>AASHTO T 59</td>
<td>140</td>
<td>400</td>
</tr>
<tr>
<td>(Project Site Acceptance/Rejection Limits)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settlement (a) 5 days, percent</td>
<td>AASHTO T 59</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Storage Stability Test (b) 1 d, 24 h, percent</td>
<td>AASHTO T 59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Demulsibility (c) 35 ml, 0.8% sodium Dioctyl Sulfosucinate, percent</td>
<td>AASHTO T 59</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>AASHTO T 59</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>AASHTO T 59</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td><strong>Distillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Residue (d), percent</td>
<td></td>
<td>65</td>
<td></td>
</tr>
<tr>
<td><strong>Residue from Distillation Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100 g, 5 s, dmm</td>
<td>AASHTO T 49</td>
<td>40</td>
<td>200</td>
</tr>
<tr>
<td>Torsional Recovery (e)</td>
<td></td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

(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 ± 5°F (177±3°C) maximum temperature to be held for 15 minutes.

(e) CA 332 (California Test Method)

**Co-mill latex and asphalt during emulsification**
### Table 11

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF, 122° F (50° C), s</td>
<td>AASHTO T 59</td>
<td>50 - 450</td>
</tr>
<tr>
<td>Percent residue</td>
<td>AASHTO T 59</td>
<td>60 min</td>
</tr>
<tr>
<td>Storage Stability Test, 1d, 24h, percent</td>
<td>AASHTO T 59</td>
<td>1 max</td>
</tr>
<tr>
<td>Sieve, percent</td>
<td>AASHTO T 59</td>
<td>0.10 max</td>
</tr>
<tr>
<td>Particle charge</td>
<td>AASHTO T 59</td>
<td>Positive</td>
</tr>
<tr>
<td>Oil Distillate, percent by volume of emulsion</td>
<td>AASHTO T 59</td>
<td>5-15</td>
</tr>
<tr>
<td><strong>Residue</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100g, 5 sec, dmm</td>
<td>AASHTO T 59</td>
<td>100-250</td>
</tr>
<tr>
<td>Solubility, percent</td>
<td>AASHTO T 59</td>
<td>97.5 min.</td>
</tr>
</tbody>
</table>

### Table 12

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)</td>
<td>AASHTO T 59</td>
<td>70</td>
<td>300</td>
</tr>
<tr>
<td>Storage Stability Test, 1d, 24 h, percent</td>
<td>AASHTO T 59</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>AASHTO T 59</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td><strong>Distillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Distillate, by volume of emulsion, percent</td>
<td>AASHTO T 59</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Residue, percent</td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td><strong>Residue from Distillation Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100g, 5 s, dmm</td>
<td>AASHTO T 49</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>Float Test, 140° F (60° C), s</td>
<td>AASHTO T 50</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Solubility in Trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>97.5</td>
<td></td>
</tr>
<tr>
<td>Ductility, 77° F (25° C) 5cm/min, cm</td>
<td>AASHTO T 51</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td>Test method</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Emulsion</td>
<td>AASHTO T 59</td>
<td>100</td>
<td>450</td>
</tr>
<tr>
<td>Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)</td>
<td>AASHTO T 59</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Storage Stability Test, 1 d, 24 h, percent</td>
<td>AASHTO T 59</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>AASHTO T 59</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Distillation</td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td>AASHTO T 59</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Residue (b), percent</td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100 g, 5 s, dmm</td>
<td>AASHTO T 49</td>
<td>70</td>
<td>300</td>
</tr>
<tr>
<td>Float Test, 140° F (60° C), s</td>
<td>AASHTO T 50</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>97.5</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, 77° F (25° C), percent</td>
<td>AASHTO T 301</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

(a) Supply an HFMS-2P (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours.

(b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5° F (177 ± 3° C) maximum temperature to be held for 15 minutes.
Table 14

<table>
<thead>
<tr>
<th>High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2SP) (a)</th>
<th>Tests</th>
<th>Test method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF, 122º F (50º C), s (Project Site Acceptance/Rejection Limits)</td>
<td></td>
<td>AASHTO T 59</td>
<td>50</td>
<td>450</td>
</tr>
<tr>
<td>Storage Stability Test, 1 d, 24 h, percent</td>
<td></td>
<td>AASHTO T 59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td></td>
<td>AASHTO T 59</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Distillation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td></td>
<td>AASHTO T 59</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Residue (b), percent</td>
<td></td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Residue from Distillation Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77º F (25º C), 100 g, 5 s, dmm</td>
<td></td>
<td>AASHTO T 49</td>
<td>150</td>
<td>300(c)</td>
</tr>
<tr>
<td>Float Test, 140ºF (60ºC), s</td>
<td></td>
<td>AASHTO T 50</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene, percent</td>
<td></td>
<td>AASHTO T 44</td>
<td>97.5</td>
<td></td>
</tr>
<tr>
<td>Elongation Recovery(d), 77º F (25º C), percent</td>
<td></td>
<td>AASHTO T 301</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

(a) Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours.

(b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5º F (177 ± 3º C) 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

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF @ 122° F (50° C), s</td>
<td>AASHTO T 59</td>
<td>50</td>
<td>450</td>
</tr>
<tr>
<td>(Project Site Acceptance/Rejection Limits)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Stability Test (b) 1 d, 24 h, percent</td>
<td>AASHTO T 59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Demulsibility 0.02 N Ca Cl₂, percent</td>
<td>AASHTO T 59</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>AASHTO T 59</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td><strong>Distillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td>AASHTO T 59</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Residue (b), percent</td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td><strong>Residue from Distillation Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77° F (25° C), 100 g, 5 s, dmm</td>
<td>AASHTO T 49</td>
<td>70</td>
<td>150</td>
</tr>
<tr>
<td>Float Test, 140° F (60° C), s</td>
<td>AASHTO T 50</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>97.5</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery, 77° F (25° C), percent</td>
<td>AASHTO T 301</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>(a) Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5°F (177±3°C) maximum temperature to be held for 15 minutes.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 16

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulsion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SF @ 122° F (50° C), s</td>
<td>AASHTO T 59</td>
<td>140</td>
<td>400</td>
</tr>
<tr>
<td>(Project Site Rejection/Acceptance Limits)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability test, 24 h, percent</td>
<td>AASHTO T 59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Demulsibility, 35 mL 0.8 percent Sodium Diocyl SulfoSucinate, percent</td>
<td>AASHTO T 59</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Particle charge test</td>
<td>AASHTO T 59</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Sieve test, percent</td>
<td>AASHTO T 59</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td><strong>Distillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil distillate, by volume of emulsion, percent</td>
<td>AASHTO T 59</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Residue, percent</td>
<td>AASHTO T 59</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Use PG58-22 and PG64-22 as base asphalt cement for CRS-2A, B, respectively. Specification for high temperature performance – original and RTFO G*/sinδ within 3° C of grade.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours.

Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5°F (177±3°C) maximum temperature to be held for 15 minutes.
Table 17

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, SF, 77º F (25º C), s</td>
<td>AASHTO T 59</td>
<td>15 Min    40 Max</td>
</tr>
<tr>
<td>Residue , percent W (a)</td>
<td>AASHTO T 59</td>
<td>60 Min.  65 Max.</td>
</tr>
<tr>
<td>Miscibility Test (b)</td>
<td>AASHTO T 59</td>
<td>No Coagulation</td>
</tr>
<tr>
<td>Sieve Test, percent W (c)</td>
<td>AASHTO T 59</td>
<td>0.20 Max</td>
</tr>
<tr>
<td>5-day Settlement, percent W</td>
<td>AASHTO T 59</td>
<td>5.0 Max.</td>
</tr>
<tr>
<td>Particle Charge</td>
<td>AASHTO T 59</td>
<td>Positive</td>
</tr>
<tr>
<td>Light Transmittance , %</td>
<td>UDOT MOI 8-973</td>
<td>30 Max.</td>
</tr>
<tr>
<td>Cement Mixing</td>
<td>AASHTO T 59</td>
<td>2 Max.</td>
</tr>
</tbody>
</table>

**Residue from Distillation (a)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, 140º F (60º C), mm²/s</td>
<td>ASTM D 4402</td>
<td>150 – 300</td>
</tr>
<tr>
<td>Flash Point, COC, º F (º C)</td>
<td>AASHTO T 48</td>
<td>385 Min.</td>
</tr>
<tr>
<td>Asphaltenes, percent W</td>
<td>ASTM D 2006</td>
<td>0.4 Min.  0.75 Max.</td>
</tr>
<tr>
<td>Maltene Distribution Ratio (PC + A₁)/(S + A₂)</td>
<td>ASTM D 2006</td>
<td>0.3 Min.  0.6 Max.</td>
</tr>
<tr>
<td>Saturated Hydrocarbons, S (d)</td>
<td>ASTM D 2006</td>
<td>21 Min.  28 Max.</td>
</tr>
<tr>
<td>PC/S Ratio (d)</td>
<td>ASTM D 2006</td>
<td>1.5 Min.</td>
</tr>
</tbody>
</table>

(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, A₁ = First Acidaffins A₂ = Second Acidaffins, S = Saturated Hydrocarbons
Table 18

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, SF, 77º F (25º C), s</td>
<td>AASHTO T 59</td>
<td>25 - 150</td>
</tr>
<tr>
<td>Residue, percent W</td>
<td>AASHTO T 59 (mod) (a)</td>
<td>62 Min.</td>
</tr>
<tr>
<td>Sieve Test, percent W</td>
<td>AASHTO T 59</td>
<td>0.10 Max.</td>
</tr>
<tr>
<td>5-day Settlement</td>
<td>AASHTO T 59</td>
<td>5.0 Max.</td>
</tr>
<tr>
<td>Particle Charge</td>
<td>AASHTO T 59</td>
<td>Positive</td>
</tr>
<tr>
<td>Pumping Stability (b)</td>
<td></td>
<td>Pass</td>
</tr>
</tbody>
</table>

**Residue from Distillation (a)**

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity @ 140º F (60º C), mm²/s</td>
<td>AASHTO T 201</td>
<td>2,500 - 7,500</td>
</tr>
<tr>
<td>Solubility in 1,1,1 Trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>98 Min.</td>
</tr>
<tr>
<td>Flash Point, COC</td>
<td>AASHTO T 48</td>
<td>204º C, Min.</td>
</tr>
<tr>
<td>Asphaltenes, percent W</td>
<td>ASTM D 2007</td>
<td>15 Max.</td>
</tr>
<tr>
<td>Saturates, percent W</td>
<td>ASTM D 2007</td>
<td>30 Max.</td>
</tr>
<tr>
<td>Aromatics, percent W</td>
<td>ASTM D 2007</td>
<td>25 Min.</td>
</tr>
</tbody>
</table>

(a) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5º F (149 ± 3º C) maximum temperature to be held for 15 minutes.

(b) Test pumping stability by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77º F (25º C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.

Type B – an emulsified blend of lube oil or lube oil extract and petroleum asphalt.
Table 19

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, SF, 77º F (25º C), s</td>
<td>AASHTO T 59</td>
<td>50 - 200</td>
</tr>
<tr>
<td>Residue(a), percent W</td>
<td>AASHTO T 59</td>
<td>62 Min.</td>
</tr>
<tr>
<td>Sieve Test, percent W</td>
<td>AASHTO T 59</td>
<td>0.20 Max.</td>
</tr>
<tr>
<td>5-day Settlement, percent W</td>
<td>AASHTO T 59</td>
<td>5.0 Max.</td>
</tr>
<tr>
<td>Particle Charge</td>
<td>AASHTO T 59</td>
<td>Positive</td>
</tr>
<tr>
<td>Rolling Stability (b)</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td>Residue from Distillation (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity (c) 275º F (135º C), cP</td>
<td>ASTM D 4402</td>
<td>150 - 300</td>
</tr>
<tr>
<td>Penetration, 77º F (25º C), dmm</td>
<td>AASHTO T 49</td>
<td>180 Min.</td>
</tr>
<tr>
<td>Solubility in 1,1,1 Trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>98 Min.</td>
</tr>
<tr>
<td>Flash Point, COC, º F (º C)</td>
<td>AASHTO T 48</td>
<td>400(204) Min.</td>
</tr>
<tr>
<td>Asphaltenes, percent W</td>
<td>ASTM D 2007</td>
<td>20 - 40</td>
</tr>
<tr>
<td>Saturates, percent % W</td>
<td>ASTM D 2007</td>
<td>20 Max.</td>
</tr>
<tr>
<td>Aromatics, percent W</td>
<td>ASTM D 2007</td>
<td>20 Min.</td>
</tr>
<tr>
<td>PC/S Ratio</td>
<td>ASTM D 2007</td>
<td>1.5 Min.</td>
</tr>
</tbody>
</table>

(a) Determine the distillation by AASHTO T 59 with modifications to include a 300±5ºF (149 ± 3º C) maximum temperature to be held for 15 minutes.

(b) Pumping stability is tested by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77º F (25º C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.

(c) Brookfield Thermocel Apparatus-LV model. ≥ 50 rpm with a #21 spindle, 7.1 g residue, at > 10 torque

As required by the Asphalt Emulsion Quality Management Plan, UDOT Minimum Sampling and Testing Requirements, Section 508) the supplier certifies that the base stock contains at least 15% by weight of Gilsonite Ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.
Table 20

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, SF, 77° F (25° C), s</td>
<td>AASHTO T 59</td>
<td>10 - 100</td>
</tr>
<tr>
<td>Residue (a), percent W (Type C supplied ready to use 1:1 or 2:1.)</td>
<td>AASHTO T 59</td>
<td>30 Min. 1:1, 40 Min. 2:1</td>
</tr>
<tr>
<td>Sieve Test, percent W (b)</td>
<td></td>
<td>0.10 Max.</td>
</tr>
<tr>
<td>5-day Settlement, percent W</td>
<td>AASHTO T 59</td>
<td>5.0 Max.</td>
</tr>
<tr>
<td>Particle Charge</td>
<td>AASHTO T 59</td>
<td>Positive</td>
</tr>
<tr>
<td>pH (May be used if particle charge test is inconclusive)</td>
<td></td>
<td>2.0 - 7.0</td>
</tr>
<tr>
<td>Pumping Stability (c)</td>
<td></td>
<td>Pass</td>
</tr>
</tbody>
</table>

**Tests of Residue from Distillation (a)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, 275° F (135° C), mm²/s</td>
<td>AASHTO T 201</td>
<td>475 - 1,500</td>
</tr>
<tr>
<td>Solubility in 1,1,1 Trichloroethylene, percent</td>
<td>AASHTO T 44</td>
<td>97.5 Min.</td>
</tr>
<tr>
<td>RTFO mass loss, percent W</td>
<td>AASHTO T 240</td>
<td>2.5 Max.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>AASHTO T 228</td>
<td>0.98 Min.</td>
</tr>
<tr>
<td>Flash Point, COC</td>
<td>AASHTO T 48</td>
<td>232° C, Min.</td>
</tr>
<tr>
<td>Saturates, percent W</td>
<td>ASTM D 2007</td>
<td>10 Max.</td>
</tr>
<tr>
<td>Polar Compounds, percent W</td>
<td>ASTM D 2007</td>
<td>30 Min.</td>
</tr>
<tr>
<td>Aromatics, percent W</td>
<td>ASTM D 2007</td>
<td>15 Min.</td>
</tr>
</tbody>
</table>

(a) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5° F (149 ± 3° C) maximum temperature to be held for 15 minutes.

(b) Test method identical to AASHTO T 59 except that distilled water is used in place of 2% sodium oleate solution.

(c) Test pumping stability by pumping 475 ml of Type diluted 1 part concentrate to 1 part water, at 77° F (25° C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.

As required by the Asphalt Emulsion Quality Management Plan, UDOT Minimum Sampling and Testing Requirements, Section 508), the supplier certifies that the base stock contains at least 10% by weight of Gilsonite ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.
Table 21

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, SF, 77° F (25° C), s</td>
<td>AASHTO T 59</td>
<td>30 - 90</td>
</tr>
<tr>
<td>Residue, (b) percent W</td>
<td>AASHTO T 59</td>
<td>65</td>
</tr>
<tr>
<td>Sieve Test, percent W</td>
<td>AASHTO T 59</td>
<td>0.10 Max.</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>2.0 - 5.0</td>
</tr>
</tbody>
</table>

Residue from Distillation (b)

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, 140° F (60° C), cm²/s</td>
<td>AASHTO T 201</td>
<td>300 - 1200</td>
</tr>
<tr>
<td>Viscosity, 275° F (135° C), mm²/s</td>
<td>AASHTO T 201</td>
<td>300 Min.</td>
</tr>
<tr>
<td>Modified Torsional Recovery (a) percent</td>
<td>CA 332 (Mod)</td>
<td>40 Min.</td>
</tr>
<tr>
<td>Toughness, 77° F (25° C), in-lb</td>
<td>ASTM D 5801</td>
<td>8 Min.</td>
</tr>
<tr>
<td>Tenacity, 77° F (25° C), in-lb</td>
<td>ASTM D 5801</td>
<td>5.3 Min.</td>
</tr>
<tr>
<td>Asphaltenes, percent W</td>
<td>ASTM D 2007</td>
<td>16 Max.</td>
</tr>
<tr>
<td>Saturates, percent W</td>
<td>ASTM D 2007</td>
<td>20 Max.</td>
</tr>
</tbody>
</table>

(a) Torsional recovery measurement to include first 30 seconds.
(b) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5° F (149 ± 3°C) maximum temperature to be held for 15 minutes.

2.3 HOT-POUR CRACK SEALANT FOR BITUMINOUS CONCRETE

A. Combine a homogenous blend of materials to produce a sealant according to 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

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO T 51</td>
<td>Ductility, modified, 1cm/min, 39.2°F (4°C), cm</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>UDOT method 967</td>
<td>Cold Temperature Flexibility</td>
<td>no cracks</td>
<td></td>
</tr>
<tr>
<td>AASHTO T 300 (a)</td>
<td>Force-Ductility, lb force</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ASTM D 5329</td>
<td>Flow, 140°F (60°C), 5 hrs 75° angle, core, mm</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AASHTO M 282 (b)</td>
<td>Tensile-Adhesion, modified</td>
<td>300%</td>
<td></td>
</tr>
<tr>
<td>AASHTO T 228</td>
<td>Specific Gravity, 60°F (15.6°C)</td>
<td>1.140</td>
<td></td>
</tr>
<tr>
<td>ASTM D 5329</td>
<td>Cone Penetration, 77°F (25°C), 150 g, 5 sec., dmm</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>ASTM D 5329</td>
<td>Resilience, 77°F (25°C), 20 sec., percent</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ASTM D 4402</td>
<td>Viscosity, 380°F (193.3°C), SC4-27 spindle, 20 rpm, Cp</td>
<td>2,500</td>
<td></td>
</tr>
<tr>
<td>ASTM D 5329</td>
<td>Bond, Non-Immersed as specified in AASHTO M 282</td>
<td>Pass</td>
<td></td>
</tr>
</tbody>
</table>

(a) Maximum of 4 lb force during the specified elongation of 30 cm @ 1 cm/min, 39.2°F (4°C).
(b) Delete Bond, Non-Immersed modification in AASHTO M 282. Perform tensile-adhesion test according to ASTM D 5329.

PART 3 EXECUTION Not Used

END OF SECTION
SECTION 02746

HYDRATED LIME

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for incorporating hydrated lime into all asphalt mixes.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 303: Lime for Asphalt Mixtures
B. ASTM C 110: Physical Testing of Quicklime, Hydrated Lime, and Limestone
C. ASTM C 1097: Hydrated Lime for Use in Asphaltic-Concrete Mixtures
D. ASTM C 1602: Mixing Water Used in the production of Hydraulic Cement Concrete
E. UDOT Materials Manual of Instruction
F. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Verification that the supplier is pre-qualified.

1.6 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 HYDRATED LIME

A. Hydrated Lime – Refer to AASHTO M 303, Type I.
   1. Refer to ASTM C 1097, Physical Requirements.
   2. Use test method ASTM C 110.

2.2 WATER

A. Use potable water or water according to ASTM C 1602.

PART 3 EXECUTION

3.1 APPLICATION

A. Add hydrated lime to all asphalt pavement mixes.
   1. Add lime as determined in the approved mix design.
   2. Base the amount of hydrated lime used on the dry weight of the
      virgin aggregate.
   3. Use either Method A or B, unless Method B is called for in the bid
      schedule.
   4. Use Method A only when the mix is produced by a Certified
      Supplier. Refer to the UDOT Quality Management Plan 514 Hot-
      Mix Asphalt.

B. Method A – Dynamic Feed Lime Slurry
   1. Lime Slurry – One part lime and at least three parts water by
      weight.
   2. Add at least 1 percent lime by weight of the virgin aggregate.
   3. Deliver lime slurry to the twin shaft pugmill for mixing with
      aggregate.
   4. Adjust quantity (percent) of lime as necessary, based on results of
      Hamburg Wheel Tracker test.
   5. Verify that Lime Slurry equipment is operating at all times.
      a. The Engineer may require Method B, marination of the
         aggregate/hydrated lime mixture in the stockpile if the HMA
         is supplied without hydrated lime slurry treatment.

C. Method B – Lime and Aggregate Stockpile Marination
   1. Method B is an option for a certified Hot-Mix Asphalt Supplier.
   2. Method B is required for all Hot-Mix Asphalt Suppliers that are not
      certified according to the UDOT Quality Management Plan 514 Hot-
      Mix Asphalt.
a. The Engineer will inspect the marination process when the HMA supplier is not certified at the time of production.

3. The Department applies a deduction for mix produced by a non-certified supplier to cover the cost of the inspection. The deduction is according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

4. Provide sufficient free moisture to thoroughly wet the aggregate and activate the lime before introducing hydrated lime.

5. Add at least 1½ percent lime by weight of the virgin aggregate.

6. Thoroughly mix wet aggregate/lime mixture in a twin shaft pugmill.

7. Marinate the aggregate/lime mixture in the stockpile for at least 48 hours.

8. Adjust quantity (percent) of lime as necessary, based on results of Hamburg Wheel Tracker test, UDOT Materials Manual of Instruction 990.

9. Use the wet cured aggregate within 60 days except as otherwise provided in the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

D. Mixing Methods A and B – Provide a horizontal twin shaft pugmill.

1. Adjust mixing paddles in the pugmill so that the aggregate being discharged is completely coated by the lime slurry.

2. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.

3.2 CONTROL AND MONITOR

A. Control the lime addition process according to the requirements of the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

B. Monitor and document the lime addition process according to the requirements of the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

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 asphalt to a prepared subgrade or untreated base course.
   2. Tack coat – 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 02721: Untreated Base Course
C. Section 02745: Asphalt Material

1.3  REFERENCES

A. AASHTO M 208: Cationic Emulsified Asphalts
B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
C. AASHTO T 201: Kinematic Viscosity of Asphalts

1.4  DEFINITIONS

A. Cutback Asphalt – Asphalt product using a solvent to reduce viscosity. MC-70 and MC-250 as used in this Section, article 2.1 refer to Medium Cure (MC). The number following “MC” describes the viscosity of the product during application, higher numbers indicating higher viscosity (thicker). Do not dilute these products. These products meet the requirements of Section 02745.

B. Emulsified Asphalt – A group of asphalt products using water and soap (emulsifier) to reduce viscosity. These products consist of approximately 60 percent asphalt and 40 percent emulsifier.
1. Refer to Section 02745 for the exact ratio as well as other properties. The product is called a “straight” or a “concentrate” emulsion in this condition.

2. CSS 1h and CQS 1h as used in this Section, article 2.1 refer to Cationic Slow Set and Quick Set respectively. The 1h designation refers to the residual binder grade as “hard” or an AC-20.

3. A diluted product may be used to better control distribution when the residual application rate is small (0.03 gal/yd$^2$).
   a. The product will be referred to as a 1:1 or 2:1 dilute meaning 2 parts water to 1 part emulsion when this is done.
   b. Add the water parts to the emulsion part and multiply by the undiluted application rate to obtain the diluted application rate in this case.
   Example:
   
   Undiluted application rate $= 0.05$ gal
   $2:1$ diluted emulsion \((2+1) \times 0.05 = .15$ gal/yd$^2$

1.5 SUBMITTALS

   A. Material invoice or bill of lading.

PART 2 PRODUCTS

2.1 PRIME COAT

   A. MC-70 or MC-250. Refer to Section 02745.

   B. Blotter material – Granular materials, Table 1 when tested according to AASHTO T 27.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>90 to 100</td>
</tr>
<tr>
<td>No. 10</td>
<td>25 to 80</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 to 15</td>
</tr>
</tbody>
</table>

2.2 TACK COAT

   A. CQS-1h or CSS-1h emulsified asphalt. Refer to AASHTO M 208 and Section 02745. Select emulsion according to the time constraints required for Maintenance of Traffic (MOT) and the ability to fully cure before allowing traffic on the roadway.

Prime Coat/Tack Coat
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January 1, 2012
1. Residual asphalt content to be approximately 60 percent.
   a. Dilute at terminal only.
   b. Do not change dilution before obtaining written approval from the Engineer.

B. Tack coat for paving fabrics is a PG 58-22 or PG 64-22.

C. Do not use an emulsion or cutback in paving fabric placement.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Prime Coat
   1. Shape the surface to the required grade and section.
   2. Keep the surface free from ruts, corrugations, or other irregularities.
   3. Compact the surface according to Section 02721.

B. Tack Coat
   1. Clean the surface of all materials that prevent the tack coat from bonding to the existing surface such as mud, dirt, leaves, and water.
   2. Cover all tacked surface areas with surfacing materials the same day the tack coat is applied.

3.2 APPLICATION

A. Apply at the following rates:
   1. Prime Coat – 0.5 gal/yd\(^2\)
   2. Tack Coat – Refer to Table 2

<table>
<thead>
<tr>
<th>Existing Pavement Condition</th>
<th>Residual</th>
<th>Undiluted</th>
</tr>
</thead>
<tbody>
<tr>
<td>New HMA</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Oxidized HMA</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Milled HMA</td>
<td>0.07</td>
<td>0.12</td>
</tr>
<tr>
<td>Milled PCCP</td>
<td>0.07</td>
<td>0.12</td>
</tr>
<tr>
<td>PCCP</td>
<td>0.05</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Residual – Application rate of the asphalt binder content of the emulsion.
Undiluted – Application rate of the undiluted emulsion.

3. Obtain approval for the quantities, rate of application, temperatures, and areas to be treated before any application. Application rates may vary according to field conditions.
B. Do not apply prime coat or tack coat:
   1. On a wet surface or where surface conditions prevent proper adhesion.
   2. When the surface temperature is below 50 degrees F.
   3. When weather conditions prevent proper adhesion.

C. Protect all structures including items such as guardrails and guide posts from being spattered or marred.

D. Use a pressure distributor to apply the asphalt in a uniform, continuous spread.

E. Keep the viscosity between 50 and 100 centistokes. Refer to AASHTO T 201.

F. Immediately apply another application to under primed surface.

G. Apply tack coat between all lifts of Hot Mix Asphalt and to all surfaces, including vertical that will come in contact with Hot Mix Asphalt. Apply prime coat as specified in the plans at the contract bid price or at the contractor’s discretion to protect the grade from damage at no cost to the Department.

H. Spread blotter material if the prime coat does not penetrate. Use the quantities required to absorb the excess asphalt.

I. Allow prime or tack coat to fully cure before allowing traffic on paving.

### 3.3 TRAFFIC CONTROL

A. Refer to Section 01554.

B. Maintain the prime coat/tack coat until the next course is placed.

C. Keep all traffic off the prime coat until it has cured and dried.

END OF SECTION
SECTION 02751

PARTIAL DEPTH REPAIR FOR CONCRETE PAVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove spalled or delaminated concrete in the upper ⅓ to ½ 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. AASHTO M 324: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer’s product data, 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 COMPOUND
A. Refer to Section 03390.

2.3 HOT APPLIED JOINT FILLER
A. Refer to AASHTO M 324.

PART 3 EXECUTION

3.1 REMOVE SPALLED OR DELAMINATED CONCRETE
A. Establish rectangular or circular sections, extending at least 2 inches beyond a spalled area or 6 inches beyond the failed area determined by sounding. Provide vertical perimeter saw cuts of 2 inch minimum depth. Maintain uniform depth of the repair area.

B. Complete removal with concrete saws and 30 lb class or smaller hand jackhammers.

C. The 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 with at least 2,000 psi.

B. Remove all cleaning grit before placement.

C. Sandblast clean or remove partially exposed reinforcing steel before placing the patch material.

3.3 PREPARE EXISTING JOINTS FOR PLACEMENT
A. Maintain Existing Joints – Maintain a width equal to the opening in all working joints and cracks within or adjacent to the patch by inserting a removable material such as cardboard, polyfoam, or fiberboard before placing the mix. 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 according to 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 these requirements:
      a. On site mixing permissibility and constraints
      b. Surface preparation of the repair area and appropriate bonding agent
      c. Consolidation requirements
      d. Pot life of mix
      e. Environmental conditions and limitations

3.5 FINISH

A. Finish the patched surface to within ⅛ inch of the existing pavement.

3.6 CURE AND PROTECT

A. Cure the patched surface immediately after finishing operations according to Section 03390 with the following change:
   1. Uniformly spray the surface at a rate of 50 ft²/gal.

B. Do not open to traffic until patching material has achieved required strength.

C. Protect all placements with an approved traffic control device.
D. Remove and replace to the Engineer’s satisfaction, at no cost 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 AASHTO M 324.

3.7 CLEAN PAVEMENT

A. Sweep roadway and shoulders of all debris before opening to traffic. Prevent damage to the patches from cleaning equipment.

3.8 LIMITATIONS

A. Refer to Section 02752.
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 T 22: Compressive Strength of Cylindrical Concrete Specimens
C. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
D. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests
E. American Concrete Institute (ACI) Standards
F. UDOT Minimum Sampling and Testing Requirements
G. UDOT Quality Management Plan
1.4 DEFINITIONS

A. Panel – Area of pavement within the traffic lane or shoulder bound by two transverse joints.

1.5 SUBMITTALS

A. All submittals required in Section 03055.
   1. Mix design trial batch information to include flexural test results.

B. Certified scale axle weights for each haul unit for yardage to be hauled when requested by the Engineer.

C. Portland cement concrete pavement texturing plan for approval at least 14 calendar days before concrete placement to the Engineer and the Region Pavement Engineer.

D. A written plan for approval at least 14 calendar days before concrete placement specifically showing:
   1. Ingredients
   2. Production methods
   3. Handling and placing
   4. 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.

F. Joint layout plan to the Engineer for approval at least 14 calendar days before concrete placement.

G. Cylinder storage device
   1. Written procedures for approval at the request of the Engineer, explaining operation and required monitoring or care of the device. Refer to this Section, article 2.7.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. Point of acceptance for air content is the in-place pavement.
   1. Sampling and testing will be performed at the point of placement with necessary adjustments applied based on correlation testing. The Department will:
a. Perform air test on concrete placed in front of the paver and again from the same load in the finished pavement. Record any change in air content.
b. Adjust acceptance limits for air content according to results of correlation testing to provide final in-place air content that meets the requirements specified in Section 03055.
c. Perform at least one correlation test for each day of paving operations.

2. The Engineer will mark for later removal any areas determined to be reject material.
   a. Coordinate the timing for removal of reject material with the Engineer

C. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price.

D. Thickness
   1. Contractor obtains cores for thickness according to AASHTO T 24.
      a. The Engineer marks core location.
      b. One thickness core per 12,000 ft²
   2. Determine the acceptability and pay factors for deficient thickness areas using Table 1.

<table>
<thead>
<tr>
<th>Deficient Thickness (inches)</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to ⅛</td>
<td>1.00</td>
</tr>
<tr>
<td>⅛ to ¼</td>
<td>0.90</td>
</tr>
<tr>
<td>¼ to ½</td>
<td>0.75</td>
</tr>
<tr>
<td>½ to ¾</td>
<td>0.60</td>
</tr>
<tr>
<td>&gt;¾</td>
<td>Reject</td>
</tr>
</tbody>
</table>

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. The Engineer graphs the deficient areas by plotting new cores and the original cores to define deficient areas, assuming the following:
1) The graph represents the thickness of the pavement.
2) The thickness varies linearly along the pavement length from core depth to core depth.
3) The pavement is a constant depth in the transverse direction.

3. Acceptance for thickness may be determined through alternate methods from coring with written approval from the Engineer.
   a. The Engineer obtains concurrence and written approval from the District Engineer and Region Materials Engineer.

E. Compressive Strength Acceptance Retesting
1. The 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>
<thead>
<tr>
<th>Pay Adjustments for Compressive Strength Based on 28 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi below $f'c$ (4,000)*</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>1 to 100</td>
</tr>
<tr>
<td>101 to 200</td>
</tr>
<tr>
<td>201 to 300</td>
</tr>
<tr>
<td>301 to 400</td>
</tr>
</tbody>
</table>

*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 calendar days after placement.
6. Testing laboratories must:
   a. Be a Department qualified concrete lab.
   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. Refer 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 or product approved by the Engineer within 24 hours 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 at least 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.

F. Smoothness
1. Evaluate and refer to Section 01452.

G. Quantity adjustment when paving over existing surfaces.
1. Adjust quantity when accepted batched volume overruns or under runs neat-line volume.
   a. The Engineer and Contactor determine 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 before any price adjustment for non-specification material.
3. Determine overrun/underrun quantity by the following formula:

   $$QA = 0.5\left(\frac{V_a - V_n}{V_n}\right)Q_m$$

   $QA$ = Adjusted quantity in $yd^2$
   $V_a$ = 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 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 with a permanent recording feature. A 24 hour test run may be required.

B. Use device or devices with the capacity to accommodate the required test cylinders for at least two day’s operation.
   1. Cease concrete operation when the storage capacity is reached.
C. Make the storage devices available on the job site at least 48 hours before placement.

2.8 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.

2.9 SLIP FORM PAVER

A. Self-propelled machine with no fluid leaks equipped with automatic line and grade control capability.

B. Capabilities
   1. Spreading the dumped concrete uniformly across the grade by an auger or a traveling strike-off device.
   2. Vibrating, tamping, striking-off, and shaping the concrete to the desired line grade and thickness in one continuous pass.

C. Vibrator Minimum Requirements
   1. Eccentric Diameter 1⅞ inch
   2. Frequency  7,000 to 9,000 vibrations per minute
   3. Spacing  18 inch maximum, mounted longitudinally

D. Mount vibrators to provide adequate concrete consolidation. Do not interfere with dowel bar basket assemblies.

E. 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.

F. Use trailing forms long enough to leave a smooth, straight, vertical edge.

2.10 FINISHING/TEXTURING EQUIPMENT

A. Burlap drag unless using artificial-turf drag.
B. Texturing equipment as approved by the Engineer.

C. 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.

C. Formed Paving
   1. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge.
   2. Tightly join form sections by an interlocking joint free of vertical and horizontal movement.
   3. Stop paving operations if the side forms do not meet or hold line and grade.

D. Profile grind pre-existing adjacent pavement before concrete placement. Profile grinding of pre-existing pavement is measured and paid separately, or as extra work.

3.2 BATCH AND MIX

A. Refer to AASHTO M 157.

B. Separate and stockpile in two sizes coarse aggregate sizes 2 inch to No. 4 sieve and 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.
2. Increase mixing time in 10-second increments if necessary until the mixer efficiency evaluation is passed.
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.
4. Mix for at least 30 seconds after the last addition of water or cement is made after initial batching.

D. Maintain a minimum mixing time of 80 seconds at the manufacturer’s recommended mixing speed after all materials are in the drum.

E. Do not add water to the mix after acceptance testing.

3.3 PLACE CONCRETE

A. Keep the base surface moistened 500 ft in front of the paver without allowing areas of standing water.

B. Discharge and place the mixed concrete within the time frame listed below after introducing the mixing water to the cement and aggregates. Concrete not placed within the following time period may be rejected. The Engineer, in conjunction with the Region Materials Engineer, may approve alternate time periods based on concrete and ambient temperatures.

1. Non-agitating Haul Equipment 45 minutes
2. Agitating Haul Equipment 75 minutes

C. Do not interfere with dowel basket assemblies if redistributing the concrete in front of the paver. Minimize redistributing the concrete in front of the paver. The Engineer may retest the concrete if redistribution occurs.

D. Provide vibrators to thoroughly consolidate concrete.

1. Position vibrators on finishing equipment ahead of strike-off auger or final screed.
2. Vibrate, screed, and mechanically tamp the spread concrete. Thoroughly vibrate adjacent to and along the faces of the forms.
   a. Stop vibrating and tamping elements when the forward movement of the paver stops.
3. Use hand-operated vibrators on a regular pattern, not to exceed 12 inches in each direction, for hand placements.

E. Workmanship conforms to ACI 304R-00.

F. Do not add water to the surface for finishing.

1. Paving operations may be shut down and the concrete rejected if water is added.
2. Do not use evaporation retarders unless directed by the Engineer.
G. Provide protection for existing surfaces when placing concrete in an adjoining longitudinal section (companion placement).
   1. Do not place concrete for companion placement before existing concrete has achieved a compressive strength of at least 2,500 psi, determined by Maturity Method, AASHTO T 325, or cast cylinders.
   2. Repair any damage to existing pavement resulting from companion placement at no cost 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 in the plans.
   1. Refer to PV Series Standard Drawings.
   2. Place in the direction of paving and parallel to the slab surface.
   3. Place by using automatic bar inserters, support on chairs, through forms, or drilled and epoxied. Manual insertion is not permitted.
   4. Maintain at least 6 inch clearance between tie bars and dowel bars.
      a. Adjust tie bar spacing at the transverse joints to provide specified clearance.
      b. Do not adjust dowel bar locations.

C. Place load transfer dowel bars in the middle third of the slab depth, parallel to the centerline and surface of the slab. Limit deviations from parallel to ¼ inch for the length of the dowel bar.

3.5 FINISH

A. Finish the surface smooth and true to grade by machine float immediately after placing concrete. Finish at a rate equal to the progress of the paving operation.

B. Shut down the mixing operation until the situation is resolved if preliminary finishing is delayed more than 30 minutes after initial screeding.

C. Fill honeycomb areas in the vertical edge of the pavement with mortar.

D. Texture the pavement by burlap drag unless the final texture includes artificial turf drag.
   1. Use at least three plies of wet burlap and drag parallel to the centerline without tearing.
   2. Complete the drag finish with one pass.
   3. Spray water directly on the final burlap drag only in the quantity necessary to keep the burlap wet.
3.6 PAVEMENT TEXTURE

A. Provide a written texturing plan to the Engineer for approval before placing pavement. Show texturing locations and describe methods that will be used for hand texturing. Refer to Table 3.

<table>
<thead>
<tr>
<th>Pavement Texturing Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 50 mph</td>
</tr>
<tr>
<td>Longitudinal Tining</td>
</tr>
<tr>
<td>Diamond Grinding</td>
</tr>
<tr>
<td>Transverse Tining</td>
</tr>
<tr>
<td>Artificial Turf Drag</td>
</tr>
<tr>
<td>≤ 50 mph</td>
</tr>
<tr>
<td>Longitudinal Tining</td>
</tr>
<tr>
<td>Diamond Grinding</td>
</tr>
<tr>
<td>Transverse Tining</td>
</tr>
</tbody>
</table>

B. Demonstrate the performance of the texturing application method before starting main line paving.

C. Longitudinal Tining
   1. Produce grooves of approximately ⅛ inch wide by ⅛ inch deep spaced ¾ inch apart and parallel to the longitudinal joint.
   2. Keep tining devices clean and free from encrusted mortar and debris to provide uniform groove dimensions.
   3. Time tining so that the grooves do not close up.

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
   1. Produce randomly spaced ½ inch to ¾ inch transverse grooves approximately ½ 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 ½ inch deep.
   3. Use turf with a blade density of 7,200 blades/ft² 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.

G. Grinding may be required to correct unacceptable texturing.

H. Rumblestrips
   1. Install by diamond grinding when required.
   2. Rotomilling is not an acceptable method of installation.

3.7 CURE

A. Immediately apply curing compound to the edges of the pavement after form removal. Refer to Section 03390.

3.8 PROTECTION

A. Protect pavement against all damage and marring.
   1. 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 one of the following:
   1. Maturity method – AASHTO T 325
   2. Cast cylinders

C. Do not permit hauling equipment or traffic on the pavement before all sawed joints are sealed.

3.9 JOINTS

A. Construct contact joints, sawed joints, or transverse expansion joints as shown in the plans and approved joint layout.

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.
   c. Profile grinding may be considered as approved by the Engineer.
4. Straighten bent tie bars and re-coat with epoxy paint at the bend point before placing concrete in the adjacent lane.

D. Transverse Contact Joints
1. Construct transverse contact joints normal to the centerline without keyways on the vertical face.
2. Use No. 10 by 18 inch dowel bars placed midpoint in the slab at 12 inches on center and embedded 9 inches on each side.
3. Form joints with bars placed through the form or saw joints with bars drilled and epoxied.

E. Longitudinal and Transverse Sawed Joints
1. Single cut all transverse and longitudinal joints. Refer to PV Series Standard Drawings.
2. Saw joints before uncontrolled cracking occurs.
3. Conduct continuous sawing operations during both day and night regardless of weather conditions.
4. Provide lighting during nighttime sawing.
5. Thoroughly clean and dry joints before placing sealant.
   a. Clean the joint using at least 100 psi air.
   b. Equip air compressors with operating oil and water traps.
6. Fill the longitudinal joints flush. Overfilling joints may require removal and replacement of joint sealant at no cost to the Department. Refer to PV Series Standard Drawings.
7. Match joints in adjacent lanes to form a continuous line across the pavement width including the concrete shoulders.

3.10 DEFECTIVE PAVEMENT PANELS

A. The Engineer determines defective panels before substantial completion.

B. Repair or replace defective pavement panels at no additional cost to the Department.
   1. Complete repairs before acceptance testing for smoothness.

C. Remove and replace panels when multiple full depth cracks separate the panel into three or more pieces.
D. Use methods that do not disturb or damage adjacent panels.

E. Remove and replace panel portions with any full depth transverse crack within 4 ft or less of a transverse sawed joint.

F. Drill and epoxy tie-bars/dowel bars as required into existing pavement.

G. Match the profile and texture of existing pavement.

H. Repair any crack connecting joints appearing before substantial completion.
   1. Rout to a 1 inch depth by \( \frac{1}{8} \) inch width and seal with silicone sealant. Refer to Section 03152.

I. Leave tight random cracks less than \( \frac{1}{64} \) inch wide undisturbed.

3.11 LIMITATIONS – GENERAL

A. Meet to limitations of Section 03055 except as modified below.

B. Night Operations
   1. Provide proper lighting from \( \frac{1}{2} \) hour after sunset to \( \frac{1}{2} \) hour before sunrise according to Section 00555.

C. Precipitation
   1. Cease operation when rain is threatening.
   2. Remove, replace, or repair any pavement damaged by rain or hail as 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. Refer to ACI 305R-99.

3.12 LIMITATIONS – COLD WEATHER

A. Cold weather limitations apply when the temperature is forecast to fall below 40 degrees F within 14 calendar days of placement.

B. Comply with the following 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 using items such as covers, insulation, and heat.
   3. Do not place concrete in contact with frozen surfaces.
4. Adequately vent combustion-type heaters that produce carbon monoxide.
5. Protect the concrete from freezing until a compressive strength of at least 3,500 psi has been achieved, determined by either:
   a. Maturity method – AASHTO T 325
   b. Field cure cylinders
6. Maintain moist conditions for exposed concrete to avoid loss of moisture from the concrete due to heat applied.
7. Limit the drop in temperature next to the concrete surfaces when removing heat to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.
8. 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
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Remove full panel or partial panel of existing pavement.
B. Clean, grade, and reconsolidate base.
C. Install dowels and tie bars.
D. Replace and cure repair material.

1.2  RELATED SECTIONS

A. Section 02752: Portland Cement Concrete Pavement
B. Section 03055: Portland Cement Concrete
C. Section 03390: Concrete Curing

1.3  REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives
B. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.
B. Sample of the end caps for approval before use on the project.
PART 2  PRODUCTS

2.1  FULL DEPTH CONCRETE PAVEMENT REPAIR MATERIAL

A. Refer to Section 02752. It is acceptable to:
   1. Use high range water reducers such as Super Plasticizers.
   2. Accelerate the rate of concrete strength gain to match the field placement schedule with written permission from the Engineer.

B. Use an Epoxy Resin Adhesive according to AASHTO M 235. Select Type and Class for the application.

PART 3  EXECUTION

3.1  PREPARATION

A. Remove panel or panel section.
   1. Determine the extent and dimensions of the repair from the plan sheets or as directed by the Engineer. Refer to PV Series Standard Drawings.
   2. Complete the removal and make full depth cuts around the perimeter of the rectangular section to be removed. 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 according to PV Series Standard Drawings. Use tie-bars or smooth dowels where indicated on standard drawings.
   2. Stockpile bars and keep them clean and free from damage.
   3. Drill holes mid-depth of the slab without causing damage to the remaining pavement section and meet bar placement tolerances.
   4. Drill multiple holes simultaneously with drills held horizontally in a rigid frame. 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.
10. Coat protruding portion of dowel bar with lubricant consisting of paraffin wax, lithium grease, or other semi-solid, inert lubricant approved by the Engineer.
11. Remove and replace loose bars at the Contractor’s expense, before placing concrete mix.

E. Prepare existing joints for placement.
   1. Maintain existing pavement joint layout.
   2. Place a bond breaker approved by the Engineer on the existing pavement edges that compose existing joints, either transverse or horizontal.
   3. Saw joint on the same line if repairs straddle an existing joint line. Saw according to Section 03390.

3.2 PLACE CONCRETE

A. Place and consolidate concrete according to Section 02752.

3.3 FINISH CONCRETE

A. Finish patch to ± ¼ inch of existing profile.
   1. Correct patch profiles in excess of ¼ inch higher than the existing pavement profile through surface grinding or removal and replacement.
   2. Correct patch profiles in excess of ¼ inch lower than the existing pavement profile through removal and replacement of the patch.
   3. Make any necessary corrections to the patch finish at no cost to the Department.

B. Do not tool joints that are to be saw cut and sealed.
C. Texture the surface to match the existing pavement.

3.4 CURE AND PROTECT CONCRETE

A. Cure the concrete pavement. Refer to Section 03390.

B. Do not open to traffic until 4,000 psi strength is reached. Verified by either:
   1. Maturity Method – Refer to AASHTO T 325.
   2. Cast cylinders

C. Cut all previously existing joints to original dimensions.

D. Fill all sawing overcuts with repair epoxy approved by the Engineer.

E. Replacement slab must perform under traffic at specified time of opening without failure.

F. Remove and replace any defective panels at no cost to the Department. Refer to Section 02752.

G. Protect the individual placements with approved barricades.

3.5 LIMITATIONS

A. Refer to Section 03055 for general limitations.

B. Refer to Section 02752 for weather limitations.

END OF SECTION
SECTION 02754

DOWEL BAR RETROFIT

PART 1  GENERAL

1.1 SECTION INCLUDES

A. Procedures and materials for installing coated dowel bars across existing transverse joints and cracks.

1.2 RELATED SECTIONS

A. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO T 22: Compressive Strength of Cylindrical Concrete Specimens

B. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete

C. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear

D. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

E. UDOT Materials Manual of Instruction

1.4 DEFINITIONS  Not Used

1.5 SUBMITTALS

A. Documentation from the manufacturer verifying that the patching material meets the requirements of this Section, article 2.1.

B. Sample of the end caps for approval before use on the project.

C. Sample of the caulking filler for approval before use on the project.
PART 2 PRODUCTS

2.1 MATERIALS

A. Dowel Bars – 1½ inch x 18 inch, smooth steel rod, according to Section 03211.

B. Bond Breaking Compound – Use a bond-breaking compound approved by the Engineer.
   1. Apply bond breaking compound at manufacturing facility.

C. Chair Devices – Coat according to Section 03211 or make the devices used to support and hold the dowel bar in place out of non-metallic materials.
   1. Provide a minimum clearance of ½ inch between the bottom of the bar and the surface upon which the chair is placed.
   2. Press chairs securely against the slot faces.

D. End Caps
   1. Place tight fitting end caps made of non-metallic materials on dowels to allow for ¼ inch movement of the bar at each end.

E. Caulking Filler

F. Patching Material
   1. Use mix with 100 percent of aggregate passing the ⅜ inch screen and at least 90 percent passing the ¹⁄₁₆ inch screen.
   2. Use prepackaged concrete patching material such as Five Star Highway Patch, AHT DB Retrofit Mortar, or an equivalent as approved by the Region Materials Engineer with an aggregate extension conforming to the manufacturer’s recommendations.
   3. Select patching material that meets the performance criteria listed in Table 1.

<table>
<thead>
<tr>
<th>Patching Material</th>
<th>Compressive Strength At 3 hours</th>
<th>Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AASHTO T 22</td>
<td></td>
<td>3000 psi</td>
</tr>
<tr>
<td></td>
<td>AASHTO T 22</td>
<td></td>
<td>5000 psi</td>
</tr>
<tr>
<td>Shrinkage in 4 days</td>
<td>ASTM C 157</td>
<td></td>
<td>0.13 percent, max</td>
</tr>
<tr>
<td>Bond Strength</td>
<td>ASTM C 882 as modified by</td>
<td></td>
<td>1000 psi, minimum @ 24 hours</td>
</tr>
<tr>
<td></td>
<td>ASTM C 928, Section 8.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

G. Joint/Crack Preservation Material – Use a rigid removable material capable of maintaining the joint or crack.

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January 1, 2012
H. All testing will be performed by a testing facility certified in applicable areas as outlined in the UDOT LQP program.

2.2 EQUIPMENT

A. Jackhammers – Use a jackhammer less than the nominal 30 lb class to prevent spalling.

B. Use gang mounted saws capable of cutting at least 3 slots per wheel path simultaneously and vacuuming water and paste residue from surface immediately after sawing.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Saw cut the pavement as shown in the PV Series Standard Drawings.

B. Jackhammer and sand blast to clean all exposed surfaces and cracks removing slurry and loose concrete.
   1. Produce a flat level surface on slot bottom.

C. Clean up and properly dispose of all residues from the saw, jackhammer, sand blasting process, and any other sources.
   1. Re-clean patching areas as determined by the Engineer if work is delayed for any reason at no extra cost to the Department.

D. Place caulking filler in existing joint or crack to prevent intrusion of patching material. Dry and clean surface receiving caulk. See PV Series Standard Drawings.

E. Use dowel bars precoated with bond breaking compound at manufacturing facility.

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.
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 before filling with patching material.
   1. Prevent standing water in the slot.
   2. Remove all excess water with compressed air.

M. Fill the slot with an approved patching material.
   1. Consolidate the material in the slot and around the dowel bar with an appropriate size vibrator.
   2. Place and cure the patching material according to manufacturer’s specifications.
   3. Require a representative from the manufacturer of the patching material to be on site for the first day’s placement.
   4. Cure using ASTM C 309, Type 1D, Class A curing compound.
   5. Finished dowel bar retrofits must be flush with pavement after grinding operations. Retrofits cannot be higher than ¼ inch in relation to existing pavement before grinding.

N. Protect the retrofit from traffic until a compressive strength of 3,000 psi is achieved, as verified initially and periodically by compressive strength tests. Refer to AASHTO T 22.

O. Replace any individual dowel bar retrofit that is delaminated, spalled, debonded, cracked, honeycombed, or otherwise failing for any reason as determined by the Engineer at no cost to the Department.

P. Begin pavement grinding within 10 working days of placing dowel bar retrofit patching materials. Continue grinding operations without interruption until completed.

Q. Remove joint preservation material as needed and repair to a depth of 2 inches and reseal.

R. Test Section
   1. Provide a test section consisting of at least 24 complete dowel bar retrofits at a location determined by the engineer before continuing further work operations.
      a. Take three 6 inch diameter full-depth cores at locations determined by the Engineer 24 hours after completing the test section to assess the installation.
1) Inspect the cores in the presence of the Engineer.
2) Verify proper dowel placement and that there are no voids around the bar circumference.
3) Backfill core locations using the approved dowel bar retrofit patching material.
4) Make visual observations of the backfill patching material and inspect for cracking.

b. Begin production operations after obtaining the Engineer’s approval.
   1) Remove and replace test section dowel bar retrofits at no cost to the Department if test section does not meet Engineer’s approval.

2. Additional cores may be required on subsequent production days following test section approval at the discretion of the Engineer.
   a. Correct deficiencies at no cost to the Department if additional cores expose defects in workmanship or materials as described in this Section, article 3.1, paragraph O.

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 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

C. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics

D. ASTM D 1622: Apparent Density of Rigid Cellular Plastics

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS

A. Copies of invoices from mix suppliers.

1.6  QUALITY ASSURANCE

A. Obtain approval from the Engineer for injection material properties before placement.

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 of non-shrink grout measured using a calibrated meter paid for at the contract unit price per cubic yard.

B. Accepted liquid quantities of High-Density Polyurethane measured using methods approved by Engineer paid for at the contract unit price per pound.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYURETHANE

A. Use water based formulation of expanding high-density polyurethane that sets to full compressive strength within 15 minutes after injection to raise slabs.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>ASTM</th>
<th>LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>D 1622</td>
<td>Min 3.8 lb/ft³ - Max 4.3 lb/ft³</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>D 790*</td>
<td>Min. 80 psi</td>
</tr>
<tr>
<td>Elongation</td>
<td>N/A</td>
<td>Max. 5.1%</td>
</tr>
<tr>
<td>Compressive Strength at Yield Point</td>
<td>D 1621</td>
<td>Min. 60 psi</td>
</tr>
</tbody>
</table>

*Use the value of flexural strength or flexural yield as tensile strength.

2.2 NON-SHRINK GROUT

A. Use packaged dry, hydraulic-cement grout (non-shrink) according to ASTM C1107.

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 1/8 inch.
E. Concrete saw capable of cutting joints between failed and non-failed slabs.

PART 3 EXECUTION

3.1 PREPARATION

A. Establish a finish target profile of pavement using elevation measuring device or string lines.

B. Saw cut joints between failed and non-failed slabs as necessary to prevent damage to non-failed slabs.

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 ± 1/8 inch of finished grade profile.

END OF SECTION
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 traffic flow.

1. Use equipment with cutting heads that have independent suspension from the power unit to allow the head to self align with the slope of the shoulder.

2. Use cutting heads that provide a smooth surface, approximately $\frac{1}{16}$ inch between peaks or valleys.

B. 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 in PV Series Standard Drawings.
   1. Establish lane widths of 12 ft before the installation of longitudinal rumble strip.
   2. Construct longitudinal rumble strip before the placement of Chip Seal Coat, if required.

B. Provide a positive way to control 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 before 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
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish acrylic water-based pavement marking paint. Refer to this Section, article 2.2 for resin requirement.

B. Apply to hot mix asphalt or portland cement concrete pavement as longitudinal lines, transverse markings, contrast lines, and other related markings.

C. Remove pavement markings.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 247: Glass Beads Used in Traffic Paints

B. ASTM D 562: Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

C. ASTM D 1155: Roundness of Glass Spheres

D. ASTM D 1475: Density of Liquid Coatings, Inks, and Related Products

E. ASTM D 1644: Nonvolatile Content of Varnishes

F. ASTM D 2205: Selection of Tests for Traffic Paints


H. ASTM D 2805: Hiding Power of Paints by Reflectometry

I. ASTM D 3723: Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing

J. ASTM D 3960: Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
K. ASTM D 5381: X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders

L. ASTM E 1347: Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

M. Federal Specification

N. Federal Standards

O. Manual on Uniform Traffic Control Devices (MUTCD)

P. UDOT Materials Manual of Instruction

Q. UDOT Minimum Sampling and Testing Requirements

R. UDOT Quality Management Plans

1.4 DEFINITIONS

A. Longitudinal Markings – pavement markings that are generally placed parallel and adjacent to the flow of traffic such as lane lines, center lines, edge lines, channelizing lines, and others.

B. Transverse Markings – pavement markings that are generally placed perpendicular and across the flow of traffic such as shoulder markings; word, symbol, and arrow markings; stop lines; crosswalk lines; speed measurement markings; parking space markings; and others.

C. Long-term stationary – work that occupies a location more than 3 days.

1.5 SUBMITTALS

A. Documentation of the manufacturer and production batch identification for the paint used.

1.6 ACCEPTANCE

A. Provide fixtures such as ball valves, gate valves, or others on paint truck for the purposes of obtaining field samples.

B. The Department will:
   1. Accept Pavement Marking Paint from qualified manufacturer supplied samples.
   2. Sample from the applicator’s yard, at the Department’s discretion for acceptance.
C. Stop all agitation before sample is drawn.

D. The Engineer will:
1. Visually inspect longitudinal lines and transverse markings to verify compliance with the required dimensions.
2. Inspect at the end of each production day or more frequently as required.
3. Verify quantities applied by either of the following methods:
   a. Measuring both paint and bead tanks before and after application.
   b. Witnessing the meter readings before and after application.
      1) A printout of meter readings instead of witnessing may be accepted at the Engineer’s discretion.
4. Sample in the field according to the UDOT Quality Management Plan 513, Pavement Marking Paint and the UDOT Minimum Sampling and Testing Requirements.

E. Repaint any line or legend failing to meet bead application rates and dimensional requirements.
   1. Do not remove earlier application.

F. Price Reductions
1. The Department price reductions for pavement markings installed below the specified wet mil thickness are outlined in Table 1.

<table>
<thead>
<tr>
<th>Price Reduction for Wet Mil Thickness</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 percent below the specified mil thickness</td>
<td>1.00</td>
</tr>
<tr>
<td>Less than 10 percent below the Specified wet mil thickness</td>
<td>0.75</td>
</tr>
<tr>
<td>Less than 15 percent below the Specified wet mil thickness</td>
<td>0.50</td>
</tr>
<tr>
<td>15 percent or more below the Specified wet mil thickness</td>
<td>0.00 *</td>
</tr>
</tbody>
</table>

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.

2. The Department will apply price reductions for applied pavement markings that do not meet the requirements of Table 4 when the batch is sampled at the applicator’s yard for quality verification according to UDOT Quality Management Plan 513, Pavement Marking Paint.
   a. Apply the lowest pay factor from Tables 2 and 3.
3. The Department will require repainting for pavement markings more than five percentage points below total solids, pigment, or non-volatile vehicle properties from Table 4 when the project is sampled for quality verification according to Minimum Sampling and Testing Requirements.

Table 2

<table>
<thead>
<tr>
<th>Price Reduction for Total Solids, Pigment and Non-Volatile Vehicle</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.5 percent below or above the specified percentage</td>
<td>1.00</td>
</tr>
<tr>
<td>Less than 1.0 percent below the specified percentage</td>
<td>0.95</td>
</tr>
<tr>
<td>Less than 2.0 percent below the specified percentage</td>
<td>0.85</td>
</tr>
<tr>
<td>2.0 percent or more below the specified percentage</td>
<td>0.00 *</td>
</tr>
</tbody>
</table>

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.

Table 3

<table>
<thead>
<tr>
<th>Price Reductions for remaining requirements of Table 4</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.2 percent deficient</td>
<td>1.00</td>
</tr>
<tr>
<td>Less than 1 percent deficient</td>
<td>0.90</td>
</tr>
<tr>
<td>Less than 2 percent deficient</td>
<td>0.80</td>
</tr>
<tr>
<td>Less than 3 percent deficient</td>
<td>0.70</td>
</tr>
<tr>
<td>Less than 4 percent deficient</td>
<td>0.60</td>
</tr>
<tr>
<td>Less than 5 percent deficient</td>
<td>0.50</td>
</tr>
<tr>
<td>5 percent or more below specified quantitative requirements</td>
<td>0.00 *</td>
</tr>
</tbody>
</table>

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.
PART 2 PRODUCTS

2.1 PAINT

A. Meet the requirements for Acrylic Water Based Paint specified in Table 4.

<table>
<thead>
<tr>
<th>Property</th>
<th>White</th>
<th>Yellow</th>
<th>Black</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment – Percent by weight, minimum</td>
<td>62.0</td>
<td>62.0</td>
<td>62.0</td>
<td>ASTM D 3723</td>
</tr>
<tr>
<td>Total Solids – Percent by weight, minimum</td>
<td>77.0</td>
<td>77.0</td>
<td>77.0</td>
<td>ASTM D 1644</td>
</tr>
<tr>
<td>Nonvolatile vehicle – Percent by weight vehicle, minimum*</td>
<td>43.0</td>
<td>43.0</td>
<td>43.0</td>
<td>ASTM D 3723</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASTM D 1644</td>
</tr>
<tr>
<td>Viscosity, KU @ 77 degrees F</td>
<td>80 – 95</td>
<td>80 – 95</td>
<td>80 – 95</td>
<td>ASTM D 562</td>
</tr>
<tr>
<td>Density, lb/gal, minimum</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td>ASTM D 1475</td>
</tr>
<tr>
<td>Volatile Organic Content (VOC) – lb/gal, maximum</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>ASTM D 3960</td>
</tr>
<tr>
<td>Titanium Dioxide Content, lb/gal</td>
<td>1.0 min</td>
<td>0.2 max</td>
<td>N/A</td>
<td>ASTM D 5381</td>
</tr>
<tr>
<td>Color Definition</td>
<td>37875</td>
<td>33538</td>
<td>N/A</td>
<td>Federal Standard 595B</td>
</tr>
<tr>
<td>Directional Reflectance Minimum</td>
<td>90.0</td>
<td>50.0</td>
<td>N/A</td>
<td>ASTM E 1347</td>
</tr>
<tr>
<td>Dry Opacity – Minimum (5 mils wet)</td>
<td>0.95</td>
<td>0.95</td>
<td>N/A</td>
<td>ASTM D 2805</td>
</tr>
</tbody>
</table>

* Binder – 100 percent acrylic cross-linking polymer, by weight, as determined by infrared analysis and other chemical analysis available to the Department. Refer to ASTM D 2205.

B. No-Pick-Up Time

1. Paint may not smear or track three minutes after application to the roadway using standard application equipment, at the mil thickness required, and with an ambient shaded temperature of at least 50 degrees F.

C. Additional Requirements

1. Free of lead, chromium, or other related heavy metals. Refer to ASTM D 5381.
2. Refer to ASTM D 2743 and ASTM D 5381 for tests used to verify paint samples meet ASTM requirements.
2.2 GLASS SPHERES (BEADS) USED IN PAVEMENT MARKING PAINT

A. Longitudinal Lines – Refer to AASHTO M 247, Specific Properties, with the following exceptions:
   1. Gradation
      No. 18 sieve, accumulated percent passing 65 – 80
      No. 30 sieve, accumulated percent passing 30 – 50
      No. 50 sieve, accumulated percent passing 0 – 5
   2. Coating – Dual coating for optimum adhesion and embedment.
   3. Roundness – 80 percent true spheres below the number 30 sieve.
      Refer to ASTM D 1155
   5. Refractive Index – Minimum 1.51 by oil immersion method.
   6. Air Inclusions – Less than 5 percent by visual inspection.
   7. Hardness – Beads above the number 30 sieve exhibit an average hardness of C70.5 when measured using the Rockwell C scale method and using a minimum sample of 100 beads.
   8. Crushing Strength – Beads above the number 30 sieve exhibit an average crushing strength of 60,000 psi when measured by the L/D\(^2\) method and with a minimum sample of 100 beads.
   9. Chemical Resistance – Beads resistant to hydrochloric acid, water, calcium chloride, and sodium sulfide. TT-B Federal Specification 1325C sections 4.3.6 to 4.3.9.

B. Transverse Markings – Refer to AASHTO M 247, Specific Properties, with the following exceptions:
   1. Gradation
      No. 20 US sieve, accumulative percent passing 90 – 95
      No. 30 US sieve, accumulative percent passing 45 – 70
      No. 50 US sieve, accumulative percent passing 5 – 25
      No. 80 US sieve, accumulative percent passing 0 – 5
   2. Coating – Dual coating for optimum adhesion and embedment.
   3. Roundness – The glass beads will have at least 75 percent true spheres.
   4. Refractive index – Minimum 1.51 by oil immersion method.
   5. Air Inclusions – Less than 10 percent by visual inspection.
   6. Have at least 80 percent true spheres.

C. 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 cost 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, curing compounds, and other foreign material and follow manufacturer’s recommendations for surface preparation.

3.2 APPLICATION

A. Use Qualified Applicators as identified in UDOT Quality Management Plan 513, Pavement Marking Paint.

B. Apply Pavement marking paint at the following wet mil thickness:
   1. 20-25 wet mils for all longitudinal markings.
   2. **Approximate** application rate for required mil thickness requirements:
      a. 4 inch Solid Line – From 190 to 240 ft/gal
      b. 4 inch Broken Line – From 760 to 960 ft/gal
      c. 8 inch Solid Line – From 95 to 120 ft/gal

Calculation – Determine wet mil thickness

4 inch Solid Line – Wet mils = \[
\frac{4812.516 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}
\]

4 inch Broken Line – Wet mils = \[
\frac{19250.064 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}
\]

8 inch Solid Line – Wet mils = \[
\frac{2406.258 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}
\]

Where:

\(X = \) application rate. (Meter readings or dipping tanks).

Pavement Marking Paint
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C. Refer to Table 1 for price reduction of pavement markings that are less than required wet mils in thickness.

D. No additional payment for pavement markings placed in excess of required wet mils in thickness or exceeding dimensional requirements outlined in this Section, article 3.2 paragraph B.

E. Glass Sphere (Beads) – Apply at least 8 lb/gal of paint, the full length and width of line and pavement markings.
   2. Do not apply glass beads to contrast lines (black paint).

F. Begin striping operations no later than 24 hours after ordered by the Engineer.
   1. Apply two applications on new bituminous surfaces.
      a. Verify timing of second application with the Engineer.

G. Apply lines and pavement markings only when the air and pavement temperature are:
   1. 50 degrees F and rising for Acrylic Water Based Paint.
      a. Non-grooved lines and markings applied at temperatures below 50 degrees F are temporary and must be repainted, when temperature conditions are met.
         1) Do not remove earlier application.
      b. Grooved lines and markings applied below 50 degrees F must be removed and reapplied when temperature conditions are met.

H. Comply with TC Series Standard Drawings.

3.3 CONTRACTOR QUALITY CONTROL

A. Adhere to the requirements of UDOT Quality Management Plan 513, Pavement Marking Paint

3.4 REMOVE PAVEMENT MARKINGS

A. Use equipment specifically designed for removal of pavement marking material.

B. Use one of these removal methods
   1. High pressure water spray
   2. Sand blasting
   3. Shot blasting
C. Do not use grinding without prior written approval from the Engineer.
   1. The Engineer will consult with the Region Traffic Operations Engineer before issuing written approval.

D. Do not eliminate or obscure existing striping, instead of removal, by covering with black paint or any other covering.
   1. The Engineer may grant prior written approval for use of black paint or other obscuring material for work durations shorter than “long term stationary” as defined in this Section, article 1.4 and in the Temporary Traffic Control section of the MUTCD.

END OF SECTION
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. Material Warranty
   1. Manufacturer provides a full warranty covering 100 percent of the pavement marking materials.
   2. Contractor is responsible for quality control of the proper placement of the materials and all other factors that affect the service life of the materials.
   3. Contractor removes and replaces 100 percent of the markings for all failed sections at no cost to Department in the event of a performance failure. Failed sections for each pavement marking materials are defined in this Section, Part 2.

B. Installation Warranty
   1. Manufacturer provides a warranty bond or letter of credit for the total installed price of the material as included in the Contractor’s bid.
   2. Warranty bond or letter of credit covers the specified service life of the materials and begins after all pavement markings are installed and accepted.
   3. Submit bond or letter of credit to the Engineer before placing the material.
1.6 DELIVERY, STORAGE, AND HANDLING

A. According to manufacturer’s recommendations.
B. Provide Material Safety Data Sheets (MSDS) when material is delivered.

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 to determine acceptable performance according to this Section, article 2.1.

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   24 months
D. Performance measures for retro-reflectivity 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 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 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 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 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 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 METHACRYLYATE

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. Minimum surface life for the following applications under all traffic volumes and wear conditions:
   1. Longitudinal lines 48 months
   2. Legends and symbols 18 months

C. Performance Measures for Retro-reflectivity and 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.

D. 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.

E. Use beads according to manufacturer’s recommendations.

2.4 PREFORMED THERMOPLASTIC HEAT FUSED PAVEMENT MARKING MATERIALS

A. Used for Legends and Symbols only, on all pavement surfaces.

B. Heat-fused preformed and sprayed pavement marking materials.

C. Minimum Service Life for Legends and Symbols under all traffic volumes and wear conditions is 24 months.

D. Performance Measures for Retro-reflectivity and 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. Heat Fused 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 using a mil thickness gauge.

2.5 HOT MELT THERMOPLASTIC PAVEMENT MARKING MATERIALS

A. Used for long lines only, on all pavement surfaces.

B. Minimum service life for long lines – 24 months.
   1. Applies under all traffic volumes and wear conditions.

C. Performance measures for Retro-reflectivity and Durability.
   2. Minimum Durability – 90 percent of each legend or symbol present.
   3. Failure to meet any of the specified performance measures on at least 90 percent of the legend or symbol is considered a complete failure.
      a. Replace under the warranty terms.

D. Hot-melt Thermoplastic
   1. Remove and replace legends and symbols that are below 80 wet mils in thickness using a mil thickness gauge.
   2. No payment for materials placed in excess of 125 wet mils.

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 02721: Untreated Base Course (UTBC)
C. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork
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 05120: Structural Steel

1.3 REFERENCES
A. AASHTO M 306: Drainage, Sewer, Utility, and Related Castings
B. ASTM A 48: Grey Iron Castings

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS
A. Concrete mix design for Engineer’s approval.
B. Hot and cold weather plan.
C. Manufacturer’s product data, specifications, and recommended application instructions for concrete curing compound, expansion joint filler, and detectable warning surface.

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. Premolded material. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

A. Refer to Section 02721.

2.4 STEEL

A. Reinforcing – Refer to Section 03211. Deformed billet-steel reinforcing bars as specified.

B. Structural – Refer to Section 05120 and as specified in the plans.

2.5 DETECTABLE WARNING SURFACE

A. Use In-line truncated dome pattern that meets the requirements of GW Series Standard Drawings.

B. Provide a color that contrasts visually with the adjoining surfaces, either light-on-dark or dark-on-light.

C. Minimize number of panels used.

D. Do not cut panels.
E. Acceptable products for installation:

1. Polymer Composite Panel – Epoxy polymer composition, homogenous integral color, UV stable, skid resistant, non-glare finished panel. Use modular panel size 2 ft by 4 ft or 2 ft by 2 ft. Use for new construction or retrofit construction.

2. Polymer Concrete Panel – Constructed principally of polymer of cementitious concrete material, homogeneous integral color, UV stable, skid resistant panel. Use modular panel size 2 ft by 4 ft or 2 ft by 2 ft. Use for new construction only.

3. Precast Concrete Panel – High strength concrete with structural monofilament fibers, homogeneous integral color, UV stable, skid resistant panel. Use modular panel size 2 ft by 2 ft. Use for new construction only.

4. Gray Iron Casting – Manufactured from iron conforming to ASTM A 48 Class 35B, as specified in AASHTO M 306, uniform quality, free from sand holes, gas holes, cracks, and other surface defects. Provide reasonably smooth, cleaned by shot blasting, free of burned-on sand skid resistant, skid resistant, weathered iron finished panel with embedment anchors. Use modular panel size 2 ft x 2 ft square or curved panels as specified. Use for new construction only.

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 and Section 02721.

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 ⅜ inch 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 according to 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 according to manufacturer 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. Polymer Concrete Panel, Precast Concrete Panel, Cast Iron Plate Installation
   1. Place as shown on drawings. Install according to manufacturer recommendations for cast-in-place 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

A. Concrete mix design for Engineer’s approval.
B. Hot and cold weather plan.
C. Manufacturer’s product data, specifications, and recommended application instructions for concrete curing compound and expansion joint filler.

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. Flatwork – High purity, chemically inert, unfading, and alkali-fast synthetic pigment coloring material.

2.2 EXPANSION JOINT FILLER

A. Premolded 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. Refer to Section 02056.

B. Place and compact Untreated Base Course. Refer to Section 02721.

C. Concrete flatwork coloring
   1. Conform to the samples provided by the Engineer.
   2. Provide a matching sample, 1 ft² 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 $\frac{1}{2}$ 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 $\frac{3}{16}$ 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 $\frac{1}{2}$ 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 02765: Pavement Marking Paint

1.3 REFERENCES

A. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing

B. AASHTO T 19: Unit Weight and Voids in Aggregate

C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

D. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

E. AASHTO T 104: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

F. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

G. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
H. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate

I. UDOT Materials Manual of Instruction

J. UDOT Minimum Sampling and Testing Requirements

K. UDOT Quality Management Plan

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Submit test reports verifying the Cover Material meets requirements of this Section, Part 2.

B. Verify that asphalt/polymer emulsion meets Section 02745

C. Verify the 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 according to this Section, Part 2.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. Meet gradation limits shown in Table 2 for Cover Material.

PART 2 PRODUCTS

2.1 CATIONIC EMULSIONS

A. CRS-2A according to Section 02745.

B. CRS-2P according to Section 02745.
C. LMCRS-2 according to Section 02745.

2.2 HIGH FLOAT EMULSIONS

A. HFRS-2P according to Section 02745.

B. HFMS-2 according to Section 02745.

C. HFMS-2P according to Section 02745.

2.3 FLUSH COAT

A. Use the emulsion as designated in Special Provision 02742S, diluted two parts concentrate to one part water by the Manufacturer.

2.4 COVER MATERIAL

A. Use crusher processed virgin aggregate consisting of natural stone, gravel, or slag according to Table 1.

Table 1

<table>
<thead>
<tr>
<th>Chip Seal Cover Material Properties</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>*Unit Weight</td>
<td>AASHTO T 19</td>
<td>100 lb/ft³, max</td>
</tr>
<tr>
<td>One Fractured Face</td>
<td>AASHTO T 335</td>
<td>95% minimum</td>
</tr>
<tr>
<td>Two Fractured Faces</td>
<td>AASHTO T 335</td>
<td>90% minimum</td>
</tr>
<tr>
<td>*LA wear</td>
<td>AASHTO T 96</td>
<td>30% maximum</td>
</tr>
<tr>
<td>Soundness</td>
<td>AASHTO T 104</td>
<td>10% maximum</td>
</tr>
<tr>
<td>Flakiness Index</td>
<td>Materials MOI 8-933</td>
<td>17 maximum</td>
</tr>
<tr>
<td>*Stripping</td>
<td>Materials MOI 8-945</td>
<td>10% maximum</td>
</tr>
<tr>
<td>*Polishing</td>
<td>AASHTO T 278, T 279</td>
<td>31 minimum</td>
</tr>
</tbody>
</table>

* The Department has the right to waive this requirement if the aggregates have proven acceptable through successful past performance as determined by the Engineer.

B. Meet gradation limits in Table 2. Refer to AASHTO T 27 and T 11.

Table 2

<table>
<thead>
<tr>
<th>Gradation Limits</th>
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<tbody>
<tr>
<td>Sieve Size</td>
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<tr>
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<tr>
<td></td>
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<td>¼ in</td>
</tr>
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<td>⅜ in</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 8</td>
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<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

* The Department has the right to waive this requirement if the aggregates have proven acceptable through successful past performance as determined by the Engineer.
2.5 BLOTTER MATERIAL
A. Refer to Section 02748.

2.6 TEMPORARY RAISED PAVEMENT MARKERS
A. Refer to Section 01558.

2.7 PAVEMENT MARKING PAINT
A. Refer to Section 02765.

2.8 EQUIPMENT
A. Use distributor trucks according to the following requirements:
   1. Tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of the tank contents.
   2. Insulated tanks capable of storing the binder at temperatures that allow the binder to remain consistent with the appropriate viscosity for proper application rates.
      a. Use tanks equipped with baffles to prevent pressure surges resulting from the asphalt sloshing in the tank when starting and stopping.
      b. Use trucks equipped with devices to provide for accurate and rapid correlation and control of the amount of bituminous material being applied with that of the truck or distributor gauges.
   3. Constant volume circulation pumps and heaters to maintain a pressurized system so binder will be uniformly heated.
      a. Circulation pump must spray a constant volume for the entire length of the spray bar for each application.
   4. Spray bar and nozzles designed to provide an appropriate fan width to provide uniform transverse distribution without corrugation or streaking.
      a. Adjust the spray bar height to provide uniform distribution of binder across the application width and triple lapping of the binder on the pavement surface.
      b. Use a fully circulating spray bar with a positive shutoff valve.
   5. Computerized rate control system allowing the operator to control all distributor operations from the cab to include:
      a. Pressure regulation of the material application and automatic rate control adjustment to the unit ground speed.
         1) Hydrostatic system capable of maintaining a tolerance of $\pm 0.3$ gal/yd$^2$. 
b. Spray bar height and width adjustment and shut off of individual spray bar sections.

B. Use a self-propelled aggregate (chip) spreader specifically designed and manufactured for chip seal operations, equipped with the following:
   1. Computerized controls that will apply a uniform, even layer of aggregate across the full width of the binder and adjust output to the unit ground speed.
      a. Use gates adjustable to drop the correct amount of aggregate plus or minus 1 lb/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 at least three articulating type pneumatic rollers for rolling operations.
   1. Use rollers weighing between 8 tons minimum and 12 tons maximum with a minimum width of 6 ft.
   2. Use rollers with pneumatic tires of equal size diameter and having treads satisfactory to the Engineer.
   3. Inflate tires so that the entire roller width area is compacted by either the rear-axle tires or the front-axle tires.
      a. Inflate tires to 90 lb/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 using 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 but not limited to guardrail, guideposts, concrete barriers, all drains, and parapet walls.

C. Cover manholes, valve boxes, drop inlets, and other service utility entrances before placing any chip seal coat.

D. Stockpile blotter material at least 0.25 lb/yd\(^2\) according to Section 02748 at a site within 20 minutes delivery time of each road section being chip sealed. Have application equipment on site before beginning chip seal work.
   1. Stockpiling of blotter material may be waived upon Engineer approval if blotter material can be obtained and ready to spread within 20 minutes of a road section being chip sealed.
   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 cannot be maintained throughout all night time hours.

E. Do not open to traffic the same day chip seal coat is placed on Interstate routes.
   1. Sweep and open to traffic no earlier than 6:00 a.m. the day following placement of cover material.

F. Apply bituminous flush coat material after receiving approval from the Engineer but no earlier than 6 days after application of the cover material.
   1. Apply bituminous flush coat material when the air temperature in the shade is 50 degrees F and rising and the pavement temperature is 70 degrees F and rising.
   2. Do not apply bituminous flush coat material during fog, rain, or other adverse conditions.

3.3 COVER MATERIAL STOCKPILE

A. Construct on a clean base to minimize contamination.

B. Construct individual 500 ton stockpiles of aggregates. Construct to facilitate uniform dampening. Avoid excess moisture.
   1. Engineer approves stockpiles at least one and a maximum of seven days before use.
   2. Combining, altering, or moving 500 ton stockpiles may require re-approval by the Engineer before use.

C. Notify the Engineer at least seven calendar days before placement in order for the initial stockpiles to be sampled and tested for acceptance.

D. Obtain the Engineer’s written acceptance of a stockpile before use.

E. Rework or remove material not meeting specifications from the stockpile area. Identify stockpiles that will be reworked.

F. The Department will retest corrected material for acceptance.

3.4 TEMPORARY PAVEMENT MARKINGS

A. Apply raised pavement markers according to Section 01558.

B. Apply temporary pavement marking paint as directed by the Engineer.
3.5 ASPHALT MATERIAL/Cover MATERIAL APPLICATION

A. Apply asphalt material at a rate sufficient to obtain 50 percent chip embedment before the rolling operation and 70 percent chip embedment after rolling operation.
   1. Adjust application rates throughout the project depending on existing conditions.

B. Apply the asphalt emulsion at a minimum temperature of 145 degrees F.

C. Do not apply asphalt material if material does not spray through the distributor in a uniform way and remain in place on the roadway.

D. Place building paper adjacent to the transverse construction joint before starting each spraying operation.
   1. Maintain the control valve to act instantaneously both at start-up and cut-off.

E. Locate longitudinal joints within 6 inches of the traffic lane line location.
   1. Construct meet lines with no skip or voids between adjacent passes.
   2. Do not place a double thickness of cover material.

F. Calibrate the spreader at the beginning of each day and as often as necessary to comply with Table 3.
   1. Maintain a distance of less than 150 ft between the distributor and the chip spreader.
   2. Maintain the chip spreader speed so that chips do not bounce or roll during application.

<table>
<thead>
<tr>
<th>Approximate Spread Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Weight</strong></td>
</tr>
<tr>
<td>lbs/ft³</td>
</tr>
<tr>
<td>60 – 65</td>
</tr>
<tr>
<td>65 – 70</td>
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<tr>
<td>70 – 75</td>
</tr>
<tr>
<td>75 – 80</td>
</tr>
<tr>
<td>80 – 85</td>
</tr>
<tr>
<td>85 – 90</td>
</tr>
<tr>
<td>90 – 95</td>
</tr>
<tr>
<td>95 – 100</td>
</tr>
</tbody>
</table>
3.6 SURFACE ROLLING

A. Use at least three pneumatic-tire rollers in a longitudinal direction to roll surface after the cover material has been spread.

B. Roll at least three passes to seat the cover material.
   1. A pass is defined as traveling in one direction only.

C. Control bleeding with blotter material and as directed by the Engineer.

D. Set the roller speed to prevent bouncing or skidding. Do not to exceed 5 mph.
   1. Reduce roller speeds during directional changes to prevent surface tearing.

E. Synchronize the speed of the distributor and chip spreader with that of the rolling operation.
   1. Begin initial rolling, consisting of one complete coverage, immediately behind the chip spreader.
   2. Begin secondary rolling, consisting of second and third coverage, immediately after completing initial rolling.
   3. Synchronize all operations to keep rolling operations within 2,500 feet of the ongoing chip seal application.

F. Sweep excess cover material off the roadway after the emulsion has set.
   1. Remove excess cover material to the satisfaction of the Engineer before opening the roadway to traffic.

G. Repair all damage to the seal coat before opening the roadway to traffic.

3.7 BITUMINOUS FLUSH COAT APPLICATION

A. Clean the surface of all dirt, sand, dust, loose chips, and other objectionable material to the satisfaction of the Engineer before applying bituminous flush coat.

B. Apply the bituminous flush coat at a rate of 0.11, ± 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.

3.8 TRAFFIC CONTROL

A. Refer to Section 01554.
3.9 PAVEMENT MARKING PAINT

A. Allow at least 7 calendar days after completing flush coat before applying permanent pavement markings. Refer to Section 02765.

END OF SECTION
SECTION 02786

OPEN-GRADED SURFACE COURSE (OGSC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing OGSC.

1.2 RELATED SECTIONS

A. Section 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 T 335: Determining the Percentage of Fracture in Coarse Aggregate

M. UDOT Materials Manual of Instruction

N. UDOT Minimum Sampling and Testing Requirements

O. UDOT Quality Management Plans

1.4 DEFINITIONS

1.5 SUBMITTALS

A. Job mix gradation – at least 10 working days before paving.
   1. Materials and documentation according to Materials Manual of Instruction, Section 954.
   2. Aggregate suitability test results.

B. Changes in Job Mix Gradation
   1. Written request for a change in a job-mix gradation.
   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 that asphalt binder meets the requirements of Section 02745.

E. Engineering analysis for rejected lot or sublot. Refer to this Section, article 1.6, paragraph E.

1.6 ACCEPTANCE

A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. A lot equals the number of tons placed during each production day.
   1. A lot is evaluated on the test results of four samples, with the following exceptions:
      a. Compute incentive/disincentive using the test results from three samples if only three samples can be taken for the production day.
b. Add the lot to the next day’s production if three random samples cannot be taken.
c. Add the lot to the previous day’s production for the last day’s production if three random samples cannot be taken.
d. The lot may be increased to include up to three production days when 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 – The Department will compute incentive/disincentive for asphalt binder content based on Table 1 using the single test result with the largest deviation from the target. Refer to AASHTO T 308.
   a. Apply incentive to the entire lot.
   b. Disincentive is applied only to the sublot defined as a percentage of the lot represented by the test.
   c. Any lot that includes one or more sublots in disincentive is not eligible for incentive

3. Gradation – The Department will compute incentive/disincentive for gradation based on Percent Within Limits computation using Tables 2, 3, 4, and 5. Refer to AASHTO T 30
   a. The Department will reject the lot if the Percent Within Limits is less than 60 percent.

4. Any lot rejected based on either gradation or asphalt binder content will not be eligible for any incentive.

C. Thickness
   1. Verify the thickness with a depth probe and take corrective action if necessary.
      a. Minimum thickness – Plan depth minus 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

<table>
<thead>
<tr>
<th>Binder Content</th>
<th>Pay Adjustment in $/ton OGSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within ± 0.30% of target</td>
<td>+1.00</td>
</tr>
<tr>
<td>Between ± 0.31% and ± 0.45% of target</td>
<td>0.00</td>
</tr>
<tr>
<td>Between ± 0.46% ± 0.60% of target</td>
<td>-2.00</td>
</tr>
<tr>
<td>Greater than ± 0.61%</td>
<td>Reject</td>
</tr>
</tbody>
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### Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UL and LL</th>
</tr>
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<tbody>
<tr>
<td>⅜ inch sieve</td>
<td>Target Value ± 6.0 percent</td>
</tr>
<tr>
<td># 4 sieve</td>
<td>Target Value ± 6.0 percent</td>
</tr>
<tr>
<td># 8 sieve</td>
<td>Target Value ± 5.0 percent</td>
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<tr>
<td># 200 sieve</td>
<td>Target Value ± 2.0 percent</td>
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### Table 3

<table>
<thead>
<tr>
<th>Gradation</th>
<th>Incentive/Disincentive (Dollars/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
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</tr>
<tr>
<td>&gt; 99</td>
<td>1.50</td>
</tr>
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<td>96-99</td>
<td>1.00</td>
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<td>&lt;60</td>
<td>≤ 0.35</td>
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</tbody>
</table>

Enter table in the appropriate "number of tests" column and round down to the nearest value.
Table 5

Definitions, Abbreviations, and Formulas for Acceptance

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Value (TV)</td>
<td>The target values for gradation and asphalt binder content.</td>
</tr>
<tr>
<td>Average (AVE)</td>
<td>The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.</td>
</tr>
<tr>
<td>Sample Standard Deviations</td>
<td>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.</td>
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<td>Upper Limit (UL)</td>
<td>The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 2)</td>
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<td>Upper Quality Index (QU)</td>
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<td>Lower Quality Index (QL)</td>
<td>QL = (AVE - LL)/s</td>
</tr>
<tr>
<td>Percentage of Lot Within UL (PU)</td>
<td>Determined by entering Table 4 with QU.</td>
</tr>
<tr>
<td>Percentage of Lot Within LL (PL)</td>
<td>Determined by entering Table 4 with QL.</td>
</tr>
<tr>
<td>Total Percentage of Lot (PL) Within UL and LL (PT)</td>
<td>PT = (PU + PL) – 100</td>
</tr>
<tr>
<td>Incentive/Disincentive</td>
<td>Determined by entering Table 3 with PT or PL.</td>
</tr>
</tbody>
</table>

All values for AVE, s, QU, and QL will be calculated to at least a two decimal places and will be carried through all further calculations. Rounding to lower accuracy is not allowed.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Refer to Section 02745.


2.2 HYDRATED LIME

A. Refer to Section 02746.

2.3 AGGREGATE MATERIALS

A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
B. Meet the following requirements to determine the acceptability of the aggregate, including Table 6.

1. Coarse aggregate
   a. Retained on # 4 sieve.

2. Fine aggregate
   a. Clean, hard grained, and angular.
   b. Passing the # 4 sieve.

Table 6

<table>
<thead>
<tr>
<th>Aggregate Properties</th>
<th>Test Method</th>
<th>Test Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Fractured Face</td>
<td>AASHTO T 335</td>
<td>95 percent min.</td>
</tr>
<tr>
<td>Two Fractured Face</td>
<td>AASHTO T 335</td>
<td>90 percent min.</td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
<td>AASHTO T 304</td>
<td>45 min.</td>
</tr>
<tr>
<td>L.A. Wear</td>
<td>AASHTO T 96</td>
<td>30% max.</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>AASHTO T 176</td>
<td>60 min.</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>AASHTO T 89 and T 90</td>
<td>0</td>
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<tr>
<td>Polish Test</td>
<td>AASHTO T 278 &amp; T 279</td>
<td>31 min.</td>
</tr>
<tr>
<td>Soundness (sodium sulfate)</td>
<td>AASHTO T 104</td>
<td>12% max. loss with five cycles</td>
</tr>
<tr>
<td>Clay Lumps and Friable Particles</td>
<td>AASHTO T 112</td>
<td>2% max.</td>
</tr>
<tr>
<td>Natural Fines</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Percent Passing by Dry Weight of Aggregate</th>
<th>Sieve Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>½ inch</td>
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<tr>
<td></td>
<td>¾ inch</td>
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<tr>
<td></td>
<td># 4</td>
</tr>
<tr>
<td></td>
<td># 8</td>
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<tr>
<td></td>
<td># 200</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Percent</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 - 100</td>
<td></td>
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<tr>
<td>35 - 45</td>
<td></td>
</tr>
<tr>
<td>14 - 20</td>
<td></td>
</tr>
<tr>
<td>2 - 4</td>
<td></td>
</tr>
</tbody>
</table>

**PART 3 EXECUTION**

**3.1 MIX**

A. Mix until all particles are coated.

B. Treat aggregate with hydrated lime. Refer to Section 02746.
   1. Method A or B.
   2. The Department applies a deduction for mix produced by a non-certified supplier to cover the costs of inspection. The deduction is applied according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

**3.2 SURFACE PLACEMENT**

A. Apply the tack coat at a uniform rate. Refer to Section 02748.
   1. 0.10 gal/yd² on new pavement
   2. 0.15 gal/yd² 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 02787

BONDED WEARING COURSE (BWC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for the placement of a Bonded Wearing Course (BWC) and associated Polymer-Modified Emulsion Membrane.

1.2 RELATED SECTIONS

A. Section 01452: Pavement Smoothness
B. Section 01456: Materials Dispute Resolution
C. Section 02741: Hot Mix Asphalt (HMA)
D. Section 02742S: Project Specific Surfacing Requirements
E. Section 02745: Asphalt Material
F. Section 02746: Hydrated Lime

1.3 REFERENCES

A. AASHTO T 11: Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
C. AASHTO T 44: Solubility of Bituminous Materials
D. AASHTO T 49: Penetration of Bituminous Materials
E. AASHTO T 59: Testing Emulsified Asphalt
F. AASHTO T 89: Determining the Liquid Limit of Soils
G. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
H. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
I. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
J. AASHTO T 112: Clay Lumps and Friable Particle in Aggregate
K. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
L. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
M. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
N. AASHTO T 283: Resistance of Compacted Bituminous Mixture to Moisture
O. AASHTO T 301: Elastic Recovery Test of Bituminous Materials by Means of a Ductilometer
P. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
Q. AASHTO T 305: Determination of Drain down Characteristics in Uncompacted Asphalt Mixtures
R. AASHTO T 312: Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
S. AASHTO T 327: Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
T. AASHTO T 330: The Qualitative Detection of Harmful Clays of the Smectite Group in Aggregates Using Methylene Blue Aggregates
U. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
V. ASTM D 2995: Estimating Application Rate of Bituminous Distributors
W. ASTM D 3042: Insoluble Residue in Carbonate Aggregate
X. Asphalt Institute Standards
Y. UDOT Materials Manual of Instruction
1.4 DEFINITIONS

A. Bonded Wearing Course (BWC) – A spray-paver applied surface treatment consisting of a warm Polymer-Modified Emulsion Membrane and an ultra-thin, gap-graded, and hot mix asphalt overlay. It is typically less than 1 inch thick. The hot mix asphalt surface course is placed immediately on the emulsion. A BWC is a homogeneous wearing surface and pavement seal that can be opened to traffic immediately after cooling.

B. Polymer-Modified Emulsion Membrane (PMEM) – A warm, modified emulsion applied to the pavement to seal the underlying pavement and provide a strong bond to the surface course.

C. Production Day – A 24 hour period in which BWC is being placed.

1.5 SUBMITTALS

A. Mix design data for verification at least 10 working days before paving. Do not pave until verification is complete.
   1. Include all information on selection of design aggregate structure showing the target values of percent passing on all sieves listed in Table 9.
   2. Indicate the design asphalt binder content and the estimated asphalt binder film thickness.
   3. Provide test results verifying that proposed aggregate meets the requirements of Table 8.
   4. Indicate the target job mix gradation and supply QC data for the target selection.
      a. Use these target values for price adjustments.

B. Lottman test data using Method A lime slurry for all sources. Refer to this Section, article 2.5.
   1. Submit both A and B lime slurry data for new sources having no historic data.
   2. Meet minimum Tensile Strength Ratio (TSR) of 80 percent.

C. Draindown test results using AASHTO T 305.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

Bonded Wearing Course (BWC)
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January 1, 2012
B. A lot equals the number of square yards placed during each production day.
   1. The lot may be increased to include up to three production days as agreed upon in advance by both the Contractor and the Engineer when daily production rates are anticipated to be less than 15,000 yd$^2$.

C. Asphalt Binder Content and Gradation
   1. The Engineer evaluates a lot on the test results of four samples with the following exceptions:
      a. Compute Incentive/Disincentive using the test results from three samples if only three samples can be taken for the production day.
      b. Combine test results with the next day of production if at least three random samples cannot be taken. Take one sample for each 15,000 yd$^2$, or portion thereof, from the following day’s production. Evaluate with the appropriate number of tests “n” in Table 4.
      c. Add the lot to the previous day’s production for the final day’s production if three random samples cannot be taken.
      d. Evaluate with the appropriate number of tests “n” in Table 4.
   2. The Engineer informs the Contractor of the time and place of sampling not more than 15 minutes before the sampling.
      a. Samples taken will be sufficiently large to allow for repeat testing according to Section 01456.
      b. Retained material for repeat testing will be immediately possessed and stored by the Engineer until the represented lots are accepted.
   3. Compute Incentive/Disincentive for binder content per lot based on Table 1 using the single test result with the largest deviation from the target.
   4. Incentive/Disincentive for gradation is based on Percent within Limits (PT) computation using Table 2, 3, 4, and 5.
   5. The Department will reject the lot if the PT is less than 60 percent.
   6. Any lot rejected based on gradation or binder content will not be eligible for any incentive.

B. Submit an engineering analysis within one week when requesting to allow a rejected lot to remain in place.
   1. Include in the analysis data and engineering principles indicating why the pavement should remain in place.
   2. The Resident Engineer, District Engineer, and Region Materials Engineer will review the analysis for acceptance, denial, or revision within three working days of receiving the analysis.
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 will deduct 40 percent of the bid price if a rejected lot is allowed to remain in place.

D. Thickness
1. Verify the thickness with a depth probe and take corrective action if necessary.
   a. Minimum thickness – Plan depth

E. Polymer Modified Emulsion Membrane (PMEM) application rate
1. Verify the application rate of the PMEM for each lot and apply pay adjustment based on Table 6.
   a. A lot equals the number of square yards placed during each production day.
   b. Use the weight of PMEM provided on the weight ticket to convert from tons to gallons.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Incentive/Disincentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder Content</td>
<td>Pay Adjustment (dollars per yd$^2$ of BWC)</td>
</tr>
<tr>
<td>Within ± 0.30% of target</td>
<td>+0.05</td>
</tr>
<tr>
<td>Between ± 0.31% and ± 0.45% of target</td>
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</tr>
<tr>
<td>Between ± 0.46% ± 0.60% of target</td>
<td>-0.10</td>
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<tr>
<td>Greater than ± 0.61%</td>
<td>Reject</td>
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</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Gradation Upper and Lower Limit Determination</th>
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<tbody>
<tr>
<td>Parameter</td>
<td>UL and LL</td>
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<tr>
<td>½ inch sieve for BWC Type B</td>
<td>Target Value ± 6.0 percent</td>
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<td>3/8 inch sieve for BWC Type C</td>
<td>Target Value ± 6.0 percent</td>
</tr>
<tr>
<td># 4 sieve</td>
<td>Target Value ± 6.0 percent</td>
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<tr>
<td># 8 sieve</td>
<td>Target Value ± 5.0 percent</td>
</tr>
<tr>
<td># 50 sieve</td>
<td>Target Value ± 3.0 percent</td>
</tr>
<tr>
<td># 200 sieve</td>
<td>Target Value ± 2.0 percent</td>
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</table>
Table 3
Incentive/Disincentive for Gradation

<table>
<thead>
<tr>
<th>PT Based on Min. Four Samples</th>
<th>Pay Adjustment (dollars per yd$^2$ of BWC)</th>
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</thead>
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<tr>
<td>&gt; 99</td>
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<td>96-99</td>
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<td>&lt;60</td>
<td>Reject</td>
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<td>PU/PL</td>
<td>n=3</td>
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<tr>
<td>60</td>
<td>0.36</td>
</tr>
<tr>
<td>&lt;60</td>
<td>≤0.35</td>
</tr>
</tbody>
</table>

Enter table in the appropriate sample size column and round down to the nearest value.

**Bonded Wearing Course (BWC)**

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January 1, 2012
### Table 5

**Definitions, Abbreviations, and Formulas for Acceptance**

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Value (TV)</td>
<td>The target values for gradation and asphalt binder content are given in the Contractor's volumetric mix design.</td>
</tr>
<tr>
<td>Average (AVE)</td>
<td>The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.</td>
</tr>
<tr>
<td>Standard Deviation (s)</td>
<td>The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE divided by the number of test results minus one. This statement does not limit the methods of calculations of s. Other methods that obtain the same value may be used.</td>
</tr>
<tr>
<td>Upper Limit (UL)</td>
<td>The value above the TV of each measured characteristic that defines the upper limit of acceptable production.  (Table 2)</td>
</tr>
<tr>
<td>Lower Limit (LL)</td>
<td>The value below the TV of each measured characteristic that defines the lower limit of acceptable production.  (Table 2)</td>
</tr>
<tr>
<td>Upper Quality Index (QU)</td>
<td>QU = (UL - AVE)/s</td>
</tr>
<tr>
<td>Lower Quality Index (QL)</td>
<td>QL = (AVE - LL)/s</td>
</tr>
<tr>
<td>Percentage of Lot Within UL (PU)</td>
<td>Determined by entering Table 4 with QU</td>
</tr>
<tr>
<td>Percentage of Lot Within LL (PL)</td>
<td>Determined by entering Table 4 with QL</td>
</tr>
<tr>
<td>Total Percentage of Lot (PL) Within UL and LL (PT)</td>
<td>PT = (PU + PL) – 100</td>
</tr>
</tbody>
</table>

Incentive/Disincentive

Determined by entering Table 1 and 3 with PT or PL.

Calculate all values for AVE, s, QU, and QL to two decimal place accuracy and carried through all further calculations. Rounding to lower accuracy is not allowed.
Table 6

<table>
<thead>
<tr>
<th>Actual Field PMEM Rate (Gallons/Square Yard)</th>
<th>Pay Adjustment (dollars per yd² of BWC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Specified Rate ±0.03</td>
<td>0</td>
</tr>
<tr>
<td>Within Specified Rate ± 0.03 to ± 0.06</td>
<td>-2.00</td>
</tr>
<tr>
<td>Not Within Specified Rate ± 0.06</td>
<td>Remove and Replace</td>
</tr>
</tbody>
</table>

PART 2  PRODUCTS

2.1  PERFORMANCE GRADED ASPHALT BINDER

A. Project Specific Surfacing Requirements. Refer to Section 02742S.

B. Refer to Section 02745.

2.2  POLYMER MODIFIED EMULSION MEMBRANE (PMEM)

A. Project Specific Surfacing Requirements. Refer to Section 02742S.

B. Refer to Section 02745.

C. Supply PMEM from a Department approved producer under the provisions outlined in UDOT Quality Management Plan 508, Asphalt Emulsion.

D. Meet the requirements of Table 7.
Table 7

Polymer Modified Emulsion Membrane (a)

<table>
<thead>
<tr>
<th>Tests</th>
<th>AASHTO Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SFS, 122º F (50º C), sec</td>
<td>T 59</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Storage Stability Test, 1 d, 24 h, percent</td>
<td>T 59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sieve Test (b), percent</td>
<td>T 59</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Demulsibility, % 35 ml 0.8% sodium dioctyl sulfosuccinate</td>
<td>T 59</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Distillation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Distillate, by volume of emulsion, percent</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Residue (c), percent</td>
<td></td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Residue from Distillation Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 77º F (25º C), 100 g, 5s, dmm</td>
<td>T 49</td>
<td>60</td>
<td>150</td>
</tr>
<tr>
<td>Elastic Recovery (d), percent</td>
<td>T 301</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Solubility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solubility in Organic Solvent, percent</td>
<td>T 44</td>
<td>97.5</td>
<td></td>
</tr>
</tbody>
</table>

(a) The emulsion will be smooth and homogeneous throughout with no white, milky separation, pumpable and suitable for application through spray bars after standing undisturbed for 24 hours. Modify before emulsification.

(b) The sieve test may be waived if successful application of the material has been achieved in the field.

(c) Distillation is determined by AASHTO T 59 with modifications to include a 350 ± 5° F (177 ± 3° C) maximum temperature to be held for a period of 15 minutes.

(d) Modify paragraph 4.5 of AASHTO T 301 as follows: Stop the ductilometer and within two seconds, sever the specimen at its center with a pair of scissors after 20 cm has been reached.

2.3 HYDRATED LIME

A. Meet the requirements of Section 02746.

2.4 AGGREGATE MATERIALS

A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.

B. Refer to Table 8 to determine the suitability 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 8

<table>
<thead>
<tr>
<th>Aggregate Properties</th>
<th>Test Method</th>
<th>Test Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Fractured Face</td>
<td>AASHTO T 335</td>
<td>95% min.</td>
</tr>
<tr>
<td>Two Fractured Face</td>
<td>AASHTO T 335</td>
<td>90% min.</td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
<td>AASHTO T 304</td>
<td>45% min.</td>
</tr>
<tr>
<td>Flakiness Index</td>
<td>UDOT MOI 933 (Based on ¾ inch sieve and above)</td>
<td>17% max.</td>
</tr>
<tr>
<td>L.A. Wear</td>
<td>AASHTO T 96</td>
<td>30% max.</td>
</tr>
<tr>
<td>Micro-Deval Loss</td>
<td>AASHTO T 327</td>
<td>18% max. loss</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>AASHTO T 176</td>
<td>60 min.</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>AASHTO T 89 and T 90</td>
<td>0</td>
</tr>
<tr>
<td>Polish Test</td>
<td>AASHTO T 278 and T 279</td>
<td>31 min.</td>
</tr>
<tr>
<td>Soundness (sodium sulfate)</td>
<td>AASHTO T 104</td>
<td>12% max. loss with five cycles</td>
</tr>
<tr>
<td>Clay Lumps and Friable Particles</td>
<td>AASHTO T 112</td>
<td>2% max.</td>
</tr>
<tr>
<td>Natural Fines</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Methylene Blue</td>
<td>AASHTO T 330</td>
<td>10% max.</td>
</tr>
</tbody>
</table>

### C. Meet gradation requirements in Table 9.

### Table 9

<table>
<thead>
<tr>
<th>Aggregate Gradation</th>
<th>Percent Passing by Dry Weight of Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AASHTO T 11, T 27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ inch</td>
<td>100</td>
<td>75 - 100</td>
<td>55 - 80</td>
</tr>
<tr>
<td>½ inch</td>
<td>100</td>
<td>75 - 100</td>
<td>55 - 80</td>
</tr>
<tr>
<td>¾ inch</td>
<td>100</td>
<td>75 - 100</td>
<td>55 - 80</td>
</tr>
<tr>
<td># 4</td>
<td>40 - 55</td>
<td>22 - 38</td>
<td>22 - 38</td>
</tr>
<tr>
<td># 8</td>
<td>22 - 32</td>
<td>19 - 32</td>
<td>19 - 32</td>
</tr>
<tr>
<td>#16</td>
<td>15 - 25</td>
<td>15 - 25</td>
<td>15 - 25</td>
</tr>
<tr>
<td>#30</td>
<td>10 - 18</td>
<td>10 - 18</td>
<td>10 - 18</td>
</tr>
<tr>
<td>#50</td>
<td>8 - 13</td>
<td>8 - 13</td>
<td>8 - 13</td>
</tr>
<tr>
<td>#100</td>
<td>6 - 10</td>
<td>6 - 10</td>
<td>6 - 10</td>
</tr>
<tr>
<td>#200</td>
<td>4 - 7</td>
<td>4 - 7</td>
<td>4 - 7</td>
</tr>
</tbody>
</table>
2.5 JOB MIX DESIGN

A. Meet the following requirements:
   1. Establish optimum binder content, minimum 5.0 percent by weight of mixture, corresponding to an estimated asphalt film thickness of at least 10 microns based on effective binder content and aggregate surface area calculated according to Asphalt Institute MS-2 Table 6.1.
   2. Verify draindown at optimum binder content is less than 0.10 percent when tested according to AASHTO T 305.
   3. Moisture susceptibility (Lottman), AASHTO T 283, with the following modifications:
      a. Compact samples according to AASHTO T 312 using a 4 inch diameter mold and 30 gyrations.
      b. Use mix quantity necessary to obtain compacted samples 2.5 ± 0.05 inch high.
      c. Further test compacted samples regardless of air void levels achieved after 30 gyrations.
      d. Apply vacuum to samples to be conditioned for 1 minute and proceed without calculating percent saturation.
   4. Use a laboratory accredited by AASHTO Materials Reference Laboratory (AMRL) for all testing.

B. Designate Department approved asphalt binder supplier.

C. Designate Department approved PMEM supplier.

D. Use mixing and compaction temperatures supplied by the Engineer.

E. The Department Region Materials Lab will verify the Mix Design.

PART 3 EXECUTION

3.1 MIXING

A. Mix as specified in Section 02741.
   1. The mineral aggregate coating will be considered satisfactory when all particles are coated.

3.2 PAVER CHARACTERISTICS

A. Use a self-priming paver designed and built for applying the BWC and approved by the Engineer with the following characteristics:
1. Equipped with a receiving hopper, asphalt emulsion storage tank, system for measuring the PMEM volume applied, spray bar, and a heated, variable-width screed.
2. Capable of spraying the PMEM, applying the hot mix asphalt overlay, and leveling the surface of the mat in one pass.
3. Capable of placing the hot mix asphalt within five seconds after the application of the PMEM.
4. Capable of paving at a controlled speed from 30 to 90 feet per minute.
   a. Make no contact between the wheel or other part of the paving machine and the PMEM before applying the hot mix asphalt.

B. Use a paver with a screed that is able to crown the pavement at the center and have vertically adjusted extensions to accommodate the desired pavement profile.

3.3 MATERIAL TRANSFER VEHICLE CHARACTERISTICS

A. Use Material Transfer Vehicle (MTV) approved by the Engineer with the following characteristics:
   1. Able to remix the BWC to eliminate truck end segregation, minimize temperature segregation, and deliver a uniform BWC to the paver.
   2. Self-propelled machine totally independent of the paver.
   3. High capacity truck unloading system to receive BWC from the haul units.
   4. Minimum 25 ton on-board BWC surge capacity to minimize paver start/stops and maximize trucking efficiency.
   5. Equipped with a pivoting paver loading conveyor.
      a. Able to swing to either side to allow off-lane paving.
   6. Paver hopper
      a. Equipped with a hopper insert with a minimum capacity of 7 tons.
      b. Hopper insert with mass flow design to deliver remixed BWC directly to the paver conveyor system.

3.4 SURFACE PREPARATION

A. Protect and cover manhole covers, drains, grates, catch basins, and other utility structures with plastic or building felt before paving.
   1. Clearly reference each location.

B. Remove thermoplastic traffic markings.

C. Remove symbols, characters, or other markings greater than ¼ inch above the existing pavement.
D. Allow at least two weeks for any crack sealant to cure before placing BWC.

E. Thoroughly clean the pavement surface to be overlaid of deleterious material, giving specific attention to accumulated mud and debris.
   1. Use pressurized water or vacuum systems, if necessary, to obtain a clean surface.

3.5 PRE-PAVING MEETING

A. Arrange for contractor’s supervisory personnel, crew, and the testing laboratory personnel to meet with a representative of the Department at a mutually agreed time within two weeks before starting the BWC process to discuss methods of accomplishing all phases of the work.
   1. Arrange for a representative of the mix design and emulsion supplier to be present.

3.6 SURFACE PLACEMENT

A. Provide a clean surface before and during paving operations.
   1. Immediately remove any loose material in front of the paver.

B. Spray the PMEM with a metered mechanical pressure spray bar at a temperature of 120 to 180 degrees F at the specified application rate.
   1. Overlap the vertical edge with the outside nozzle 0.5 to 1.5 inches when paving next to a vertical edge to guarantee proper application of the PMEM.
   2. Verify the application of the PMEM is uniform over the entire surface to be paved.

C. Calibrate the Spray Paver for application of PMEM according to ASTM D 2995 or an approved method by the Engineer before start of BWC production.
   1. Recalibrate Spray Paver before the startup of nonconsecutive placements of BWC material.
   2. Calibrate machine at 13 ft width and 17 ft width.
      a. Verify spread rates for right and left sides are uniform, meet the specified application rates, and do not vary more than 20 percent between right and left side pads.
   3. Calibrate the machine on-site or within BWC mix haul distance and in the presence of the Engineer.
   4. Maintain a copy of the manufacturer application settings with the spray paving equipment.
      a. Include the nozzle size and target shot rate settings.
D. Apply hot BWC at a temperature of 290 to 330 degrees F immediately over the PMEM application.

E. Place hot BWC over the full width of the PMEM with a heated screed.

F. Maintain a steady spray-paver speed.

G. Roll BWC material sufficiently to seat without fracturing mix aggregate.

H. Use steel-wheeled, 2-axle tandem rollers, each weighing at least 10 tons.
   1. Use well-maintained rollers equipped with functioning water system and scrapers to prevent adhesion of the fresh mix onto the roller drums.
   2. Supply adequate roller units to guarantee the rolling will be accomplished promptly following the placement of the material.
   3. Use a release agent (added to the water system) as needed to prevent adhesion of the fresh mix to the roller drum and wheels.
   4. Use static mode for rolling.
   5. Do not allow the rollers to remain stationary on the freshly placed material.

I. Construct longitudinal joints within 6 inches of lane lines or at the center of lane at the direction of the Engineer, but never in a wheel path.

J. Construct a transverse joint when the paving operation stops for more than 30 minutes.

K. Do not overlap or hot-lap BWC.

L. Pave through lanes after paving adjacent:
   1. Shoulders
   2. Tapers
   3. Transitions
   4. Road connections
   5. Private drives
   6. Curve widenings
   7. Chain control lanes
   8. Turnouts
   9. Left turn pockets
   10. Median borders
   11. On and off ramps

M. Verify all edges of adjacent areas to through lanes that have been paved with BWC have straight, uniform, longitudinal lines, and neat vertical edges to guarantee surface is neat in appearance after through lanes are paved.
N. Do not reintroduce previously applied BWC into the paving process over PMEM.

O. Stop paving and remove and dispose of the contaminated material if PMEM is spilled into the spray-paver hopper.

P. Meet the requirements of Section 01452 for smoothness.

Q. Report daily totals of placement materials to the Engineer and include the following:
   1. Tonnage of BWC material placed with weight tickets
   2. Gallons of PMEM applied with weight tickets
   3. Square yards for the production day
   4. Gallons per square yard of PMEM placed
   5. Pounds per square yard of BWC material placed

3.7 LIMITATIONS

A. Place between May 1, and September 15, when both the air temperature in the shade and the pavement surface temperature are above 60 degrees F and rising.

B. Do not place if the Engineer determines excessive moisture is present in the pavement structure.

C. Do not place during rain, when the surface is wet, or during other adverse weather conditions.

D. Do not open the new pavement to traffic until the rolling operation is complete and the material has cooled below 185 degrees F.

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: Mineral Filler for Bituminous Paving Mixtures

B. AASHTO M 29: Fine Aggregate for Bituminous Paving Mixtures

C. AASHTO M 208: Cationic Emulsified Asphalt

D. AASHTO T 11: Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregate

E. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

F. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

H. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

I. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

J. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
K. ISSA A105 Guidelines
L. UDOT Quality Management Plan
M. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS
Not Used

1.5 SUBMITTALS

A. Mix Design and test results to the Engineer 10 days before beginning construction.
   1. Meet the requirements of this Section, article 2.7.
   2. Include target gradation for combined aggregate and mineral filler.

B. Test reports for aggregate.
   1. Meet the requirements of this Section, article 2.2.

C. Manufacturer’s Certificate of Compliance for Mineral Filler.

D. Verification that the emulsified asphalt supplier adheres to UDOT Quality Management Plan 508 Asphalt Emulsion.
   1. Certificate of analysis/compliance from the manufacturer for each shipment.

1.6 ACCEPTANCE

A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

B. Meet the Target Tolerance of Table 1.

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

A. Use a cationic emulsified asphalt grade CQS-1H according to AASHTO M 208.

B. Verify that the shipment is the same as the mix design.

C. Refer to UDOT Quality Management Plan 508 Asphalt Emulsion.
2.2 AGGREGATE

A. Use 100 percent manufactured sand, slag, crushed fines, or a combination. Refer to AASHTO M 29.

B. Use aggregate that is clean and free from organic matter or other detrimental substances.

C. Use an aggregate blend with a sand equivalent of 45 or more. Refer to AASHTO T 176.

D. Meet a minimum polishing value of 31. Refer to AASHTO T 278 and AASHTO T 279.

E. Use aggregate with 35 percent or less loss by abrasion. Refer to AASHTO T 96.

F. Meet 15 percent soundness maximum using 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 target tolerance and still remain within the gradation band in Table 1. Refer to AASHTO T 11 and AASHTO T 27.

| Table 1 |
|-----------------|-----------------|-----------------|
| **Sieve Size**  | **Gradation Band (% Passing)** | **Target Tolerance** |
| ⅜ inch          | 100              | +/- 5%          |
| No. 4            | 70-90            | +/- 5%          |
| No. 8            | 45-70            | +/- 5%          |
| No. 16           | 28-50            | +/- 5%          |
| No. 30           | 19-34            | +/- 5%          |
| No. 50           | 12-28            | +/- 4%          |
| No. 100          | 7-18             | +/- 3%          |
| No. 200          | 5-15             | +/- 2%          |
2.5 WATER

A. Potable and free from harmful salts and contaminants.

2.6 ADDITIVES

A. Use additives as required to accelerate or retard the break-set of the slurry seal or to improve the resulting finished surface.
   1. Determine the initial additive quantities by the mix design for the slurry mix or individual materials.
   2. Obtain Engineer approval.

2.7 SLURRY SEAL MIX DESIGN

A. Use a Department approved laboratory conforming to the ISSA A105 tested listed in Table 2.
   1. Use the same materials and aggregate gradation to be used on the project.

<table>
<thead>
<tr>
<th>ISSA TEST NO.</th>
<th>DESCRIPTION</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSA TB 106</td>
<td>Slurry Seal Consistency</td>
<td>2cm Minimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3cm Maximum</td>
</tr>
<tr>
<td>ISSA TB-139</td>
<td>Wet Cohesion 30 Minutes Minimum (Set)</td>
<td>12 kg-cm Minimum</td>
</tr>
<tr>
<td>For quick-traffic systems</td>
<td></td>
<td>Wet Cohesion 60 Minutes Minimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 kg-cm Minimum</td>
</tr>
<tr>
<td>ISSA TB 109</td>
<td>Excess Asphalt by LWT Sand Abrasion</td>
<td>50 g/ft² Maximum</td>
</tr>
<tr>
<td>For heavy-traffic areas only</td>
<td></td>
<td>(538 g/m² Maximum)</td>
</tr>
<tr>
<td>ISSA TB-114</td>
<td>Wet Stripping</td>
<td>Pass (90% Minimum)</td>
</tr>
<tr>
<td>ISSA TB-100</td>
<td>Wet-Track Abrasion Loss, One-hour Soak</td>
<td>75 g/ft² (807 g/m²)</td>
</tr>
<tr>
<td>ISSA TB-113</td>
<td>Mix Time**</td>
<td>Controllable to 180 Seconds Minimum</td>
</tr>
</tbody>
</table>

** 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.

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b) Either type machine – Accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving mixer and to discharge the mixed product on a continuous-flow basis.

2. Maintain sufficient storage capacity within the machine for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls.

B. Calibrate each mixing unit in the presence of the Engineer before a machine is used on a project

PART 3 EXECUTION

3.1 LIMITATIONS

A. Do not apply slurry seal during rain, when road surface moisture is present, or during other adverse weather conditions.

B. Do not apply slurry seal if either the pavement or air temperature is below 50 degrees F and falling. Slurry seal may be applied when both the pavement and air temperatures are above 45 degrees F and rising.

C. Do not apply slurry seal when the temperature is projected below 33 degrees F within 24 hours of placing slurry seal.

D. Cease slurry seal operations when weather or other conditions prolong opening road surface to traffic beyond two hours.

E. Keep traffic off roadway surface until the slurry seal has cured.

3.2 STOCKPILE

A. Construct individual 500-ton stockpiles of slurry seal aggregates.

1. Engineer approves stockpiles at least one and at most seven days before use.

B. Notify the Engineer at least seven calendar days before slurry seal placement in order for the initial stockpiles to be sampled and tested for acceptance.

C. Obtain the Engineer’s written acceptance of all stockpiles before use in slurry seal.

D. Remove material not meeting specifications from the stockpile area.
E. The Department will retest corrected material for acceptance.

3.3 PREPARATION

A. Clean the surface of all dirt, sand, dust, oil, and other objectionable material immediately before applying the slurry.

B. Allow cracks to dry thoroughly before applying slurry seal when using water to clean the surface.

C. Protect manholes, valve boxes, drop inlets, and other service utility entrances before surfacing.

3.4 APPLICATION

A. Pre-wet the entire surface by fogging ahead of the slurry box. 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$^2$ of dry aggregate.

D. Do not add additional water for any reason, once the mixture has been placed onto the road surface.

E. Remove and replace the slurry if any of the following occurs:
   1. Lump, ball, 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. Remove slurry seal placed on concrete at no cost to the Department.

C. Maintain straight lines at all locations.
D. Place slurry seal at side streets and intersections out to right-of-way line.

E. Use hand squeegees to spread slurry in areas that cannot be reached with slurry seal machine.
   1. Lightly dampen areas before mix placement.
   2. Provide complete and uniform coverage.
   3. Avoid unsightly appearance from hand work.
   4. Use the same type of finish in hand worked areas as applied by the spreader box.

F. Use construction paper or comparable products so all beginning and ending joint lines from each construction pass are straight.

END OF SECTION
SECTION 02821

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. 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

B. Fittings
   1. Malleable cast iron or pressed steel coated. Refer to AASHTO M 232.

C. Caps
   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. Refer to AASHTO M 232.
   2. Provide cap to permit passage of top rail when top rail is used.

2.3 CHAIN LINK FABRIC

A. Provide either Type I zinc-coated steel or Type II aluminum-coated steel fence fabric as specified in AASHTO M 181, ASTM A 392, and ASTM A 491.

B. 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 as specified in AASHTO M 280.

B. Use 0.099 inch diameter barbed wire with 0.080 inch diameter 4-point barbs on 5 inch centers.

C. Provide aluminum coated barbed wire when aluminum coated fence is used as specified in 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 according to FG Series Standard Drawings.
   1. Fasten gate frame corners together with pressed steel or malleable iron corner ells, riveted or welded as shown.
   2. Galvanize welded steel gate frames after fabrication as specified. AASHTO M 111.
   3. Do not use closed cells that will prohibit dipping into galvanizing tanks.

B. Follow the same standards for chain link fence fabric for covering the gate frames as for other fence fabric.

C. Furnish each gate with the appropriate hinges, latch, and drop-bar locking device.

PART 3 EXECUTION

3.1 INSTALL POSTS

A. Install according to FG Series Standard Drawings.

B. Do not exceed the following spacing requirements when placing posts:

<table>
<thead>
<tr>
<th>Radii of Curve</th>
<th>Maximum Post Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangent or 500 ft</td>
<td>10 ft</td>
</tr>
<tr>
<td>200 ft to 500 ft</td>
<td>8 ft</td>
</tr>
<tr>
<td>100 ft to 200 ft</td>
<td>6 ft</td>
</tr>
<tr>
<td>0 ft to 100 ft</td>
<td>5 ft</td>
</tr>
</tbody>
</table>

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 at least 6 inches below each post.
   2. Construct at least 12 inch diameter bases for end posts, pull posts, corner posts, gate posts, and line posts.

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. AASHTO M 281: Steel Fence Posts and Assemblies, Hot-Wrought
F. ASTM A 392: Zinc Coated Steel Chain Link Fence Fabric
G. ASTM A 641: Zinc-Coated (Galvanized) Carbon Steel Wire
H. National Electrical Code (NEC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used
PART 2 PRODUCTS

2.1 WIRE MESH FENCE

A. Refer to AASHTO M 279.

B. Grade 60, nominal 0.099 inch farm grade wire mesh fencing with 6 inch vertical wire spacing.

C. Class I zinc coating.

2.2 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 AASHTO M 279.

B. Heavy gauge chain-link, galvanized 9 gauge 2⅝ inch mesh as an alternative. Refer to ASTM A 392.

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 must 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, 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, at least 4 inches x 4 inches, may be rough sawn or S4S lumber.
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 treating 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 AASHTO M 281.

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. Use 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. Dimensions 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 \( \frac{3}{8} \) 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 \( \frac{5}{8} \) inches in diameter or larger.

G. Frame and walk gates must be made of 1 inch galvanized steel tubing.

H. Fastener for single gates must be an 18 inch length of galvanized chain secured to the gate at one end and fitted with a snap fastener on the loose end.

I. All double drive gates must have a center latch in place of a chain fastener. A pin from the latch must fit in a socket embedded in concrete.

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 according to FG Series Standard Drawings.

2.10 CONCRETE

A. Class B concrete. Refer to Section 03055.

B. Contractor may substitute higher class of concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Clear and grade a minimum area to permit proper fence installation.

3.2 INSTALLATION

A. Install end-braced posts in existing cross fences when intersected by the new right-of-way fence.
B. Brace corner post in two directions.

C. Brace end and gate posts in one direction.

D. Compact backfill material around post.

E. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.

F. Use a ¾ 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, according 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 according to FG Series Standard Drawings.

END OF SECTION
SECTION 02823
RIGHT-OF-WAY POLE FENCE

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Materials and procedures for constructing right-of-way pole fences.

1.2  RELATED SECTIONS

A. Section 06055: Timber and Timber Treatment

1.3  REFERENCES  Not Used

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used

PART 2  PRODUCTS

2.1  UNTREATED WOOD POSTS FOR LINES, GATES, ENDS, AND CORNERS

A. Native juniper or approved equal.

B. Line posts must have a minimum diameter of 6 inches.

C. All posts must be sound, free of decay or defects, and structurally suitable.

2.2  TREATED WOOD POSTS AND WOOD POLE RAILS

A. Sound douglas fir, hemlock, or pine that is free from decay, splits, multiple cracks, any other defect, and structurally suitable.

B. Round posts and pole rails
   1. Round posts must have a minimum diameter of 6 inches.
   2. Round pole rails must have a minimum diameter of 3 inches and a maximum diameter of 6 inches.
   3. A line drawn between the centers of the butt and tip of each post and pole rail must be inside the actual longitudinal centerline of the post or pole rail within 1.67 percent of its length.
   4. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
5. Fabricate posts and pole rails before pressure treatment of the wood members.
6. 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.
7. Treat posts and pole rails according to Section 06055.
8. Keep round posts and pole rails free of bark, protruding knots, or other irregularities.

PART 3  EXECUTION

3.1  PREPARATION

A. Clear and grade a minimum area to permit proper fence installation.

3.2  INSTALLATION

A. Install end posts a maximum of 14 inches away from the corner brace post of the Corner Brace Wildlife Escape Ramp.

B. Extend horizontal pole rails past end post to a maximum of 12 inches.

C. Compact backfill material around post.

D. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.

E. Use a ½ inch diameter threaded rod with two nuts and two washers to connect horizontal pole rails to the adjacent posts.

F. Install horizontal pole rails in 21 ft sections.

G. Fasten 21 ft horizontal pole rails in sections. Install first section, skip a section, and install next section. Install these sections at designated heights. Place the 21 ft horizontal pole rails in the skipped sections on top of the previously set rails and fasten to posts.

END OF SECTION
SECTION 02825
CATTLE GUARD

PART 1   GENERAL

1.1 SECTION INCLUDES
A. Materials and procedures for furnishing and installing Precast Cattle Guard.

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 05120: Structural Steel

1.3 REFERENCES
A. AASHTO/AWS D1.5: Bridge Welding Code

1.4 DEFINITIONS   Not Used

1.5 SUBMITTALS   Not Used

PART 2   PRODUCTS

2.1 PRECAST CONCRETE CATTLE GUARD
A. Includes Precast Concrete Cattle Guard Units, Traffic Grill Units, Welded End Guard Units, and attachments. 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 for materials and fabrication.

2.4 AGGREGATE

A. Granular Backfill Borrow – Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavate for Precast Concrete Cattle Guard foundation according to SW Series Standard Drawings. Refer to Section 02317.

B. Cover properly excavated area for cattle guard foundation with granular backfill borrow, 2 ft deep. Compact granular backfill borrow according to Section 02056.
   1. Hand screed to the required grade using properly placed screed rails.
   2. Refer to SW Series Standard Drawings.

3.2 INSTALLATION

A. Place the Precast Concrete Cattle Guard on the compacted granular backfill borrow. Place Traffic Grill Units on the Precast Concrete Cattle Guard Units. Install Welded End Guard Units at each end.

B. Construct Welded End Guard Units and Precast Concrete Cattle Guard according to SW Series Standard Drawings.

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: Wood Fiber 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. Refer to 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. Refer to FG Series Standard Drawings.

1.5 SUBMITTALS Not Used
PART 2  PRODUCTS

2.1 TIMBER PLANKS
   A. Sound lodgepole pine, ponderosa pine, engelmann spruce, douglas fir, hem-fir, or western larch of grading WWPA No. 2 treated and free from decay, splits, multiple cracks, any other defect, and structurally suitable. Refer to Section 06055.

2.2 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 20d galvanized nails or zinc plated steel lag screws $5/16 \times 4$ inch.

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.


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


1.2 RELATED SECTIONS

A. Section 01554: Traffic Control
B. Section 02056: Embankment, Borrow, and Backfill
C. Section 02842: Delineators
D. Section 02890: Retroreflective Sheeting
E. Section 03055: Portland Cement Concrete
F. Section 03211: Reinforcing Steel and Welded Wire
G. 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 – Refer to BA Series Standard Drawings.
   1. Minimum galvanizing requirement: Refer to AASHTO M 180, Type 1, Class A.

B. Bottom W-Beam rail or steel rub rail – Refer to BA Series Standard Drawings.
   1. W-Beam – Refer to requirements of this Section.
   2. Channel rub rail – Refer to AASHTO M 160 and AASHTO M 270.
      a. Refer to AASHTO M 111 after all punching and cutting is complete.

C. Hardware – Refer to BA Series Standard Drawings.
   1. Manufacturer – Refer to AASHTO M 180.
   2. Coatings – Refer to AASHTO M 232 or M 298.

2.2 W-BEAM GUARDRAIL POSTS AND OFFSET BLOCKS

A. All elements according to BA Series Standard Drawings.
   1. Steel post – Refer to AASHTO M 270 and AASHTO M 160.
      a. Refer to 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 according to NCHRP 350 test requirements.
   4. Visually inspected and accepted by the Engineer.
2.3 TRANSITION ELEMENTS

A. All elements according to BA Series Standard Drawings.
   1. Refer to the requirements of this section for W-Beam guardrail, posts, blocks, and hardware.

B. Choose appropriate curb section according to plan requirement and BA Series Standard Drawings.

2.4 ANCHOR ELEMENTS

A. All elements according to BA Series Standard Drawings.
   1. Refer to the requirements of this Section for W-Beam guardrail, posts, blocks, and hardware.
   2. Anchor Plate – Refer to AASHTO M 270.
      a. Refer to AASHTO M 111 after all punching, drilling, and cutting is complete.
   3. Bearing Plate – Refer to AASHTO M 270.
      a. Refer to AASHTO M 111 after all punching, drilling, and cutting is complete.
   4. Anchor Post Foundation Tube and Plate.
      a. Tube – Refer to ASTM A 500.
      b. Plate – Refer to AASHTO M 270.
      c. Refer to AASHTO M 111 after all punching, drilling, cutting, and welding is complete.

2.5 W-BEAM BURIED-IN-BACKSLOPE TERMINALS

A. All elements according to BA Series Standard Drawings.
   1. Refer to plan set for terminal requirement.
   2. Refer to BA Series Standard Drawings for Buried-In-Backslope Terminal Anchor options.
      a. Steel Post with plate – Refer to AASHTO M 270 and AASHTO M 160. Refer to 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 according to BA Series Standard Drawings.
   1. Refer to plan set for radius requirements.
   2. Shop bend all curves.
   3. Refer to this Section for W-Beam guardrail and anchor system.
4. Controlled Release Terminal Post (CRT) breakaway post according to wood post and block requirements of this Section.
   a. Drill two 3½ inch holes center of post, 29 and 45 inches from top of post.

2.7 **W-BEAM NESTED GUARDRAIL**

A. All elements according to BA Series Standard Drawings.
   1. W-Beam – Refer to requirements of this Section.
   2. CRT breakaway post – Refer to wood post and block requirements of this section.
      a. Drill two 3½ inch holes center of post, 29 and 45 inches from top of post.

2.8 **W-BEAM MEDIAN BARRIER**

A. All elements according to BA Series Standard Drawings.
   1. Refer to requirements of this section for W-Beam guardrail, posts, blocks, rub rail channel, and hardware.

2.9 **BARRIER DELINEATION**

A. Sheeting – Refer to Section 02890.

B. Hardware – Refer to GW Series Standard Drawings.

**PART 3 EXECUTION**

3.1 **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, guardrail end treatment, and crash cushions.
   2. Protect work area when removing guardrail barriers, guardrail end treatment, or crash cushions until the barriers, guardrail end treatment, or crash cushion are reconstructed or the hazard is mitigated. Refer to Section 01554 and TC Series Standard Drawings.

3.3 POSTS AND BLOCKS
A. Drill all required holes in posts and blocks according to BA Series Standard Drawings before installation.
   1. Field drilling post is acceptable when installing the bottom rail.
      a. Coat 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 according to BA Series Standard Drawings before installation.
   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
B. Section 02890: Retroreflective Sheeting

1.3  REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
C. ASTM D 638: Tensile Properties of Plastics
D. ASTM D 4956: Standard Specification for Retroreflective Sheeting for Traffic Control
E. ASTM G 23: Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used
PART 2 PRODUCTS

2.1 STEEL POSTS

A. Supply and galvanize posts as specified. Refer to ASTM A 1011 and AASHTO M 111.

B. Use flanged, channel-shaped steel posts that weight 2 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 1,100 psi. Refer to ASTM D 638.

2.3 QUALITY CONTROL – FLEXIBLE POST TESTING

A. Meet Cold Bend Test
   1. Subject two posts to a temperature of -10 degrees F, ± 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 according to ASTM G 23, Method 1.
   2. Acceptable results:
      a. Exposure does not result in delamination, distress, or discoloration.
      b. Sheeting is not removable from the specimens without damage.
      c. Post is resistant to ultraviolet light, ozone, hydrocarbons, and other weathering.

2.4 SHEETING
   A. Refer to Section 02890.

2.5 PAINT
   A. Refer to Section 02765.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Posts – Visibly free of bends or twists both before and after installation.

END OF SECTION
SECTION 02843

CRASH CUSHIONS AND BARRIER END TREATMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install crash cushions and barrier end treatments.

B. Furnish and install crash cushion and barrier end treatment markings.

1.2 RELATED SECTION

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02890: Retroreflective Sheeting

1.3 REFERENCES

A. Energite® III Module Systems Design Manual

B. Manual for Assessing Safety Hardware (MASH)


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 before installation.

B. 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 AND BARRIER END TREATMENTS

A. Select from the current approved products list and UDOT Guidelines for Crash Cushions and Barrier End Treatments.
   1. Refer to the current UDOT Guidelines for Crash Cushions and Barrier End Treatments, current edition 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 Department Web site. Refer to http://www.udot.utah.gov/go/standardsreferences.
   a. Systems tested under NCHRP Report 350 requirements and a letter of acceptance issued by FHWA.
      1) Products approved before January 1, 2011
   b. Systems tested under Manual for Assessing Safety Hardware (MASH) requirements and a letter of acceptance issued by FHWA.
      1) Products approved after January 1, 2011
   c. Supply four sets of shop drawings and installation drawings for each system type supplied.
      1) Distribute drawings to Contractor, installation contractor, Engineer or designated representative, and local maintenance supervisor.

2. Refer to CC Series Standard Drawings for approved crash cushion or end treatment type.

B. Crash Cushion 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 according to the 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 back of system is within the maximum required clear zone.
         1) Two transition elements required when system is installed with W-beam median barrier.
      e. 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 according to the plans.
   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 the maximum required 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 the approach ends of median W-beam guardrail and the 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. Refer to BA 4 Series Standard Drawings.
   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. Systems are self restoring upon initial design impact.
   a. Supply system with an adequate width according to the 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 back of system is within the maximum required clear zone.
      1) Two transition elements required when system is installed with W-beam median barrier.
e. 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.

   1) Design sand barrel array to meet roadway design speed.

b. Certify sand barrels and components meet NCHRP-350 for non-re-directive gating crash cushions.

c. Construct sand barrels using a frangible polyethylene material that will shatter upon impact.
   1) Use yellow sand barrels.
   2) Permanently apply manufactured date, month, and year to each piece of the barrel system.
   3) Use one or two piece barrel construction.
   4) Interface cones with the barrel to prevent sand leakage but allow for drainage of excess water for sand barrel systems that use barrel and cone configuration.
   5) Provide lids for each sand barrel. Fasten lid securely to barrel.

d. Provide sand barrels that hold the required amounts of sand according to requirements of the typical sand barrel array.
   1) 200 lb, 400 lb, 700 lb, 1,400 lb, and 2,100 lb.
   2) Mark each barrel in a manner that the amount of sand required for the nominal weight is visible for systems that are designed using barrels for multiple sand weight requirements.

e. 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.

C. End Treatment Types

1. Type F – Protects 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 according to manufacturer and to the manufacturer’s specifications.
c. Supply crash cushion markings. Refer to CC Series Standard Drawings.

2. Type G – Protects 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.

3. Type H – Protects 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 and self-adhesive sheeting requirements:
   1. Refer to CC Series Standard Drawings.
   2. Construct marker plate 18 x 18 inches using 0.032 gauge aluminum with appropriate object marker sheeting.
      a. Drill a $\frac{7}{16}$ inch hole in each corner of plate.
      b. Sheeting – Refer to Section 02890.
         1) Date placement specified in Section 02890 is not required.
   a. Date placement specified in Section 02890 is not required.
   b. Use appropriate sheeting type for the substrate that sheeting is placed on.
   c. Place a minimum of 324 in\(^2\), typically 18 x 18 inch, on the approach end of crash cushion or barrier end treatment.
   d. Use of manufacturer’s supplied object marker sheeting is acceptable when sheet type and amount meet or exceed requirements.

B. 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. Refer to Section 02890.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prepare site to finished grade before installing crash cushion or barrier end treatment.
   1. Construct approach areas and recovery areas to meet Department Standards and system requirements before system installation.
      a. Refer to CC Series Standard Drawings for system requirements.
   2. Construct concrete pad according to system requirements when applicable.
      a. Crash Cushion Types A, B, and D require concrete pad when installed in a permanent applications.
         1) End Treatment Type F QuadTrend 350 requires a concrete pad and concrete anchor system in all applications. Refer to manufacturer’s requirements.
         2) End Treatment Type F BEAT-SSCC can be mounted on a concrete pad with surface mounted posts. Refer to manufacturer’s concrete mounting requirements.
      b. Crash Cushion Type C and End Treatment Types F, G, and H.
         1) Do not drive steel posts, wood posts, or foundation tubes through asphalt greater than 6 inches in depth.
2) Leave out hole required when installing ground mounted system into asphalt or concrete.
   a) Drill a 16 inch hole through asphalt or concrete or cut 15 inch x 15 inch hole through asphalt or concrete.
   b) Install post face or foundation tube face to front, traffic side, of hole.
   c. Use manufacturer’s specification for concrete pad construction.
   d. 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 before 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. CC Series Standard Drawings and UDOT Guidelines for Crash Cushion and Barrier End Treatments.
   2. Manufacturer’s specifications and recommendations.
   3. Use manufacturer certified installer to perform the installation.

C. 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 in this Section, article 3.1, paragraph C1a apply.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for fabricating and placing precast concrete barriers including New Jersey and constant slope shapes.

B. Materials and procedures for placing cast-in-place constant slope barriers.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02075: Geotextiles

C. Section 02842: Delineators

D. Section 03055: Portland Cement Concrete

E. Section 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 13553: ATMS Conduit

1.3 REFERENCES

A. ASTM A 36: Carbon Structural Steel

B. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics

C. ASTM D 1777: Thickness of Textile Materials

D. ASTM D 6364: Determining Short-Term Compression Behavior of Geosynthetics
E. AWS D1.5: Bridge Welding Code
F. 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. Welding – Refer to AWS D1.5.

2.3 REINFORCING STEEL
   A. Refer to Section 03211.

2.4 BARRIER SEAL
   A. Polyester polyurethane open-cell foam 100 percent impregnated with asphalt.
   B. Foam Unit Weight Requirements
      1. Before impregnation 68 lbs/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 reinforcing steel. Refer to Section 03211.
B. Hot and cold weather limitations. Refer to Section 03055.

2.6 PRECAST NEW JERSEY SHAPE AND CONSTANT SLOPE CONCRETE BARRIER

A. Pre-qualify the fabricator as a supplier of precast concrete products according to the UDOT Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Mark each barrier with 1½ inch numbers indicating the date of casting and identification number supplied by the inspector. Mark “WORK ZONE ONLY” if barrier uses uncoated reinforcement. 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. Use equipment capable of vertical adjustment to the grade line while in forward motion.

B. Use equipment with an attached grade line gauge or pointer to make a continual comparison with the barrier being placed and the offset guideline.

C. Use equipment capable of accommodating pavement to barrier reinforcing bars.
2.10 CAST-IN-PLACE CONSTANT SLOPE CONCRETE BARRIER

A. Electrical/ATMS Conduits, Junction Boxes, and Pull Boxes
   1. Size and quantity according to contract drawings.
   2. Refer to Section 13553.

B. Expansion Joints – Refer to Section 03152.

2.11 COMPOSITE DRAINAGE MATERIAL

A. Use a two-layer geocomposite sheet drain consisting of drainage geotextile bonded to one side of a three-dimensional drainage core.
   1. Drainage geotextile – Refer to Section 02075.
   2. Drainage core:
      a. High strength polystyrene or polypropylene.
      b. Minimum compressive strength = 15,000 lbs/ft^2. Refer to ASTM D 1621 or ASTM D 6364.
      c. Minimum thickness = 0.40 inches. Refer to ASTM D 1777.
      d. Capable of multidirectional flow.

2.12 RIGID PLASTIC FOAM

A. Refer to Section 03310.

PART 3 EXECUTION

3.1 PREPARATION

A. Site Considerations
   1. Protect work area when removing traffic barriers and crash cushions until the barriers and crash cushion are reconstructed or the hazard is mitigated. Refer to Section 01554.
   2. Precast Concrete Barrier – Complete grading requirements and place any required paved surfaces before installing barrier. Refer to BA Series Standard Drawings. Complete grading requirements before barrier or crash cushion installation. Refer to CC Series Standard Drawings.

B. Cast-In-Place Constant Slope Barrier
   1. Give the surface a final soft brush finish with strokes parallel to the line of barriers before applying curing compound.
   2. Do not finish with a brush application of grout.
   3. Refer to Section 03392.
4. Complete grading requirements before crash cushion installation. Refer to CC Series Standard Drawings.

3.2 PRECAST CONCRETE BARRIER – 32 INCH NEW JERSEY SHAPE AND CONSTANT SLOPE CONCRETE BARRIER – 42 INCH

A. Installation includes moving, stockpiling, and placing all barriers.

B. Place seal between each barrier unit so that enough pressure is exerted on the sealing material to form and maintain a permanent bond.

C. Refer to BA Series Standard Drawings.

3.3 CAST-IN-PLACE CONSTANT SLOPE CONCRETE BARRIER – 42 INCH AND 54 INCH

A. Obtain Engineer approval before placing the barrier.

B. Refer to BA Series Standard Drawings.

C. Fixed forms – Do not use precast mortar blocks to support the reinforcing steel.

D. Constant Slope Barrier Placed by Extrusion or Slip Form
   1. Provide an offset guideline for the extrusion or slip form machine to maintain the predetermined grade.
   2. Feed concrete to the extrusion or slip form machine at a uniform rate.
   3. Operate machine uniformly restraining forward motion.
      a. Produce well-compacted, dense concrete with consistency that maintains the shape of the barrier without support.
      b. Produce a well-compacted mass of concrete free from surface pits larger than 1 inch in diameter and requiring no further finishing.
   4. Saw or cut joints before applying curing compound.

E. Mark barrier at beginning, end, and 1,000 ft intervals with 1½ inch numbers indicating the date of casting and test level rating supplied by the Engineer. Impress ¼ inch deep into the front face of barrier, 6 inches below the top.

F. Curing – Refer to Section 03390.

G. 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 02845

HIGH TENSION CABLE BARRIER

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Cable barrier materials and cable barrier/W-beam guardrail anchor systems.

1.2  RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill
B. Section 02841: W-beam Guardrail
C. Section 02843: Crash Cushions
D. Section 02890: Retroreflective Sheeting
E. Section 03055: Portland Cement Concrete
F. Section 03211: Reinforcing Steel and Welded Wire
G. Section 05120: Structural Steel

1.3  REFERENCES

A. AASHTO M 30: Zinc coated Steel Wire Rope and Fittings for Highway Guardrail
B. AASHTO M 268: Retroreflective Sheeting for Traffic Control
C. AASHTO AWS D1.1: Structural Welding Code – Steel
D. ASTM A 36: Carbon Structural Steel
E. ASTM A 123: Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products
F. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
G. ASTM A 709: Carbon Structural Steel
H. ASTM A 741: Zinc-Coated Wire Rope and Fittings for Highway Guardrail

I. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

J. International Organization for Standardization (ISO) Standards

K. NCHRP 350: Recommended Procedures for the Evaluation of Highway Features

L. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Letters of Acceptance – Refer to this Section, article 2.1, paragraph D.

B. Certification – Refer to this Section, article 2.2, paragraph A1a.

C. Training requirements – Refer to this Section, article 3.1.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide cable barrier system with the following requirements:
   1. Capable of roadside or median installation.
   2. System meeting NCHRP 350 Test Level 3 on a 6H:1V or flatter slope.
   3. Maximum deflection of 8 ft under NCHRP 350 TL-3 conditions with 10 ft post spacing.
   4. Capable of post and cable separation during impact.
   5. Produce no flying debris capable of vehicle windshield intrusion.
   7. Cable Barrier Concrete Bridge Departure Parapet Bracket.
   8. Cable Barrier/W-beam Guardrail Attachment Assembly.
   9. Cable Barrier/W-beam Guardrail Anchor Assembly.
  10. Cable Barrier/W-beam Guardrail Attachment Rail.

B. Provide socketed cast-in-place concrete foundations for line post.
C. Provide all hardware and miscellaneous items associated with cable barrier system, cable barrier/W-beam attachment assembly, and cable barrier/W-beam guardrail anchor assembly.

D. Receive pre-qualification before bidding on the system.
   1. Provide Department’s Letter of Acceptance
   2. Provide manufacturer’s FHWA Letters of Acceptance

E. Supply system parts within 48 hours of request.

F. Conduct manufacturer-supplied training a minimum of 14 days before installing the system.

2.2 MATERIALS

A. Wire Rope – Galvanized wire rope ¾ inch 3 x 7, construct according to AASHTO M 30/ASTM A 741 Type I, Class A coating, with a Modified Breaking Strength Minimum equal to 39,000 lb.
   1. Wire rope meets manufacturer’s specifications.
      Pre-stretch wire rope during manufacturing to exhibit a minimum wire rope modulus of elasticity of 19,000,000 psi according to ISO 12076-202, Wire Rope Modulus of Elasticity with no bedding or pre-stretching of the rope permitted in testing.
      a. Furnish a separate certification from the wire rope manufacturer stating it meets the cable barrier manufacturer’s requirements if the wire rope is an outsourced product of the cable barrier system manufacturer.
      b. Factory swaged ends on each end of typical cable length.
         1) Each cable will have a left hand thread on one end and a right hand thread on the other end, 1 inch in diameter. Ends able to accept a closed body style turnbuckle.
         2) Provide galvanized hardware.

B. Hardware and Miscellaneous Items
   1. Meet manufacturer’s requirements for all hardware and miscellaneous items as outlined in the manufacturer’s specifications for the installation of the cable barrier system.
      Furnish galvanized hardware when applicable. Items to include but not limited to the following:
      a. Anchor and terminal fittings
         1) 1 inch diameter fittings required
      b. Turnbuckles, rigging screws, field splice connections
         1) 1 inch diameter fittings required
      c. Parts used to separate and hold cable barrier at designed height.
d. Use post cap when required under this Section, article 3.8, paragraph B2 for the purpose of attaching delineation directly facing traffic.

C. Line post, sleeve sockets – 3 ft, 5 ft, and 10 ft post spacings.
   1. Size as shown in manufacturer’s specifications.
      a. Line posts
         1) Meet all manufacturers’ specifications.
         2) Posts specified in ASTM A 1011 or ASTM A 36.
         3) Galvanize according to ASTM A 123, after fabrication.
         4) Post is able to hold the wire ropes at the design height.
      b. Line post sleeve
         1) Steel sleeves to all manufacturers’ specifications for cast-in-place post foundation option.
         2) Steel sleeves constructed using material according to ASTM A 500.
         3) Weld according to AASHTO/AWS D1.1.
         4) Welding operators must be pre-qualified. Comply with UDOT Steel and Concrete Construction Manual.
         5) Galvanize according to ASTM A 123, after fabrication.
   2. Line post foundations, cast-in-place with sleeve.
      a. Cast-in-place post foundation requires completely filling each excavated hole with concrete.
         1) Concrete class AA(AE) – Refer to Section 03055.
            a) Foundation, 12 inch diameter, 42 inch depth.
         2) Reinforcing steel
            a) Refer to Section 03211
            b) Use coated steel
            c) Refer to BA 5 Series Standard Drawings
         3) Do not use a tubular concrete form for casting foundation.

D. Cable Barrier/W-beam Guardrail Attachment Assembly – Single Sided and Double Sided assemblies. Refer to BA 5 Series Standard Drawings.
   1. Cable to W-beam Guardrail attachment rail
      a. Furnish 10 gauge W-beam guardrail cable attachment rails according to cable manufacturer’s requirements.
         1) Furnish attachment rail for use with existing W-beam guardrail installations.
      b. Furnish hardware according to manufacturer’s requirements to make cable to rail attachment.
      c. Furnish 12 gauge W-beam guardrail elements for use with W-beam guardrail median barrier when required by plan set.
d. Refer to Section 02841 for W-beam guardrail, post, blocks and hardware requirements, except as noted in this Section, article 2.2, paragraph E1.

2. Cable posts to meet manufacturer's requirements for transitioning into W-beam guardrail cable attachment rail.
   a. Delineation using AASHTO M 268 Type IX or greater.

E. Cable/W-beam Guardrail Anchor Assembly – Single Sided and Double Sided assemblies. Refer to BA 5 Series Standard Drawings.
   1. W-beam Guardrail rail elements punched as shown on BA Series Standard Drawings. Typical posts, blocks, and hardware.
      a. Refer to Section 02841.
   2. BCT cable anchor assembly, anchor plates, and bearing plates.
   3. Anchor post – Structural Steel. Refer to Section 05120.
      a. I-Beam W 6 x 15, 3 ft long.
         1) Galvanize according to ASTM A 123.
      b. Anchor Post Foundation
         1) Concrete class AA(AE) – Refer to Section 03055.
         2) Reinforcing steel – Refer to Section 03211.
            a) Use coated steel
            b) Install according to Standard Drawings.

F. Cable Barrier Concrete Bridge Parapet Departure Bracket
   1. Refer to BA 5 Series Standard Drawings.
   2. Manufacture according to standard drawing.
   3. Steel as specified in ASTM A 709 Grade 36.
   4. Galvanize according to ASTM A 123, after fabrication.
      a. Furnish specialty posts and all hardware for installations according to manufacturer’s requirements.

G. NCHRP-350 Cable Barrier Terminals
   1. Cable Barrier Terminal – NCHRP-350 Approved
      a. Use a terminal the size and shape required by the manufacturer and meet manufacturer’s specifications.
         1) Supply specialty posts as required for proper operation of terminal anchor.
      b. Concrete foundation as required by manufacturer.
      c. Object marker delineation using AASHTO M 268 Type IX or greater retroreflective sheeting.

H. Non-NCHRP 350 Cable Barrier End Anchor (deadman anchor)
   1. Additional barrier protection required for this end anchor.
      a. See plan set for offsets and required external barrier protection.
      b. Cable Barrier Anchor line posts with sleeve.
      c. Concrete foundations as required by manufacturer.
I. Delineation
1. Sheeting Requirements
   a) Refer to Section 02890
   b) Application
      1) Cable Barrier/W Beam Anchor Systems – Refer to this Section, article 3.8 paragraph A.
      2) Line Post – Refer to this Section, article 3.8 paragraph B.

J. High Tension Cable Gauge
1. Furnish gauge capable of measuring cable tension during initial installation and for repairs.

K. Shop drawings, 4 sets, for the installation of the following
   1. Cable Barrier Terminal (NCHRP 350 approved)
   2. Cable Barrier Approach Transition
   3. Typical installation of line posts and cable

L. Training Materials
   1. Installation manuals.
   3. Materials deemed necessary to conduct training for proper installation and maintenance of cable barrier system.

PART 3 EXECUTION

3.1 TRAINING AND LITERATURE

A. Provide all training materials in both hard copy and electronic PDF format.

B. Notify and provide installation and maintenance training and certification.
   1. Training conducted by the supplying manufacturer.
      a. Provide one training session before construction to the following:
         1) Contractor (Prime)
         2) Installation Contractor (Sub)
         3) Resident Engineer and designee
      b. Provide one training session before the Department accepting project and invite one or both of each of the following:
         1) Region Maintenance Engineer and designee
         2) Region Operations Engineer and designee
         3) District Engineer and designee
         4) Area Supervisor and designee
5) Local Maintenance Station personnel
6) Engineer for Maintenance (Complex) and designee
7) Representative from the Division of Traffic and Safety
8) FHWA-Utah Division representative

2. Provide 4 sets of shop drawings and manuals.
a. Distribution
   1) Resident Engineer
   2) Prime Contractor
   3) Installation Contractor (Sub)
   4) Local Maintenance Station

3. Install W-beam components using an installer who meets the requirements for training established in Section 02841.

4. Install Crash Cushion and End Treatment components using an installer who meets the requirements for training established in Section 02843.

3.2 PREPARATION

A. Site Considerations
1. Complete all grading to final grade requirements according to the plan before installing cable barrier post foundations, terminals, transitions, W-beam components, and anchor systems.
2. Apply a bare-ground treatment, 2 ft on each side of the cable system using bare ground herbicide.
   a. Apply after cable barrier foundations have been installed and the excess material has been removed or graded into surrounding area.
   b. Follow product-labeling requirements for selected product.
   c. Apply herbicide at a rate of 10 lb/acre.
   d. Have a license issued by the Utah Department of Agriculture for Right-of-Way application.

3.3 CONCRETE FOUNDATIONS REQUIREMENTS

A. Line Posts
1. Cast-in-place post foundation
   a. Excavate hole, 12 inches in diameter and 42 inches deep.
      1) Do not over excavate hole.
      2) Install manufactures’ required reinforcing steel.
         a) Refer to BA 5 Series Standard Drawings.
         b) Use coated steel. Refer to Section 03211.
      3) Install post sleeve no greater than ½ inch above finished grade of foundation.
      4) Fill the excavated hole with concrete. Dome concrete down from top of post sleeve to flush with finished grade. Refer to BA 5 Series Standard Drawings.
a) Do not use a tubular concrete form for foundation casting.
b) Post sleeve will be within ¾ inch alignment to the post on either side.
   • Sleeve alignment can be adjusted to meet placement requirements on a horizontal curve.
   • Meet manufacturer’s requirements if supplied system uses offset posts.
c) Install foundation in such a manner that the post will stand vertically and be no greater than ½ inch from plumb.

b. Use class AA(AE) concrete. Refer to Section 03055.
c. Allow concrete to cure a minimum of seven days and achieve 4,000 psi before installing cable.

B. Cast-in-place non-NCHRP 350 Cable Barrier Anchor (deadman anchor)
1. Install according to manufacturer’s specification.
a. Excavate hole and form a cast-in-place anchor.
   1) Use AA(AE) concrete for anchor system. Refer to Section 03055.
   2) Install reinforcing steel according to cable manufacturer’s requirements.
      a) Use coated steel. Refer to Section 03211.
   3) Install hardware according to cable manufacturer’s requirements for cable attachment.
   4) Install so the top of the anchor block will be at the same grade and elevation as the three consecutive posts foundations approaching the anchor block.

b. Allow concrete to cure a minimum of seven days or achieve 4,000 psi before connecting and tensioning cable.
c. Backfill with excavated material. Compact material around the cast-in-place anchor block to a minimum of 95 percent of maximum laboratory density. Refer to Section 02056. Dispose of excess material by removal or grade into surrounding area.
   1) Install so that anchor block will not move greater than 3 inches toward the opposite cable anchor or terminal during tensioning or after tensioning has been completed. Remove and replace with a larger block or secure so that no additional decrease of cable tension occurs if anchor block moves greater than 3 inches.

2. Install anchor line posts with sleeves and hardware for cable attachment as required for anchor system according to manufacturer’s specification.
a. Install foundations with post sleeves for anchor posts according to manufacturer’s requirements.
   1) Follow the same installation procedure, use the same concrete material, and allow the same curing time as required in this Section, article 3.3, paragraph B1b.

3.4 CABLE BARRIER/W-BEAM GUARDRAIL ATTACHMENT ASSEMBLY

A. Install all components of cable barrier to W-beam barrier attachment rail according to Department and manufacturer specifications.
   1. Meet the specifications as required by manufacturer for W-beam guardrail elements.
      a. Installation according to manufacturer and Department requirements.
      b. Install cable/w beam attachment rail to existing posts and blocks as shown on plan set.
         1) Remove exiting W-beam guardrail panel before installation.
             a) W-beam guardrail panels that are being reinstalled may be cut in an approved method.
             b) Do not use a cutting torch on a panel that is to be reinstalled.

3.5 CABLE/W-BEAM GUARDRAIL ANCHOR ASSEMBLY

A. Install typical W-beam guardrail or median barrier guardrail according to Section 02841 and BA 4 Series Standard Drawings.
   1. Typical W-beam rail elements punched according to BA 4 Series Standard Drawings.
   2. Typical post blocks and hardware. Refer to BA 4 Series Standard Drawings.
      a. Meet requirements for manufacturing. Refer to Section 02841.
      b. Anchor attachment rail, cable anchor assembly, anchor bracket, and associated hardware.
   4. Anchor post – Refer to Section 05120 for Structural Steel.
      a. I Beam W 6x15, 3 ft long
         1) Galvanize according to ASTM A 123
      b. Anchor Post Foundation
         1) 18 inch diameter, 60 inch deep.
         2) Class AA(AE) concrete – Refer to Section 03055.
         3) Reinforcing steel – Refer to Section 03211.
            a) Use coated steel.
3.6 CABLE BARRIER CONCRETE BRIDGE PARAPET DEPARTURE BRACKET

A. Install bracket according to BA 5 Series Standard Drawings.
   1. Core drill 1½ inch holes into parapet at specified locations.
   2. Use 1 inch diameter, high strength bolts, washers, and nuts according to ASTM A 325.
      a. Length varies based on parapet width.
      b. Do not use all-thread rod.
   3. Furnish all hardware required to make cable connection to cable bracket.
   4. Furnish specialty posts according to cable system manufacturer.
      a. Furnish hardware for specialty posts.
      b. Install specialty posts according to manufacturer’s requirements.

3.7 POST AND CABLE INSTALLATION

A. Install posts according to manufacturer’s height requirements to provide proper cable height.
   1. Install sleeve cover.

B. Install cable according to manufacturer’s requirements.

C. Tension immediately after initial installation to manufacturer’s requirements.
   1. Recheck and adjust tension 5 days, 10 days, and 15 days after initial tensioning.
   2. Maintain tension log showing time, date, location, ambient temperature, and final tension reading signed by the person performing the tension reading.
   3. Give log to the Engineer after work is completed.
      a. Include manufacturer’s recommended tension chart.

3.8 DELINEATION

A. Cable Barrier/W-beam Anchor Systems
   1. Install delineation on crash cushion or end treatment. Refer to CC Series Standard Drawings.
   2. Install delineation on W-beam rail elements. Refer to GW Series Standard Drawings.
B. Line Posts

1. Install appropriate sheeting on the first and last line post and as stated below.
   a. 3 ft spacing – 1st line with a maximum 50 ft to next line post
   b. 5 ft spacing – 1st line and 10th line post with a maximum 50 ft between posts
   c. 10 ft spacing – 1st line post with a maximum 50 ft to next line post
      1) Adjustment of one post either way to obtain maximum sheeting exposure is acceptable.
   d. Sheeting color – White or yellow, color to correspond with the adjacent edge line.
   e. Install so that sheeting is on approach side of nearest lane of traffic.
      1) Medians width less than 25 ft and barrier system within 15 ft of any travel lane.
         a) Install a minimum 10 in$^2$ on approach side of nearest lane of traffic.
         b) Install a minimum 8 in$^2$ on backside side of nearest lane of traffic.
      2) Medians width greater than 25 ft.
         a) Install a minimum 10 in$^2$ on approach side of nearest lane of traffic.

2. Location of sheeting – Refer to BA 5 Series Standard Drawings.
   a. Trinity Highway Products – CASS System
      1) Place on cable spacer blocks.
   b. Gregory Industries – Safefence System
      1) Place on cable spreader blocks.
   c. Brifen USA – Brifen Wire Rope Fence
      1) Place on post cap.

3.9 PARTS AND CONTACTS

A. Manufacturer of system will furnish the following to the Department Maintenance Division no later than five days after project acceptance:

1. Four sets of system installation details and parts list.
   a. Distribution to Central Maintenance, Region/District Maintenance Engineer, Maintenance Area Supervisor, and Maintenance Station Foreman.

2. List and contact information for repair part suppliers.

3. Supply parts directly to the Maintenance Division within 48 hours of notification.

4. List of Utah based, manufacturer trained installers.

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 02056: Embankment, Borrow, and Backfill
B. Section 02075: Geotextiles
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 09981: Concrete Coating

1.3  REFERENCES

A. AASHTO LRFD Bridge Construction Specifications
B. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
C. ASTM D 1777: Thickness of Textile Materials
D. ASTM D 6364: Determining Short-Term Compression Behavior of Geosynthetics
E. UDOT Quality Management Plans
1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of lifting devices for approval.
      a. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
      b. Include supporting engineering calculations.
      c. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.
   2. Prepare drawings according to the following:
      a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
         1) State Project Designation
         2) State Project Name
         3) State Structure Number
         4) Contractor, Fabricator, or Erector Name
         5) Contractor, Fabricator, or Erector Drawing Number
         6) Contractor, Fabricator, or Erector Sheet Number
      b. Revise and resubmit drawings when directed by the Department.
      c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.
   3. Prepare engineering calculations according to the following:
      a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or
11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
1) State Project Designation
2) State Project Name
3) State Structure Number
4) Contractor, Fabricator, or Erector Name
5) Contractor, Fabricator, or Erector Drawing Number
6) Contractor, Fabricator, or Erector Sheet Number
b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
4. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
b. This review period applies each time the drawings and calculations are submitted.
5. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
1. Manufacturer’s product data, specifications, and recommended wall installation instructions.
2. Samples of the specified surface texture architectural treatments for approval before casting the panels.
a. Refer to the plans for the required surface texture architectural treatments.

1.6 SHIPPING, HANDLING, AND STORAGE

A. Shipment Acceptance – Panels or posts may be accepted for shipment if they meet the following requirements:
1. 28 day concrete compressive strength.
2. Cured according to Section 03390.
3. Water repellent applied according to Section 09981.
   a. Water repellent may be applied at the project site after installation when approved by the Engineer.
4. 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
   1. 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. Use a form release agent that meets the following:
   1. 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. A non-petroleum release agent meeting all EPA requirements.
   3. A release agent that is not detrimental to concrete strength or durability and that does not impart color, tint, or texture to the finished product.

2.5 CURING COMPOUND

A. Refer to Section 03390.

2.6 CONCRETE COATING SYSTEM

A. Water Repellent – Refer to Section 09981.
B. Tinted Concrete Sealer – Refer to Section 09981.

2.7 GRAVEL FOR POST HOLES
A. Use Free Draining Granular Backfill. Refer to Section 02056.

2.8 ELASTOMERIC BEARING PAD
A. Refer to AASHTO LRFD Bridge Construction Specifications, Article 18.2.
B. Use 60 hardness.

2.9 BACKER ROD
A. Refer to Section 03152.

2.10 CONSTRUCTION ADHESIVE
A. Apply as recommended by the wall manufacturer.

2.11 WOOD SHIMS
A. Use any grade fir.

2.12 COMPOSITE DRAINAGE MATERIAL
A. Use a two-layer geocomposite sheet drain consisting of drainage
geotextile bonded to one side of a three-dimensional drainage core.
1. Drainage geotextile – Refer to Section 02075.
2. Drainage core:
   a. High strength polystyrene or polypropylene.
   b. Minimum compressive strength = 15,000 lbs/ft$^2$. Refer to
      ASTM D 1621 or ASTM D 6364.
   c. Minimum thickness = 0.40 inches. Refer to ASTM D 1777.
   d. Capable of multidirectional flow.

2.13 DRAINAGE GEOTEXTILE
A. Refer to Section 02075.

2.14 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 panel required and of tilting it from horizontal position to vertical position.

D. Shear factor of safety 2.66:1 for lifting from a flat position and a tension factor of safety 4:1 for lifting from a vertical position.

E. Designed for shear so that the panels can be lifted from either side.

F. Provide a sealing cover.

2.15 FABRICATION

A. Use a prequalified precast concrete products supplier according to the UDOT Quality Management Plan: Precast/Prestressed Concrete Structures.

B. Precast Concrete Posts
   1. Cast posts in metal forms. Cast pilasters in metal or wood forms.
   2. Permanently mark each post with the date of casting and the post identification number supplied by the inspector. Place markings in fresh concrete near the bottom of the post.
   3. The Department accepts posts when:
      a. Posts meet the 28-day compressive strength.
      b. Posts are cured according to Section 03390.
      c. Water repellent is applied according to Section 09981.
         1) Water repellent may be applied at the project site after installation when approved by the Engineer.
      c. Posts have been visually inspected and accepted by the Engineer.
      d. Posts 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 with smooth, solid surfaces free of voids and air pockets.
2. Permanently mark each panel with the casting date and the panel identification number supplied by Engineer on the panel end near the top.

3. Provide the 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 that are uniform, straight, and sharp.

4. The Department accepts panels when:
   a. Panels meet the 28 day compressive strength.
   b. Panels are cured according to Section 03390.
   c. Water repellent is applied according to Section 09981.
      1) Water repellent may be applied at the project site after installation when approved by the Engineer.
   d. Panels have been visually inspected and accepted by the Engineer.
   e. Panels have sides that do not deviate from a straight line by more than \( \frac{1}{8} \) 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.
PART 3 EXECUTION

3.1 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.

3.2 POST HOLES

A. Refer to SW Series Standard Drawings.

B. Place edge of post holes no closer than 2 ft from any underground utility.

3.3 CONCRETE POSTS

A. Set true to line and grade. Replace posts more than ¼ inch out of plumb in 10 ft of exposed length.

B. Replace posts that do not adequately support or accept insertion of the precast panels.

C. Replace cracked or damaged posts.

D. Attach elastomeric bearing pads to concrete posts using construction adhesive. Follow the manufacturer’s recommendations.

3.4 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.

3.5 LIFTING DEVICES

A. Place waterproof caps in the lifting devices after the panels are permanently placed.
3.6 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.
   4. Follow manufacturer’s recommendations.

C. Drainage Geotextile
   1. Place around the back side of the posts as shown in the drawings.
   2. Extend the material from the bottom of the retaining panel to the top of the fill.
   3. Attach to posts using construction adhesive.
   4. Follow manufacturer’s recommendations.

D. Free Draining Granular Backfill
   1. 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.

3.7 CONCRETE COATING SYSTEM

A. Apply tinted concrete sealer to exposed concrete surfaces of posts and panels after installation is complete and as specified on the plans. Refer to Section 09981.

B. Coat concrete surfaces to 6 inches below the finished ground line.

END OF SECTION
SECTION 02890

RETROREFLECTIVE SHEETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Retroreflective sheeting materials for traffic signs and traffic control devices.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate

B. ASTM D 4956: Retroreflective Sheeting for Traffic Control

C. Code of Federal Regulations (CFR)

D. Construction of Roads and Bridges on Federal Highway Projects FP-03

1.4 DEFINITIONS

A. Retroreflective Sheetings

1. Sheetings – The retroreflective or non-reflective material that comprises the background, legend (word messages and symbols), and border.

2. Sheeting Components – The matched component products required for the manufacture of highway signs consist of the sheeting, cutout letters and borders, adhesives, inks, and overlay films. Failure of the sheeting inks or overlay films, provided, sold, or recommended for use, constitute a failure of the entire sign and replacement under manufacturer’s warranty replacement obligations. All components and warranties will be compatible with substrates used by the Department, including Aluminum ASTM B 209 5052 - H 38 or 6061-T6.

3. Permanent signs include installations that are in their final configuration and that are expected to have a multi-year life. Examples include freeway guide signs, regulatory signs, warning signs, barrier markers, crash cushion markers, and delineation.
4. Work zone standard signs include MUTCD and Department Standard application signs including but not limited to Road Work Ahead, work zone Speed Limit Signs, Flagger Symbols, Business Access signs, and Regulatory signing within the work zone.

5. Work zone project specific signs are signs that have legends specific to the project and that cannot be reused on a future project. Examples include: “Alder Street closed from 1st to 2nd Avenue – use Birch Street” or project notification signs. These are typically used for only one construction season.

6. Flexible work zone devices include roll up signs, cones, tall cones, and flags with retroreflective sheeting.

7. Work zone channelization devices include for example drums, vertical panels, barricades, tubular markers, and pavement marking tabs.

1.5 SUBMITTALS

A. Manufacturer’s Product Data and Specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. Retroreflective Sheeting

B. Non-reflective Sheetings – As specified and according to the recommendation of the retroreflective sheeting manufacturer.

C. Use matched component cutout legends, symbols, and borders.

D. Use only acrylic EC film to achieve color. Do not use vinyl EC film to achieve color.

2.2 PERMANENT APPLICATIONS

A. Traffic Signs and Traffic Control Devices
   1. Meet or exceed the minimum requirements of ASTM Type IX.
   2. Use fluorescent sheeting for orange, yellow and yellow-green.
B. Miscellaneous Signs
1. Use ASTM Type I for Adopt a Highway and Sponsor a Highway signs.
2. Use ASTM Type I for Memorial signs.
3. Use fluorescent pink retroreflective sheeting for Traffic Incident Management Area signs.

2.3 WORK ZONE APPLICATIONS

A. Work Zone Signing
1. Standard signs
   a. Meet or exceed the minimum requirements of ASTM Type IX.
   b. Use fluorescent retroreflective sheeting for orange, yellow, and yellow-green.
2. Project specific signs
   a. Meet or exceed the minimum requirements of ASTM Type III high intensity prismatic sheeting.
   b. Use fluorescent retroreflective sheeting for orange, yellow, and yellow-green.
3. Traffic incident management area signs
   a. Use fluorescent pink.

B. Flexible signs, cones, tall cones, and sign flags
1. Use ASTM Type VI with minimum Coefficient of Retroreflection as shown in Table 1.

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<th>Observation Angle</th>
<th>Entrance Angle</th>
<th>White</th>
<th>Fluorescent Yellow-Green</th>
<th>Fluorescent Yellow</th>
<th>Fluorescent Orange</th>
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</tbody>
</table>

C. Channelization Devices
1. Meet or exceed the minimum requirements of ASTM Type IX for vertical panels, barricade Types I, II, and III, and directional indicator barricades.
2. Meet or exceed the minimum requirements of ASTM Type V for temporary raised pavement markers.
3. Meet or exceed the minimum requirements of ASTM Type IV with the minimum requirements of the Coefficient of Retroreflection as shown in Table 2 and the minimum requirements of the Color Specification Limits (daytime) of Table 3 for all other channelization devices.

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<th>Fluorescent Orange</th>
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**Table 3**

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<th>Luminance Factor (Y%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>White</td>
<td>0.303</td>
<td>0.306</td>
</tr>
<tr>
<td>Fluorescent Orange</td>
<td>0.645</td>
<td>0.355</td>
</tr>
</tbody>
</table>

Use fluorescent retroreflective sheeting for orange and yellow.

5. Do not obscure retroreflective sheeting with paint or other materials.

**PART 3 EXECUTION**

**3.1 PREPARATION**

A. Do not reverse screen sign larger than 7 ft²/color.

B. Establish proper orientation of the sheeting for all traffic signs and traffic control devices.
   1. Verify cutout legends, symbols, and borders have the same sheeting orientation as background sheeting.
3.2 INSTALLATION

A. Permanent sign and sheeting identification
   1. Affix to each sign a 1 inch high, two-digit number representing the fabrication year to the front lower left corner of each sign. Use numbers of contrasting color to sheeting color. Represent the year 2012 as “12”, and so forth.
   2. Affix to each sign a 2 inch x 2 inch impermeable, non-fading weather-resistant, self-adhesive label. Attach label where it will not obscure sheeting. The label contains the month and year of manufacture, contractor’s name, and type of sheeting.

END OF SECTION
SECTION 02891
TRAFFIC SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing traffic signs.

1.2 RELATED SECTIONS

A. Section 01721: Survey
B. Section 02317: Structural Excavation
C. Section 02890: Retroreflective Sheeting
D. Section 03055: Portland Cement Concrete
E. Section 03211: Reinforcing Steel and Welded Wire
F. Section 05120: Structural Steel

1.3 REFERENCES

A. ASTM A 500: Cold Formed Welded and Seamless Carbon Steel Structure tubing in Rounds and Shapes
B. ASTM A 513: Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
C. ASTM A 653: Steel, Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by Hot-Dip Process
D. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate
E. American Plywood Association (APA) Product Standard

1.4 DEFINITIONS

A. Traffic Sign Components
   1. Panel – Assembly of substrate and attached sheeting. Several panels may be necessary to complete one sign. Panel types are:
a. Type
1. Retroreflective sheeting on sheet aluminum.
2. PW Retroreflective sheeting on plywood-backed sheet aluminum.

b. Legend
1. Non-reflective legend, symbols, and borders.
2. Retroreflective legend and border.

2. Panel Overlay – Attaching new panels to all or part of an existing panel.
3. Panel Replacement – Removing the existing panel and attaching a new panel to the frame.
4. Sheeting – The retroreflective or non-reflective material that comprises the background, legend (word messages and symbols), and border.
5. Sheeting Components – 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 substrate used by the Department, Aluminum ASTM B 209 5052 - H 38 or 6061-T6.
6. Sign – An assembly comprised of panel, panel with frame when required, panel with “Z” bar when required.
7. Size – Width x Height.
8. Substrate – The base aluminum material, to which the background sheeting is attached.

1.5 SUBMITTALS

A. 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 or 0.125 inch thick. Refer to ASTM B 209 alloy 6061-T6, or 5052-H38.

C. Plywood Backing – According to APA product standard 1 PSI-83, Group 1½ inch thick.
   1. 90/90, high density BB exterior (Douglas Fir) B Grade.
   2. Plugged-core (Douglas Fir) with ½ inch maximum gaps.

D. Bases – According to SN Series Standard Drawings
   1. Small Sign Tubular Steel Sign Base (B1)
      a. Manufacture according to Standard Drawings.
      b. Concrete foundation according to Standard Drawings.
   2. Small Sign Tubular Steel Sign Base (B2A)
      a. Manufacture according to Standard Drawings.
   3. Small Sign Tubular Steel Post Base (B2B)
      a. Manufacture according to Standard Drawings.
      b. Concrete foundation according to Standard Drawings.
   4. Slipbase Tubular Steel Sign Base (B3)
      a. Manufacture according to Standard Drawings.
         1) 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. Tubular Steel Sign Base Barrier Mounted (B5A) (B5B)
   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
   9. Multidirectional Sign Base (B7A) (B7B) (B7C)
      a. S Section post (B7A)
         1) Match base size with post size
      b. W Section post (B7B)
         1) Match base size with post size
         Traffic Signs
         02891 – Page 3 of 6
c. W Section post (B7C)
   1) Match base size with post size

d. Concrete foundations according to SN Series Standard Drawings.

E. Posts, “T” and “U” brackets, extensions, and hardware according to SN Series Standard Drawings.
   1. Post P1
      a. 2¾ inch outside diameter 0.080 (14 Gauge)
      b. Refer to ASTM A 513
      c. Galvanize according to ASTM A 653
      d. Color – Powder coated as required
   2. Post P2
      a. 2¾ inch outside diameter 0.095 (13 Gauge)
      b. Refer to ASTM A 513
      c. Galvanize according to ASTM A 653
      d. Color – Powder coated as required
   3. Post P3
      a. 2¾ inch outside diameter 0.134 (BWG 10)
      b. Refer to ASTM A 513
      c. Galvanize according to ASTM A 653
      d. Color – Powder coated as required
   4. Post P4
      a. 2⅞ inch outside diameter 0.160 (NP 40)
      b. Refer to ASTM A 513
      c. Galvanize according to ASTM A 653
   5. Post P5
      a. 2⅞ inch outside diameter 0.276 (SCH 80)
      b. Refer to ASTM A 513
      c. Galvanize according to ASTM A 653
   6. “T” and “U” Extension and 90 degree Post Extension
      a. Manufacture according to SN Series Standard Drawings.
      b. Galvanize each according to ASTM 653
   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 and non-reflective sheeting – Refer to Section 02890.

G. Fasteners – Refer to applicable SN Series Standard Drawings.
H. Foundation – Refer to applicable SN Series Standard Drawings.
   1. Concrete – Class AA(AE) or B(AE). Refer to Section 03055.
   2. Reinforcing steel – Refer to Section 03211.
   3. Anchor bolts – Refer to Section 05120.

I. Structural steel – Structural steel frame. Refer to Section 05120.

J. 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 ft²/color.

B. Do not remove a sign that is being replaced until the new sign is placed and uncovered.

C. Compact backfill to a density equal to surrounding materials.

D. Establish proper elevation and orientation of all signs and structures and determine proper sign post lengths as dictated by construction slopes. Refer to SN Series Standard Drawings

E. Cover signs that require temporary covering with an opaque material. Secure at the rear of the sign so that the sign is not damaged. Maintain covering until covering or sign is removed.

F. Construct sign post foundations with concrete according to dimensions.

G. Affix a 1 inch high two-digit numeral representing the fabrication year to the front lower left corner of each sign. Make numbers a contrasting color to sheeting color. Represent the year 2012 as “12” and so forth. Refer to Section 02890.
H. Affix to each sign a 2 inch x 2 inch impermeable, non-fading weather-resistant, self-adhesive label.
   1. Label includes the month and year of manufacture, contractor’s name, and type of sheeting. Attach label where it will not obscure sheeting. Refer to Section 02890.

3.3 RELOCATE EXISTING SIGN

A. 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.

3.5 RELOCATE EXISTING MILEPOST SIGN

A. Refer to SN Series Standard Drawings. Sign base preference may vary by Region at the direction of the Engineer.
B. Survey location of existing milepost signs as specified in Section 01721 before removal.
C. Milepost sign may be removed and stored at beginning of project or whenever it becomes necessary after project start to facilitate project work.
D. Comply with other requirements listed in this Section, article 3.3.
E. Reestablish milepost sign at location specified in Section 01721.
F. Replace damaged signs at no cost to the Department.

END OF SECTION
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 02890: Retroreflective Sheeting
E. Section 02891: Traffic Signs
F. Section 03055: Portland Cement Concrete
G. Section 03211: Reinforcing Steel and Welded Wire
H. Section 03310: Structural Concrete
I. Section 03575: Flowable Fill
J. Section 13554: Polymer Concrete Junction Box

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: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
K. ASTM D 3035: Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
L. American Iron and Steel Institute (AISI)
M. American National Standards Institute (ANSI)
N. American Wire Gauge (AWG)
O. Electric Utility Service Equipment Requirements Committee (EUSERC)
P. Illuminating Engineering Society (IES)
Q. International Municipal Signal Association (IMSA) Standards
R. Intertek ETL Listed
S. National Electrical Code (NEC)
T. National Electrical Manufacturers Association (NEMA)
U. Pedestrian Traffic Control Signal Indicator (PTCSI) Standards
V. Rural Electrical Association (REA) Bulletin
W. Underwriters Laboratory (UL)
X. Vehicle Traffic Control Signal Head (VTCSH) Standards
1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS


B. Samples of materials for approval when requested.

C. Two copies of the following within 15 days after receiving notice to proceed:
   1. List of equipment and materials including 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. Department Vehicle Detector and Street Lighting Splice certifications for all individuals that will perform wiring splices.

1.6 QUALITY ASSURANCE

A. Electrical components according to the requirements of the National Electrical Code (NEC).

B. A Licensed Journeyman Electrician with at least 3 years experience in traffic signal construction must be responsible for and supervise all on-site work related to this Section.

C. A minimum of two IMSA Traffic Signal Field Level II certified technicians must be onsite during any work related to this Section.

1.7 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. 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 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:
\[ R_t = \text{Resistance of loop as measured at pull box.} \]
\[ R_l = \text{Resistance of loop lead in wire (from the loop to junction box). Equal to 0.002525 ohms per foot (times 2) measured from loop to pull box splice point.} \]
\[ R_d = \text{Resistance of Loop} = P \cdot T \cdot R_c \] (See Loop Resistance Table below).
\[ P = \text{Perimeter of loop in feet.} \]
\[ T = \text{Number of turns in the loop.} \]
\[ R_c = \text{Resistance of #14 AWG copper wire per foot equals 0.002525 ohms.} \]

Where:
\[ R_t = \text{Resistance of loop as measured at pull box.} \]
\[ R_l = \text{Resistance of loop lead in wire (from the loop to junction box). Equal to 0.002525 ohms per foot (times 2) measured from loop to pull box splice point.} \]
\[ R_d = \text{Resistance of Loop} = P \cdot T \cdot R_c \] (See Loop Resistance Table below).
\[ P = \text{Perimeter of loop in feet.} \]
\[ T = \text{Number of turns in the loop.} \]
\[ R_c = \text{Resistance of #14 AWG copper wire per foot equals 0.002525 ohms.} \]

4. Measure and report each loop’s insulation resistance. Minimum acceptable reading measured between the loop conductor and ground is 50 MΩ or greater when tested with a 500 V megohm meter.

<table>
<thead>
<tr>
<th>Loop Type</th>
<th>Width (ft)</th>
<th>Length (ft)</th>
<th>Turns</th>
<th>R_d Loop Resistance (ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Wide</td>
<td>6</td>
<td>4</td>
<td></td>
<td>0.22</td>
</tr>
<tr>
<td>5 Wide</td>
<td>10</td>
<td>4</td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>6 Circular</td>
<td>6</td>
<td>4</td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>6 Circular</td>
<td>5</td>
<td>6</td>
<td></td>
<td>0.24</td>
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<tr>
<td>6 Circular</td>
<td>6</td>
<td>4</td>
<td></td>
<td>0.24</td>
</tr>
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<td>6 Circular</td>
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<td></td>
<td>0.32</td>
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<tr>
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<td></td>
<td>0.36</td>
</tr>
<tr>
<td>6 Circular</td>
<td>14</td>
<td>3</td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>6 Circular</td>
<td>16</td>
<td>3</td>
<td></td>
<td>0.33</td>
</tr>
</tbody>
</table>
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 if requested.
2. Insulation resistance of supply conductors measured to ground will have not less than 100 MΩ of leakage (500 V megohm meter).

E. RADAR Detection Circuit – Demonstrate each RADAR detection circuit operates according to 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. Refer to ASTM A 570, Grade 33.
   Allowable stresses
   \[ F_b = 21,750 \text{ psi} \quad (0.66F_y) \]
   \[ F_V = 10,900 \text{ psi} \quad (0.33 F_y) \]
2. Galvanized as specified. Refer to ASTM A 123.

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
2. Zinc-plated or galvanized, as specified.
   a. Zinc-plated as specified. Refer to ASTM B 766.
   b. Galvanized steel. Refer to ASTM A 123.
3. Nuts – Free running by hand for total thread length of bolt.
B. Slip Bolts
   2. Steel – Refer to ASTM A 325.

2.4 WIRE

A. Copper – Refer to International Municipal Signal Association (IMSA).

B. Size – Refer to AWG.

C. Service Cable
   2. Refer to NEC Article 200.

D. Interconnect Cable
   1. Twisted pair filled shielded cable. Refer to IMSA 60-6.
   2. Single mode fiber optic cable.

E. Signal Cable

F. Bonding/Grounding System Wire
   1. Solid, bare, soft-drawn, copper wire. Sized to meet NEC 250-1.

G. Detector Lead-In Wire (homerun). Refer to IMSA 50-2.

H. Detector Loop Wire

I. Commercially Manufactured Preformed Loop
   1. Highly abrasion-resistant alloy cover with high tensile strength braided synthetic fiber reinforcement, maximum O.D. ⅜ inch.
   2. Withstand minimum pressure of 1,400 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 individually marked showing the direction of the wire turns.
   6. Manufacturer to provide minimum 15 year guarantee.
   1. Insulate conductors individually and encapsulate with mastic rubber pads and over wrap with vinyl electric tape. Overcoat completed splice with waterproof sealant. Refer to ASTM D 3005, Type I or II. Refer to UL 510.

K. Color Coding Tape
   1. Vinyl electric tape. Refer to UL 510.

L. RADAR Detection Circuit
   1. RADAR Detection Circuit Cable according to manufacturer’s 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.
   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. Refer to 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. Six 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 gauge 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.

E. Temporary Signal Head Cover
1. Orange heavy duty nylon, designed to completely cover all visors.
2. Integrated 2 to 3 inch wide vertical mesh for system testing.
3. Printed vertically in 4 inch black lettering, “OUT OF” on the left side of the vertical mesh and “SERVICE” on the right side of the vertical mesh.
4. Integrated elastic band with clips or nylon braided rope to secure cover to signal head.

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 pedestrian countdown signal 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 applied 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 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 300 million actuations, requiring 2 lb of force or less to actuate.

3. Provide a low-movement (maximum movement of $\frac{12}{1000}$ of an inch), pressure activated, tamper-proof, highly vandal resistant button, meeting NEMA TS-2 Mechanical Shock and Vibration requirements.

4. Provide assembly with solid state electronic Piezo switch rated for 300 million cycles with no moving plunger or moving electrical contacts.

5. Provide assembly with internal circuitry with a resetting switch 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 assembly that meets NEMA TS 2 Temperature and Humidity requirements.

8. Provide a rain tight gasket to seal between the button assembly and the frame.

9. 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.

10. 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, LED light that stays on for 3 to 5 seconds if the button is pushed and held closed, or an LED light that stays on until the pedestrian signal phase is activated.

11. Minimum 5 year unlimited warranty.

C. Pedestrian Push Button Frame

1. Provide cast aluminum frame, powder coated black, capable of supporting push button and a 9 inch x 12 inch sign, with the following characteristics:
   a. Frame attaches to the pole using two ANSI $\frac{1}{4}$ 20 x 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 ANSI 8-32 stainless steel Allen head screws.
   d. Cable guide extends through a $\frac{7}{8}$ inch diameter mounting hole in the support pole to channel wiring to the button.
2. Provide push button frame standoff brackets to mount two frames on one pedestrian signal pole.
   a. Durable solid aluminum bar or stainless steel bracket designed for various pole diameters.
   b. No additional holes required for mounting.

D. Pedestrian Push Button Sign
   1. Provide a 9 inch x 12 inch sign with corner radii that allow the sign to fit completely within the frame.
   2. Provide a two-sided R10-3 sign, with one side of the sign with a right pointing finger and arrow and the other side of the sign with a left pointing finger and arrow.
   3. Provide sign fabricated from aluminum substrate with retroreflective sheeting. Refer to Section 02891 for aluminum substrate and Section 02890 for retroreflective sheeting. Provide standard ANSI 8-32 clearance holes or eyelets for mounting.

2.8 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 countdown signal modules that meet current PTCSI standards.
   3. Use Intertek ETL listed LED modules.

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 such as lens, lamp modules, gaskets, and reflectors.
   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 clear 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 Countdown Signal Modules
   1. Provide 9 inch countdown numbers.
   2. Provide symbol message that blanks out under ambient light conditions when the pedestrian symbols are not active.
   3. Provide circuitry that isolates pedestrian/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. Department 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 Signal Modules that exhibit  
      luminous intensities less than the minimum values specified  
      in VTCSH-LED or PTCSI within the first 60 months of the  
      date of delivery.  

2.9 ELECTRICAL CONDUIT AND JUNCTION BOXES  
A. Conduit and Fittings  
   1. Schedule 40 PVC rated at 190 degrees F as specified. Refer to  
      NEMA TC-2, TC-3 – UL Listed.  
   2. SDR-11 HDPE – NEMA TC-7. Refer to ASTM 3035.  
   4. Galvanized as specified. Refer to ANSI C80.1.  
B. Steel Casing – Provide smooth steel casing with a minimum ¼ inch  
   wall thickness and diameter as specified.  
C. Junction Boxes – Refer to Section 13554.  

2.10 VEHICLE DETECTION  
A. Refer to SL Series Standard Drawings.  
B. Induction Loop Detection  
   1. PVC or preformed loops.  
      a. Use for presence or traffic queue detection.  
   2. Saw cut loops.  
      a. Use for traffic counting loops only.  
      b. Use circular loop saw or standard pavement saw. Square  
         loops require corner cuts. Avoid saw angles greater than 45  
         degrees.  
C. RADAR Detection  
   1. Use for presence or traffic queue detection.
2. Use for dilemma zone detection for 40 MPH or higher approaches and on advance signal warning systems.
3. Use for vehicle counting.

2.11 LED LUMINAIRE

A. Physical Requirements
1. Low-profile, die-cast aluminum housing with white or grey minimum 3 mil powder coat finish. Wide angular channels that allow for natural removal of dirt and debris.
2. 1.5 inch to 2.5 inch O.D. horizontal tenon mount.
3. Built in bubble level.
4. High temperature wiring.
5. Photo cell – 360 degree rotatable, twist-lock receptacle. Minimum 12 year warranty.
6. Hinged door with tool-less entry.
7. Large terminal block directly in line with incoming power wires, accommodate up to 6 AWG wire.
8. Luminaire weight and projected area within design loading limits.
9. UL 8750 and UL 1598 compliant.
11. ETL Listed for wet locations.
12. Refer to SL Series Standard Drawings.

B. LED Driver
1. Rated for a minimum 70,000 hours.
2. NEMA IP66 rated.
3. Multi-volt, multi-watt 120–277 VAC

C. LED Optics Chamber
1. NEMA IP66 rated.

D. Performance Requirements
1. IES L70 lumen maintenance minimum 70,000 hours.
2. Apparent color temperature 4,000 K – 4,500 K.
3. Type III light distribution pattern.
4. Luminaire Type A
   a. Minimum 9,000 delivered lumens per IES LM-79.
   b. Required power – maximum 140 Watts.
5. Luminaire Type B
   a. Minimum 14,500 delivered lumens per IES LM-79.
   b. Required power – maximum 230 Watts.
2.12 **GROUND ROD**

A. Copper-coated steel.

B. Refer to ANSI/UL 467.

2.13 **MOUNTING BANDS AND BUCKLES**

A. Refer to plans.

B. AISI Type 201 stainless steel.

2.14 **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.”

2.15 FLOWABLE FILL

A. Refer to Section 03575.

2.16 HOT MIX ASPHALT

A. Refer to Section 02741.

2.17 MAST ARM SIGNS

A. Provide sign fabricated from aluminum substrate. Refer to Section 02891.

B. Provide retroreflective sheeting. Refer to Section 02890.
PART 3   EXECUTION

3.1   PREPARATION

A. Refer to and follow the NEC.

B. Coordinate State Furnished Materials
   1. Receive materials at the Department’s Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse to schedule a pickup.
   2. Receive drop shipment materials at specified location.

C. Do not disconnect or remove an existing signal system until the replacement system is fully functioning.

D. Contact local power utility at least 30 days before the connection date and verify the exact location, voltage, procedure, and materials required by the power utility.

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: Class 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 mast arm signal poles to be plum from pole base to pole top after attaching the mast arm.
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 breakaway 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 unless otherwise specified.
   4. Apply tack coat evenly before final backfill.
   5. Match the composition, density, and elevation (± 3/16 inch) of the existing pavement section.

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. Refer to railroad agreement.

D. Minimum Conduit Cover
   1. Minimum cover for all roadway crossings is 24 inches for conduit placed in trench and 36 inches for directional bore conduit.
   2. Minimum cover off roadway without concrete encasement or capping is 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 or HDPE conduit underground.

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. Install cap with 7/32 inch hole for pull wire on each end of conduit.
   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.

G. Do not use a torch for bending or shaping PVC conduit. Use equipment specifically designed to heat PVC conduit to shape any required curves or radii.

H. Use couplers specifically designed to couple PVC conduit to HDPE conduit.

I. Do not exceed 270 degrees of conduit sweeps between individual junction boxes.

3.6  INSTALL JUNCTION BOX

A. Refer to Section 13554.

B. Provide minimum 10 inches spacing between adjacent junction boxes.

C. Do not place flowable fill under concrete collars or to edge of trench. Refer to AT Series Standard Drawings.
3.7 INSTALL WIRING

A. Conductors
   1. Clean and dry the inside of the conduit before installing conductors and cables.
   2. Install grounding conductor in all circuit conduits with 50 V or higher.
   3. Use powered soapstone, talc, or other approved lubricants when pulling conductors and cables in conduit.
   4. Pull all conductors and cables with mule tape.
   5. Tape the ends of unused conductors and label them as spares.
   6. Use conductors that are color coded as specified. Refer to table 4 and IMSA 20-1.

B. Bonding Conductor (Ground) Wire
   1. Size bonding wire according 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.
   3. A concrete encased electrode may be used according to NEC 250.52.A.3.2 in signal pole foundations as an alternative to a ground rod in case of excessive rocky soil conditions and under the approval of the Engineer. Qualified Department personnel must conduct a pre-pour inspection for acceptance of the electrode.

C. Arrange the wiring neatly within items such as cabinets, junction boxes, and fixtures.

D. Terminate all terminal connections by a mechanical (spade) connector.

E. Provide a separate 7 conductor cable for signal heads that control a dedicated turn phase.

F. 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 ¼ 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. 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.

G. Mark cabinet cables with colored vinyl electrical tape as specified in Table 3. Refer to UL 510.

<table>
<thead>
<tr>
<th>Table 3</th>
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</thead>
<tbody>
<tr>
<td><strong>Cables Marked with Colored Tape</strong></td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td><strong>Signal Circuit</strong></td>
</tr>
<tr>
<td><strong>Detector Circuit</strong></td>
</tr>
</tbody>
</table>

**Circuit Coding**

One band = Through, Two bands = Left Turn, Three bands = Queue, Four bands = Dilemma

| | Northbound | Southbound | Eastbound | Westbound |
| | P2 | P3 | P4 | P1 |
| **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 |

H. Connect conductors according to Table 4.
### Table 4

<table>
<thead>
<tr>
<th>Color-Coded Conductors</th>
<th>North-South</th>
<th>East-West</th>
</tr>
</thead>
</table>
| **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 | |

### 3.8 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.
   2. Do not allow twists in the loop.
   3. Do not allow splices in the 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 Traffic Counting Loop
   1. Remove all loose material and wash and dry all saw cuts.
   2. Place all loop wire in a ¼ inch polyethylene tube.
   3. 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.
4. 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. Include an additional turn in loops that are more than 8 inches below finished surface to compensate for reduced sensitivity.
2. Place loops under new pavement 1¾ inches below the surface of the base course and backfill with surrounding material.

3.9 INSTALL POWER SOURCE

A. Verify the exact location, voltage, procedure, and materials required by the power utility.

B. Refer to SL Series Standard Drawings.

3.10 INSTALL LUMINAIRE

A. As specified in plans.

B. Refer to SL Series Standard Drawings.

3.11 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 and pedestrian signal heads with temporary signal head covers if signal head activation is not immediate. New signal heads must not block active existing signals before new signal activation.

D. Install optically-programmed vehicle signal heads according to the manufacturer’s instructions.

E. Use louvered back plates on all vehicle signal heads except Type V.

F. Use cable straps for all universal vehicle signal mounts.

3.12 INSTALL PEDESTRIAN PUSH BUTTON

A. As specified in plans.

B. Refer to SL Series Standard Drawings.
3.13 INSTALL MAST ARM SIGN

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.

3.14 INSTALL RADAR DETECTION

A. Install all RADAR detection components according to the manufacturer’s specifications.

B. Mount each RADAR detection sensor at specified location using the state furnished mounting bracket.

C. Install RADAR detection sensors under the direction and supervision of Department staff as specified. Provide a fully functional detection system.

3.15 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 12 inches below the existing surface.

D. Remove abandoned junction boxes.

E. Backfill all holes with local material and compact to the density of the surrounding area.

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-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. AASHTO M 270: Structural Steel for Bridges

D. AASHTO M 291: Carbon and Alloy Steel Nuts

E. AASHTO M 293: Hardened Steel Washers

F. ASTM A 36: Carbon Structural Steel

G. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

H. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
I. ASTM A 314: Stainless Steel Billets and Bars for Forging

J. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

K. ASTM A 563: Carbons and Alloy Steel Nuts

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 844: Washers, Steel, Plain (Flat), Unhardened for General Use

R. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength


T. American Institute of Steel Construction (AISC)

U. American Petroleum Institute (API)

V. AWS D1.1 Structural Welding Code – Steel

W. AWS D1.2 Structural Welding Code – Aluminum

1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.

   1. Working drawings do not supersede the contract drawings.

B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from...
responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings
1. Detailed shop drawings of all fabricated materials for approval.
   a. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.
2. Prepare Drawings
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.
3. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.
4. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
1. Mill Test Report (MTR) for all structural steel and aluminum. Provide item number and name on all materials submittals. Refer to Section 05120.
2. Manufacturer’s certificate of compliance for nut proof load tests. Refer to Section 05120.
3. AISC, Simple Steel Bridge Structures (SBR) certification.
PART 2 PRODUCTS

2.1 MATERIALS

A. 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 according 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 anchor bolts. Refer to AASHTO M 232.
   e. Remove defects from galvanized steel threads to allow nuts to be free running by hand the entire length of threads.

B. Structural Steel – General
1. Hot dip galvanize all structural steel after fabrication. Refer to AASHTO M 111. Structural steel may be metalized using electric arc sprayed zinc wire as an alternative.
2. Refer to AWS D 1.1 for welding design and fabrication.
3. Refer to AASHTO M 232 for galvanized bolts, nuts, and washers. Use lock washers on all bolts that do not use direct-tension indicator washers.
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.

C. Structural Tubing and Associated Hardware
1. Use low carbon steel according to ASTM A 53 Grade B, ASTM A 500 Grade B, or API-5L-X42, except use chemical composition requirement of silicon either 0.00 to 0.04 percent or 0.15 to 0.25 percent. Refer to ASTM A 36, A 53 Grade B or A 500 Grade B (35,000 psi min yield strength) for other elements.
2. Structural tubing may be fabricated from structural steel according to the requirements of ASTM A 36 at the Contractor’s option provided the additional requirement for silicon content is met. Comply with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Sections 5.14 and 5.15 for dimensional tolerances, circumferential welded splices, and longitudinal seam welds.
3. Use high strength bolts, nuts, and washers at splice plates, mounting assemblies, and vertical supports attaching the sign and catwalk to the mounting assemblies. Refer to Section 05120.
4. Use direct-tension indicator washers at all splice plate connections. Refer to Section 05120.

D. All Other Structural Steel
   1. Refer to AASHTO M 270 Grade 36 for all other shapes and plates.
   2. Refer to ASTM F 593 Type 304 for stainless steel bolts.
   3. Refer to ASTM A 307 bolts, ASTM A 563 Grade A nuts, and ASTM F 844 washers for all other bolts, nuts, and washers.
   4. Refer to ASTM A 314, Class 304 for stainless steel machine screws 18-8 with round heads.
   5. Galvanize the entire sign assembly with mounting brackets. Refer to AASHTO M 111.

E. Non-shrink grout. Refer 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 of the size shown in the contract. Refer to ASTM B 221.

B. Steel
   1. Refer to this Section, Article 2.1 Paragraph D if approved by the Engineer.

2.3 FABRICATION

A. Refer to Section 05120.

B. The fabricator must have AISC, Simple Steel Bridge Structures (SBR) certification.

C. Provide hand holes for the overhead pipe frame on one side only.

D. 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.
PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility location.

B. Verify the roadway cross-section information, sign dimensions, and clearances shown in the plans 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 templates 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. Form 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 $\pm 0.02$ ft horizontal and vertical tolerances and establish base plate elevations according to the 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. Refer to Section 05120 for High Strength Bolt Installation.

H. 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.

I. Fill the void between the base plate and top of foundation with a non-shrink grout after completing the sign erection.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide boundary survey and plat.
B. Furnish and set right-of-way markers.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
B. Utah Code 17-23-17

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 RIGHT-OF-WAY MARKERS

B. Cast bronze cap – Free from defects and constructed as shown in GW Series Standard Drawings.

2.2 CONCRETE

A. Class B concrete according to Section 03055.
B. May substitute higher class of concrete.
PART 3 EXECUTION

3.1 RIGHT-OF-WAY MARKERS

A. Place right-of-way markers according to GW Series Standard Drawings. Stamp onto each right-of-way marker:
   1. Right-of-way marker number.
   2. Mark exact control point location to within 0.01 ft with center punch or “dimple.”

B. Tightly rivet cap to the pipe.

3.2 BOUNDARY SURVEY

A. Provide record of survey plat by Utah licensed surveyor.

B. File mylar copy of plat with county surveyor, region, and Department 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

WOOD FIBER MULCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of wood fiber mulch for seedbed protection and erosion control.

1.2 RELATED SECTIONS

A. Section 02922: Seed, Turf Seed, and Turf Sod

1.3 REFERENCES

Not Used

1.4 DEFINITIONS

A. Wood Fiber Mulch – A long-strand, whole wood fiber that is thermomechanically processed from clean whole wood chips capable of being hydraulically applied as a topdressing over seeded areas 2:1 and flatter or for temporary erosion protection on bare ground.

1.5 SUBMITTALS

A. Submit manufacturer’s product data and installation instructions for wood fiber mulch and tackifier.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver material and products in weather-resistant factory labeled packages showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 WOOD FIBER MULCH

A. Use mulch from the UDOT Approved List of Wood Fiber Mulches.
2.2  TACKIFIER

A.  General – Supply tackifiers that are:
   1.  Free from growth or germination inhibiting factors
   2.  Nonflammable
   3.  Nontoxic to aquatic organisms
   4.  Functional for a minimum of 180 days

B.  Tackifier A (Guar-based)
   1. Guar based product derived from the ground endosperm of the
      guar seeds (Cyamopsis tetragonolobus) and treated with
      dispersant agents.

C.  Tackifier B (Psyllium-based)
   1. Psyllium based product manufactured from the finely ground
      muciloid coating of Plantago ovata or Plantago ispaghula seeds.
   2. Will hydrate when incorporated in a water slurry and forms a firm,
      resilient, rewettable membrane on the soil surface.

D.  Tackifier C (Starch-based)
   1. Typically derived from corn or potatoes in a non-ionic, cold-water
      soluble (pre-gelatinized) granular form.

PART 3  EXECUTION

3.1  PREPARATION

A.  Complete all required grading, topsoil placement, and seeding before
    applying mulch. Do not include seed in the wood fiber mulch application.
    Verify the Engineer has provided written approval of seed incorporation.
    Refer to Section 02922.

B.  Apply wood fiber mulch within 24 hours after seeding or before
    precipitation falls. Replace eroded material if the mulch is not installed
    and a precipitation event occurs creating soil erosion. Rework the soil and
    reseed before applying the mulch.
3.2 WOOD FIBER MULCH APPLICATION

A. Apply wood fiber mulch with tackifier A, B, or C, and water at the following rates per acre:

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Fiber Mulch</td>
<td>2,000 lbs</td>
</tr>
<tr>
<td>Tackifier A or</td>
<td>50 lbs</td>
</tr>
<tr>
<td>Tackifier B or</td>
<td>100 lbs</td>
</tr>
<tr>
<td>Tackifier C</td>
<td>150 lbs</td>
</tr>
<tr>
<td>Water</td>
<td>5,000 gal</td>
</tr>
</tbody>
</table>

B. Mix water, tackifier, and wood fiber mulch in a hydroseeder according to the manufacturer’s directions.

C. Spray mulch slurry from multiple directions to form a uniform cover over the seeded areas.

D. Apply slurry to cover all disturbed areas.

E. Avoid overspray onto areas such as pavements, barriers, walls, and signs and remove any overspray from these surfaces before the slurry dries.

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. Contractor-furnished topsoil laboratory test results from each topsoil source to be used to the Engineer a minimum of seven working days before soil delivery.

PART 2    PRODUCTS

2.1 CONTRACTOR FURNISHED TOPSOIL

A. Determine PH, EC, and SAR with a saturated soil paste or 1:1 soil/water testing method. Meet the following:
   1. PH 6.0 to 8.0
   2. Electrical Conductivity (EC) Less than 4 ds/m
   3. Sodium Adsorption Ratio (SAR) Less than 10
B. Organic Matter
1. 1 to 20 percent.
2. Determined by the release upon combustion Walkley-Black or modified Walkley-Black testing method. Refer to AASHTO T 194.

C. Textural Classification
1. Loam, sandy loam, silt loam, or sandy clay loam not exceeding the percentiles in Table 1. Refer to Textural Triangle National Soils Handbook, Part 603-5.

Table 1

<table>
<thead>
<tr>
<th>Textural Classification</th>
<th>Soil Component</th>
<th>Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td>20 to 70</td>
</tr>
<tr>
<td></td>
<td>Silt</td>
<td>20 to 70</td>
</tr>
<tr>
<td></td>
<td>Clay</td>
<td>10 to 30</td>
</tr>
</tbody>
</table>

2. Determine particle size analysis by the hydrometer testing method.

D. Topsoil free of:
1. Subsoils (no B or C horizon soils)
2. Coarse sand and gravel
3. Stiff clay, hard clods, or hard pan soils
4. Rock larger than 3 inches in any dimension
5. Trash, litter, or refuse
6. Noxious weeds and weed seeds

E. Topsoil may contain a maximum of five percent rock smaller than 3 inches.

2.2 SOURCE QUALITY CONTROL – CONTRACTOR FURNISHED MATERIAL

A. Obtaining Soil Samples
1. Obtain soil samples while the Engineer is present. Provide no less than ½ lb per soil sample.
2. Obtain samples from a thin slice of soil cut from the side of a freshly dug hole or by using a soil auger or sampling tube.
3. Mix the several small samples taken from various places around the source together to produce a composite sample.
4. More than one composite sample may be required if the topsoil horizon changes significantly across the source.
5. Store samples in a clean container at room temperature and out of direct sunlight.
6. Label the location and date on each sample container.
7. Provide additional soil samples for verification if requested by the Engineer.
B. Soil Testing
1. Engineer will submit soil samples to an approved independent soil testing laboratory capable of performing the tests listed in this section, article 2.1. 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, UT  84322-4830
   (435) 797-2217
   http://www.udot.utah.gov/go/standardsreferences

   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 ft that require the placement of topsoil. Finish according to this Section, article 3.3, paragraph D.

C. Provide a suitable topsoil surface just before seeding on the remaining topsoiled areas not covered under this article, paragraph B. Obtain approval of the top soil surface from the Region Landscape Architect through the Engineer. Suitable topsoil surface is:
   1. Non-compacted and finished according to this Section, article 3.3.
   2. Weed free.
   3. Finish grade uniform surface with smooth transitions between grade changes and disturbed areas.
D. Do not strip or handle wet topsoil.

E. Establish finish grade at 1 inch below the top of all walks, curbs, mow strips, and other hard surfaces for areas receiving seed or turf seed and 1 ½ 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. Use 4 inches if no depth is indicated in the plans.

C. Disc or harrow the placed topsoil along the contour on slopes 3:1 and flatter or cat-track the slopes to create continuous cleat tracks that run parallel with the contours.

D. Cat-track slopes steeper than 3:1 to create continuous cleat tracks that run parallel with the contours.

END OF SECTION
SECTION 02922
SEED, TURF SEED, AND TURF SOD

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Seed, turf seed, and turf sod requirements and application.
B. Surface preparation.

1.2 RELATED SECTIONS
A. Section 02912: Topsoil

1.3 REFERENCES
A. Utah Seed Law

1.4 DEFINITIONS
Not Used

1.5 SUBMITTALS
A. 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 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. Fertilizer labels to Engineer.
E. Legible copy of Seed Certification Reports to Region Landscape Architect through the Engineer.
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)

G. Manufacturer’s directions on drill calibration to the Engineer two working days before seeding. Refer to this Section, article 3.3.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Mixing Seed
1. Notify Engineer seven calendar days before mixing seed.
2. Engineer will verify that the seed certification report or label represents the seed lot from which the seed is furnished.
3. Mix the different seed varieties to provide an even blend.
4. Bag the mixed seed, seal the container, and attach a signed Department label to the exterior.

B. Deliver seed or turf seed to job site in original containers showing analysis of seed mixture, net weight, and date and location of packaging. Damaged packages are not acceptable.

C. Strip turf sod from nursery no more than 24 hours before laying.

D. Deliver fertilizer in containers showing weight, chemical analysis, and name of manufacturer. Store fertilizer in a weatherproof location.

1.7 SCHEDULE

A. Pre-measure the area to be seeded before ordering seed from supplier. The Engineer must approve the measuring technique and determined quantity.
B. Seeding Window
1. Complete all general roadside seeding within the appropriate seeding window.
2. Postpone seeding until the following year if the seeding is not completed within the given window.
3. A late winter exception to the seeding window may be obtained from the Region Landscape Architect through the Engineer if suitable weather and soil conditions exist.

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Seeding Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 4,000 ft</td>
<td>October 1 – December 31</td>
</tr>
<tr>
<td>4,000 to 6,000 ft</td>
<td>September 15 – December 1</td>
</tr>
<tr>
<td>Above 6,000 ft</td>
<td>September 1 – November 15</td>
</tr>
</tbody>
</table>

C. Turf seed and turf sod can be placed only after irrigation system is installed and operational.

D. Topsoil
1. Refer to Section 02912.
2. Place topsoil just before seeding to eliminate competition from weeds.
3. Coordinate topsoil placement with the above seeding window.

PART 2 PRODUCTS

2.1 SEED AND TURF SEED

A. Meet the Utah Seed Law – Utah Code - Title 4, Chapter 16.

B. Supply seed on a pure live seed (PLS) basis.

C. Obtain seed from lots that have been tested by a state certified seed testing laboratory such as Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST).
   1. Seed germination test older than 18 months for grass seed and 9 months for shrub or tree seed are not acceptable.
   2. Based on the amount or type of seed required on a project, the Department may require additional testing by the Department of Agriculture.

D. Do not use wet, moldy, or otherwise damaged seed.

E. Seed Substitutions
   1. Contact the major seed brokers in the state to verify that the seed is unavailable before requesting a seed substitution.
2. 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 (turf sod and turf seed areas only)

A. Uniform in composition, dry, and free flowing.
   1. Turf seed or turf sod – Elemental nitrogen in granular form. Phosphorus and potassium are optional and may be applied with nitrogen in granules. Use a slow release form of a minimum 50 percent nitrogen such as sulfur coated urea or urea formaldehyde.
   2. Apply elemental nitrogen with a concentration ranging from 21-34 percent if hydoseeding method is used.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all final grading, irrigation work, trench settling, topsoil placement, and surface preparation before seed or sod application.

B. Prepare general seedbed for all seeded and sodded areas.
   1. Verify that a suitable topsoil surface has been prepared according to Section 02912 and approved by the Engineer before seeding.
   2. Do not work topsoil or seed when the soil is saturated or frozen.

C. Prepare Turf Seedbed
   1. Review finish grade to confirm that topsoil is 1 inch below the top of all walks, curbs, mow strips, and other hard surfaces.
   2. Apply fertilizer at the rate of 2 lb/100 yd² and mix thoroughly into upper 2 inches of topsoil.
   3. Do not apply fertilizer and seed at the same time in the same machine.
D. Prepare Turf Sod Surface
1. Review finish grade to confirm that topsoil is 1½ inch blow the top of all walks, curbs, mow strips, and other hard surfaces.
2. Apply fertilizer at the rate of 2 lb/100 yd² and mix thoroughly into upper 2 inches of topsoil.
3. Level and roll prepared areas using a 21 gal water-filled hand roller containing 8 to 10 gal of water.
4. Lightly rake and dampen with water the top ⅛ to ⅝ inches of soil just before laying the sod.

3.2 SEEDING – GENERAL

A. Notify the Engineer seven working days before seeding.

B. Apply seed at the rate indicated in the Seed Schedule shown in the plans. Note that drill seed and broadcast seed are applied at different rates.

3.3 DRILL SEEDING METHOD

A. Use the drill method of seeding on accessible slopes 3:1 and flatter.

B. Use a drill equipped with the following:
   1. Depth band
   2. Seed box agitator
   3. Seed metering device
   4. Furrow opener
   5. Packer wheels or drag chains

C. Use the drill manufacturer’s directions in the presence of the Engineer. Calibrate the drill to apply seed at the rate indicated in the seeding schedule.

D. Space drill rows a minimum of 6 inches and a maximum of 8 inches.

E. Fill the seed boxes no more than half full when drilling on a slope.

F. Set depth bands to drill seeds to a ½ inch depth.

G. Drill along the contour.

H. Maintain the drill at the calibrated setting throughout the seeding operation.

I. Allow the furrows that are created by the drill to remain.
3.4 BROADCAST SEEDING METHOD

A. Use the broadcast method of seeding under the following conditions:
   1. Slopes steeper than 3:1.
   2. Slopes 3:1 and flatter where the area to be seeded is inaccessible to drill.
   3. The area to be seeded is not large enough to justify using a drill.
   4. Rocky surface conditions will damage a drill.

B. Obtain approval of the broadcast method by demonstrating the procedure on a 100 yd² area.

C. Evenly broadcast seed using either:
   1. A cyclone seeder or other approved mechanical seeder.
   2. A hydroteeder.
      a) Apply seed, water, and 300 lb of cellulose fiber mulch (tracer) per acre.

D. Do not seed during windy weather or when soil is saturated.

E. Incorporate the seed into the soil by one of three methods:
   1. Cat-tracking by running the dozer up and down the slope creating continuous cleat tracks that run parallel with the contours.
   2. Hand raking the seed in ½ inch deep and along the contours of the slope.
   3. Slope chaining by pulling the chain along the contour until the seed is covered.

F. Obtain written approval from the Engineer that the seed has been adequately incorporated into the soil before applying wood fiber mulch, erosion control blanket, flexible growth medium, flexible channel liner, or other topdressing. Failure to obtain written approval will be justification for non-payment.

3.5 TURF SEEDING

A. Apply turf seed after seedbed preparation. Refer to this Section, article 3.4, paragraph C.

B. Roll seeded areas using a hand roller half filled with water.

C. Lightly water and program the irrigation system to maintain a moist seedbed.

D. Rope off newly seeded areas along walkways using bright plastic ribbon tape attached to stakes.
3.6 TURF SOD PLACEMENT

A. Timing
   1. Refer to this Section, article 1.6, paragraph C.

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 $\frac{1}{3}$ of the branches from any tree or shrub when obtaining poles and cuttings from vegetation that will remain within the right-of-way.

F. Supply poles and cuttings that meet the following size constraints:
   1. Pole – Cut branches at a 45 degree angle, 6 ft long and 1 to 3 inches in diameter from one to three-year-old growth.
   2. Willow Cutting – Cut stems at a 45 degree angle, 3 ft long, and $\frac{1}{3}$ to $\frac{3}{4}$ inch in diameter from one to two-year-old growth.

PART 3 EXECUTION

3.1 STORE
   A. Store dormant poles and cuttings acquired but not planted in the fall, until the ground thaws.
   B. Store in plastic bags at temperatures between 32 degrees F to 41 degrees F or outside in snow-filled plastic bags.
   C. Do not allow the poles or cuttings to dry out or break bud while being stored.

3.2 INSTALL
   A. Stake poles and cuttings at plan locations for approval or as directed.
   B. Create a hole deep enough to accommodate 90 percent of the length of the pole or cutting using an auger or water stinger.
   C. Remove 1 inch from the basal end of the pole or cutting just before planting.
   D. Place one pole or one cutting in the hole basal end first.
   E. Backfill and compact around the pole or cutting to eliminate air pockets.
   F. Water the pole or cutting and add more backfill if settling occurs.

END OF SECTION
SECTION 02932

TREES, SHRUBS, AND GROUNDCOVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing plant material.

1.2 RELATED SECTIONS

A. Section 02912: Topsoil

1.3 REFERENCES

A. ANSI Z 60.1: American Standard for Nursery Stock

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. 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 that do not meet ANSI specifications.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Secure required plants at a nursery within 60 calendar days from the Notice to Proceed.

B. Grow plants under full exposure to climatic conditions similar to those found on the project for a minimum of 60 calendar days.

C. Notify the Engineer at least 14 calendar days before delivering the plants to the site.

D. Deliver plant materials to the work site in covered vehicles just before placement.

E. Maintain delivered plants in a healthy condition.
   1. 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. Plants that do not meet requirements in this Section may be rejected at any time up to final acceptance.

B. Schedule a final plant inspection with the Region Landscape Architect through the Engineer after all plant material has been installed.

C. Make the required field adjustments and changes following the inspection.

1.9 SCHEDULE

A. Install irrigated plants using the following schedule:

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Planting Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 4,000 ft*</td>
<td>March 1 - December 1</td>
</tr>
<tr>
<td>4,000 to 6,000 ft</td>
<td>April 15 - October 15</td>
</tr>
<tr>
<td>Above 6,000 ft</td>
<td>May 1 - July 1</td>
</tr>
<tr>
<td>* No planting in July or August.</td>
<td></td>
</tr>
</tbody>
</table>

B. Install non-irrigated plants in the fall after the plant is dormant and before the ground freezes.
PART 2  PRODUCTS

2.1  PLANTS

A. Supply healthy plants of the species and size specified, true to form, free from disfiguring knots, sunscald, frost cracks, bark abrasions, and all forms of infestation and disease.

B. Provide legible labels attached to all plants, flats, bundles, or other containers indicating botanical genus, species, and size.

C. Supply trees with straight central leaders capable of standing upright without the support of stakes or guys.

D. Supply containerized plants with root systems fully established in the container.

E. Do not use balled and burlapped plants if the ball of earth surrounding roots has been cracked or broken or if the burlap is not secure.

F. Use bare-root plant material only with written approval by the Engineer.

PART 3  EXECUTION

3.1  PREPARATION

A. Verify that the area prepared to receive plants is graded properly according to the plan, all work is completed in the area, and that topsoil has been placed. Refer to Section 02912.

B. Install the irrigation system and have it fully operational before installing plants.

C. Stake or delineate plant locations for approval before installation.

3.2  INSTALLATION

A. General
   1. Install plants using the plan details.
   2. Water the plants within one hour of installation to saturate the rootball to a minimum of 4 inches below and around the plant hole.
      a. Add more backfill if settling occurs.
B. Containerized Plants
1. Excavate plant holes to twice the diameter and the same depth of the rootball.
2. Carefully remove the plant from its container, scarify the sides and bottom of the rootball if needed, and place it in the prepared hole.
3. Place excavated soil in 4 inch lifts around the rootball and eliminate voids by tamping the soil between each lift.

C. Balled and Burlapped Plants
1. Excavate plant holes to twice the diameter and the same depth of the rootball.
2. Gently place the plant in the prepared hole with burlap securely intact.
3. Reject mishandled or plants with broken root balls.
4. Carefully remove any wire baskets and the top half of the burlap without disturbing the root ball.

D. Tubeling Plants
1. Auger a hole the same size as the tube.
2. Gently place watered tubeling in the prepared plant pit immediately following excavation of the hole so that the roots are not tangled, compacted, or curled up at the ends.
3. Compress the soil at the base of the tubeling to eliminate voids between the rootball and existing soil.

3.3 CLEAN AND MAINTAIN

A. Remove foreign materials from site such as containers, burlap, and twine collected during installation.

B. Remove any tags, labels, or other items attached to the plant material after final plant inspection.

C. Water and maintain the plants in a healthy condition until the final plant inspection.

END OF SECTION
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
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 ISA.

1.6 QUALITY ASSURANCE
A. Contractor must provide an ISA certified arborist to supervise tree pruning.

PART 2 PRODUCTS

2.1 DISINFECTANT
A. Chlorine based
PART 3 EXECUTION

3.1 TREE PRUNING

A. Conform to ANSI Z 133.1.

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 Compliance
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 plan cross slope.
   2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
   3. Maximum of \( \frac{3}{8} \) 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 before opening to traffic. Meet environmental regulations according to Section 01355.

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 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 Compliance
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 ½ 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 before opening to traffic. Meet environmental regulations. Refer to Section 01355.

E. Remove and replace or repair damage by the Contractor’s operation outside 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.

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
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
   A. Profilograph information as required for smoothness testing. Refer to Section 01452.

PART 2 PRODUCTS

2.1 EQUIPMENT
   A. Provide and operate equipment utilizing diamond blades mounted on a self-propelled machine designed for grinding and texturing pavement.
   B. Do not use equipment that causes damage to the transverse or longitudinal joints.
   C. Use vacuuming equipment to remove residue and excess water.

PART 3 EXECUTION

3.1 GRIND
   A. Grind until the surface of both sides of the transverse joints and cracks are in the same plane and meet the required smoothness.
   B. Provide a uniform finished texture.
C. Perform grinding in a longitudinal direction. Begin and end grinding at lines normal to the pavement centerline.

D. Do not cause damage to the underlying surface of the pavement.

E. Provide resultant surface in a parallel, corrugated type texture consisting of grooves between 0.090 and 0.150 inches wide. Create a distance between the grooves of between 0.060 and 0.13 inches. Make peaks of the ridges approximately $\frac{1}{16}$ inch higher than the bottom of the grooves. Maintain cross slope drainage.

F. Provide uniform transverse slope of the pavement with no depressions or misalignment of slope greater than $\frac{1}{4}$ inch in 10 ft when tested with a 10 ft straightedge.

G. Do not grind structures.

H. All residue from the grinding process becomes property and responsibility of the Contractor.

3.2 SMOOTHNESS TESTS

A. Refer to Section 01452.

END OF SECTION
SECTION 02982
BRIDGE CONCRETE GRINDING

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Procedure for grinding new concrete bridge decks, approach slabs, and sleeper slabs for precast concrete deck panel systems.

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 surface until both sides of all joints are in the same plane and the entire surface, including the sleeper slab to roadway interface, meets the smoothness tolerances for Portland Cement Concrete Pavement (PCCP) according to this Section and Section 01452.

1. Cure shear stud blockout locations for 24 hours before grinding.
2. Meet the straight-edge requirements after grinding for all locations.
3. Limit grinding to a maximum depth of 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, approach slabs, or sleeper slabs. Any damage will be repaired at the Contractor’s expense.

E. Create a surface in a parallel, corduroy-type texture consisting of grooves between $\frac{1}{16}$ and $\frac{1}{4}$ inches wide. Use a distance between the grooves of between $\frac{1}{16}$ and $\frac{1}{4}$ inches.
   1. Limit height of ridges to $\frac{1}{16}$ inch.

F. Maintain cross slope drainage.

G. Provide uniform transverse and longitudinal slope of the concrete deck according to Section 01452 for PCCP.

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: Fine Aggregate for Portland Cement Concrete
B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete
C. AASHTO M 85: Portland Cement
D. AASHTO M 154: Air-Entraining Admixtures for Concrete
E. AASHTO M 157: Ready-Mixed Concrete
F. AASHTO M 194: Chemical Admixtures for Concrete
G. AASHTO M 295: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
H. AASHTO M 307: Silica Fume Used in Cementitious Mixtures
I. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by the Maturity Tests
J. ASTM C 150: Portland Cement
K. ASTM C 595: Blended Hydraulic Cements
L. ASTM C 1157: Hydraulic Cement
M. ASTM C 1567: Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Mix design for all class A(AE) and AA(AE) concrete to be used.
   1. Mix designs will be approved based on results of:
      a. Trial batches
      b. History from Department projects
   2. Use the same components in the trial batches that will be used in the project. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required. The Contractor assumes responsibility for the compatibility of all admixtures with the mix design and their potential effects on concrete properties.
   3. Personnel performing and witnessing trial batches and performing compressive and flexural strength testing must be Department TTQP Concrete and Concrete Strength Testing qualified.
   4. The Department or its representative may witness the trial batch.
   6. Compressive and flexural strength testing for verification of trial batches will be performed by an AASHTO accredited laboratory, approved through the Department Laboratory Qualification Program.

B. Test results verifying the coarse and fine aggregate used according to this Section, article 2.3.

C. Test results for any proposed mix design for potential reactivity of coarse and fine aggregates according to the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

D. Test results to determine the ability of the combinations of cementitious materials and aggregates to control the reactivity when using potentially reactive aggregates in a mix design.
E. Verification that cement used is from a pre-qualified supplier. Refer to this Section, article 2.2, paragraph E.

F. Written plan for admixtures. Refer to this Section, article 2.5, paragraph C.

F. Verification that fly ash or other pozzolan used is from a pre-qualified supplier. Refer to this Section, article 2.6, paragraph D.

G. Verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

H. Cold and hot weather plans.

1.6 ACCEPTANCE

A. Acceptance is according to UDOT Minimum Sampling and Testing Requirements.

B. The Department may accept the item at a reduced price when concrete is below specified strength and does not have a separate strength pay factor.
   1. The pay factor will be applied to the quantity of the bid item that is represented by the strength tests that fall below a specified strength.
   2. Department will calculate the pay factor using Table 1 based on 28 day compressive strength.

<table>
<thead>
<tr>
<th>Price Reduction for 28 Day Compressive Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psi below Specified Strength</td>
</tr>
<tr>
<td>Pay Factor</td>
</tr>
<tr>
<td>1-100</td>
</tr>
<tr>
<td>101-200</td>
</tr>
<tr>
<td>201-300</td>
</tr>
<tr>
<td>301-400</td>
</tr>
<tr>
<td>More than 400</td>
</tr>
</tbody>
</table>

3. The Engineer may accept a “reject” lot based on an engineering analysis and concurrence from the Region Materials Engineer. Apply a pay factor of 0.50 if a reject lot is allowed to remain in-place.
PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Refer to the requirements in Table 2.

Table 2
Concrete Classes and Mix Requirements

<table>
<thead>
<tr>
<th>Class</th>
<th>Coarse Aggregate or Sieve Size</th>
<th>Max. Water/Cementitious Ratio</th>
<th>Min. Cementitious Content (lb/yd³)</th>
<th>Max. Slump (Inch)</th>
<th>Air Content Percent (%)*</th>
<th>Mix Design Compressive Strength f’cr (Psi)</th>
<th>28 Day Minimum Compressive Strength f’c (Psi)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA(AE)</td>
<td>2” to No. 4</td>
<td>0.44</td>
<td>564</td>
<td>3.5</td>
<td>4.0 - 7.0</td>
<td>5,200</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>1½” to No. 4</td>
<td>0.44</td>
<td>564</td>
<td>3.5</td>
<td>4.5 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>1” to No. 4</td>
<td>0.44</td>
<td>611</td>
<td>3.5</td>
<td>5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>¾” to No. 4</td>
<td>0.44</td>
<td>611</td>
<td>3.5</td>
<td>5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
</tr>
<tr>
<td>A(AE)</td>
<td>1-½” to No. 4</td>
<td>0.53</td>
<td>470</td>
<td>3.5</td>
<td>4.5 - 7.5</td>
<td>3,900</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>1” to No. 4</td>
<td>0.53</td>
<td>470</td>
<td>3.5</td>
<td>4.5 - 7.5</td>
<td>3,900</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>¾” to No. 4</td>
<td>0.48</td>
<td>517</td>
<td>3.5</td>
<td>4.5 - 7.5</td>
<td>3,900</td>
<td>3,000</td>
</tr>
<tr>
<td>B or B(AE)</td>
<td></td>
<td>0.62</td>
<td>376</td>
<td>5</td>
<td>--</td>
<td>3,250</td>
<td>2,500</td>
</tr>
</tbody>
</table>

* Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.

** For f’c over 4,000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria.

B. Maximum nominal size of coarse aggregate:
1. Not larger than 1/5 the narrowest dimension between sides of forms.
2. Not larger than ⅓ the depth of slabs.
3. Not larger than ¾ the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.

C. Do not exceed water/cementitious ratio.
1. Calculate the water/cementitious ratio (w/c) according to the following formula:
   \[
   \frac{W}{C} = \frac{\text{Water}}{\text{Cement + Pozzolan}}
   \]

D. Do not exceed 30 percent total pozzolan in any mix unless approved or otherwise specified.

E. Use 94 lb additional cementitious material per cubic yard for concrete deposited in water.
F. Use Table 2 to determine the slump requirements when not using water-reducing admixtures.
1. Slump requirements when using low range water reducers –
   Maximum of 5 inches for all classes of concrete.
2. Slump requirements when using high range water reducers –
   Maximum of 9 inches for all classes of concrete.

2.2 CEMENT

A. Use Type II portland cement or blended hydraulic cement unless
   otherwise specified. Refer to ASTM C 150, ASTM C 595, ASTM C 1157.

B. Portland Cement
   1. Refer to Tables 1 and 3 in ASTM C 150.
   2. Refer to Table 2 in ASTM C 150 for low-alkali cement.

C. Blended Hydraulic Cement
   1. Blended hydraulic cement substituted for portland cement:
      a. Use ASTM C 1567 to verify that expansion is less than 0.1
         percent 14 days after the zero reading.
      b. Refer to the equivalent cements listed in Table 3.
   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>
<thead>
<tr>
<th>Portland Cement/Blended Hydraulic Cement Equivalencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO M 85</td>
</tr>
<tr>
<td>(Low Alkali)</td>
</tr>
<tr>
<td><strong>ASTM C 595</strong></td>
</tr>
<tr>
<td><strong>ASTM C 1157</strong></td>
</tr>
<tr>
<td><strong>Type I</strong></td>
</tr>
<tr>
<td>IP</td>
</tr>
<tr>
<td>GU</td>
</tr>
<tr>
<td><strong>Type II</strong></td>
</tr>
<tr>
<td>IP (MS)</td>
</tr>
<tr>
<td>MS</td>
</tr>
<tr>
<td><strong>Type III</strong></td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>HE</td>
</tr>
<tr>
<td><strong>Type V</strong></td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>HS</td>
</tr>
</tbody>
</table>

* Use only when specified

D. Do not use cement that contains lumps or is partially set.

E. Use cement from the list of Department qualified suppliers list maintained
   by the Department Materials Quality Assurance Section.

F. Do not mix cements originating from different sources.

G. Do not use air-entrained cement.
H. Department will sample and test the cement according to UDOT Quality Management Plan 502: Cement.

2.3 AGGREGATE

A. Coarse Aggregate for Normal Concrete Mixes
   1. Use coarse aggregate that meets AASHTO M 80 physical properties. Use one of the gradations in Table 4.
   2. Do not exceed percentages of deleterious substances as specified in AASHTO M 80, Table 2, for Class A aggregates.

<table>
<thead>
<tr>
<th>Aggregate or Sieve Size (inches)</th>
<th>2½</th>
<th>2</th>
<th>1½</th>
<th>1</th>
<th>¾</th>
<th>½</th>
<th>¼</th>
<th>No. 4</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>35-70</td>
<td>10-30</td>
<td>0-5</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1½ to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>35-70</td>
<td>10-30</td>
<td>0-5</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>25-60</td>
<td>0-10</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¾ to No. 4</td>
<td>100</td>
<td>90-100</td>
<td>20-55</td>
<td>0-10</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Fine Aggregate for Normal Concrete Mixes
   1. Use fine aggregate that meets AASHTO M 6 physical properties. Use the gradation in Table 5.
   2. Do not exceed percentages of deleterious substances as specified in AASHTO M 6, Table 2, for class A aggregates, using option “b” for material finer than the No. 200 sieve.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>45 to 80</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 to 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 to 3.0</td>
</tr>
</tbody>
</table>

2.4 WATER

A. Use potable water or water that meets ASTM C 1602, including Table 2.

B. Screen out extraneous material when pumping water from areas such as streams, ponds, and lakes.
2.5 **ADMIXTURES**

A. Do not use calcium chloride.

B. Air Entrainment according to AASHTO M 154, including Section 5.

C. Water Reducing Agents
   1. Refer to AASHTO M 194.
   2. 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.

D. Accelerators – Refer to AASHTO M 194.

E. Set Retarding Admixtures – Refer to 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.

F. Site-added air-entrainment – Refer to AASHTO M 154.
   1. Limit the use of site-added air-entraining agents to one addition per load, regardless of quantity.
   2. Use pre-measured admixtures.
   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 according to AASHTO M 295 except table 2.
      a. Loss on Ignition (LOI) Not to exceed 3 percent.
      b. Allowable CaO content Not to exceed 15 percent.
      c. Use fly ash from the list of Department pre-qualified sources maintained by Department Central Materials.
d. Label the storage silo for fly ash to distinguish it from cement.
e. 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. Refer to AASHTO M 295.
2. May use instead of fly ash provided that the expansion does not exceed 0.1 percent. Refer to ASTM C 1567.


D. Use pozzolan from the list of Department qualified suppliers list maintained by the Department Central Materials.

E. Department will sample and test the pozzolan according to the UDOT Quality Management Plan 507: Flyash and Pozzolan.

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 not be accepted more than 30 days before use.
5. Provide separate stockpiles for coarse and fine aggregates.
6. Construct stockpiles to minimize segregation of aggregates.
7. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

3.2 BATCH MATERIALS

A. Refer to 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, 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. Design mixes to meet the requirements of this Section and project specific criteria.

B. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
   1. Use at least 20 percent by weight of the total cementitious system when using fly ash.

C. Use only concrete mixes that have been approved by the Region Materials Engineer.

D. Obtain concurrence from the Resident Engineer for the project specific application of an approved mix.

3.4 LIMITATIONS – GENERAL

A. Timing – Place concrete as follows unless otherwise specified:
   1. Within 90 minutes of batching when the air temperature is below 80 degrees F.
   2. Within 75 minutes of batching when the air temperature is between 80 and 85 degrees F.
   3. Within 60 minutes of batching when the air temperature is above 85 degrees F.
   4. Before initial set.

B. Concrete Temperature – Place concrete when the concrete temperature is between 50 and 90 degrees F unless otherwise specified.

C. Pumping and Conveying Equipment
   1. Do not use equipment or a combination of equipment and the configuration of that equipment that causes a loss of entrained air content that exceeds ½ of the range of air content allowed by specification.
   2. Contractor is responsible for verification and monitoring of air loss.

D. Cold Weather – Comply with the following regulations for placing concrete when the temperature is forecast to fall below 40 degrees F within 14 days of placement.
1. Determine the concrete temperature with a surface thermometer insulated from surrounding air.
2. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 36 degrees F and ambient temperature is ascending.
3. Cease operations when the ambient temperature is 45 degrees F and decreasing unless adequate precautions are taken and approved by the Engineer.
4. Do not place during adverse weather including rain, snow, and high winds without adequate protection approved by the Engineer.
5. Do not use chemical anti-freeze additives in the concrete. This does not apply to normal accelerators. Refer to AASHTO M 194.
6. Provide all necessary cold weather protection for placing operations and in-place concrete such as cover, insulation, and heat.
7. 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.
8. Adequately vent combustion-type heaters that produce carbon monoxide.
   a. Position heaters and ducts so the hot dry air does not cause areas of the concrete surface to overheat or dry.
9. Maintain moist conditions to avoid excessive loss of moisture from the concrete when applying external heat.
10. Limit the drop in temperature of concrete surfaces to 20 degrees F during any 12 hour period when removing heat until the surface temperature of the concrete reaches that of the atmosphere.
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.

E. Hot Weather – Cool all surfaces that will come in contact with the concrete to below 95 degrees F.

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 03056
SELF-CONSOLIDATING CONCRETE (SCC)

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Materials and procedures for producing self-consolidating concrete.

1.2 RELATED SECTIONS
A. Section 03055: Portland Cement Concrete

1.3 REFERENCES
A. AASHTO M 6: Fine Aggregate for Portland Cement Concrete
B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete
C. AASHTO TP 73: Slump Flow of Self-Consolidating Concrete (SCC)
D. AASHTO TP 74: Passing Ability of Self-Consolidating Concrete (SCC) by J-Ring
E. AASHTO TP 80: Visual Stability Index (VSI) of Self-Consolidating Concrete (SCC)
F. ASTM C 494: Chemical Admixtures for Concrete
G. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete
H. ASTM C 1610: Static Segregation of Self-Consolidating Concrete Using Column Technique
I. American Concrete Institute (ACI) Standards
J. UDOT Materials Manual of Instruction
K. UDOT Minimum Sampling and Testing Requirements
L. UDOT Quality Management Plans
1.4 DEFINITIONS

A. Self-Consolidating Concrete (SCC) – A highly flowable and non-segregating concrete mixture that spreads into place, is able to flow and fill all corners of the formwork, even in the presence of congested reinforcement by means of its own mass with no mechanical vibration.

1.5 SUBMITTALS

A. Mix design for each mixture to the Engineer for approval before use.
   1. Mix designs will be approved based on results of trial batches or on history from Department projects within the last year.
   2. Use the same components in the trial batches that will be used in the project. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required. The Contractor assumes responsibility for the compatibility of all admixtures with the mix design and their potential effects on concrete properties.
   3. Personnel performing and witnessing trial batches and performing compressive and flexural strength testing must be Department TTQP Concrete and Concrete Strength Testing qualified.
   4. The Department or its representative may witness the trial batch.
   6. Compressive strength testing for verification of trial batches will be performed by an AASHTO accredited laboratory, approved through the Department Laboratory Qualification Program.

B. Test results verifying the coarse and fine aggregate used meets this Section, article 2.3.
   1. Meet the operating bands shown in Table 2.

C. Product data and manufacturer's recommendations for use for the Viscosity Modifying Admixture (VMA).

D. Test results for any proposed mix design for potential reactivity of coarse and fine aggregates according to the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

E. Results from appropriate testing to determine the ability of the combinations of cementitious materials and aggregates to control the reactivity when using potentially reactive aggregates in a mix design.

F. Verification that cement used is from a pre-qualified supplier. Refer to this Section, article 2.2.
G. Verification that fly ash or other pozzolan used is from a pre-qualified supplier. Refer to this Section, article 2.6.

H. Verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

I. Cold and hot weather plans according to this Section, article 3.5 Limitations.

J. The Materials Engineer approves submittal.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material according to UDOT Minimum Sampling and Testing Requirements.

B. Refer to this Section, Part 2.

C. Concrete below specified strength and the item does not have a separate strength pay factor.
   1. The Department may accept item at a reduced price.
   2. The pay factor will be applied to items represented by the strength tests that fall below the specified strength.
   3. The Department will calculate the pay factor on 28 day compressive strength. Refer to Table 1.

Table 1

<table>
<thead>
<tr>
<th>28 Day Compressive Strength</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psi Below Specified Strength</td>
<td></td>
</tr>
<tr>
<td>1 – 100</td>
<td>0.95</td>
</tr>
<tr>
<td>101 – 200</td>
<td>0.90</td>
</tr>
<tr>
<td>201 – 300</td>
<td>0.85</td>
</tr>
<tr>
<td>301 – 400</td>
<td>0.80</td>
</tr>
<tr>
<td>More than 400</td>
<td>Reject</td>
</tr>
</tbody>
</table>

4. The Engineer may allow a “reject” lot to remain in place based on an engineering analysis and concurrence from the Materials Engineer. Apply a pay factor of 0.50 if a rejected lot is allowed to remain in place.
PART 2  PRODUCTS

2.1  MIX REQUIREMENTS

A.  Air content – 5.0 percent to 7.5 percent

B.  Slump Flow – 18 to 32 inches. Refer to AASHTO TP 73.

C.  Compressive Strength
   1.  AA(AE) compressive strength requirements unless otherwise specified. Refer to Section 03055.

D.  Visual Stability Index rating 0 – 1. Refer to AASHTO TP 80.

E.  Static Segregation – less than 10 percent. Refer to ASTM C 1610.

F.  Maximum nominal size of coarse aggregate:
   1.  Not larger than $\frac{1}{5}$ of the narrowest dimension between sides of forms.
   2.  Not larger than $\frac{1}{3}$ the depth of slabs.
   3.  Not larger than $\frac{3}{4}$ of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least.

G.  Do not exceed water/cementitious ratio of 0.40.

H.  Calculate the water/cementitious ratio (w/c) according to the following formula:

$$\frac{W}{C} = \frac{\text{Water}}{\text{Cement} + \text{Pozzolan}}$$

2.2  CEMENT

A.  Refer to Section 03055.

2.3  AGGREGATES

A.  Use Coarse Aggregate according to AASHTO M 80 physical properties and the combined gradation requirements of Table 2.
   1.  Do not exceed percentages of deleterious substances as shown in AASHTO M 80, Table 2, for Class A aggregates.
B. Use Fine Aggregate according to AASHTO M 6 physical properties and the combined gradation requirements of Table 2.

1. Do not exceed percentages of deleterious substances according to AASHTO M 6 for class A aggregates, using class B for material finer than the No. 200 sieve.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>¾ inch Operating Bands</th>
<th>½ inch Operating Bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ inch</td>
<td>95 – 100</td>
<td>–</td>
</tr>
<tr>
<td>½ inch</td>
<td>65 – 95</td>
<td>95 – 100</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>58 – 83</td>
<td>65 – 95</td>
</tr>
<tr>
<td>No. 4</td>
<td>35 – 65</td>
<td>50 – 80</td>
</tr>
<tr>
<td>No. 8</td>
<td>25 – 50</td>
<td>30 – 60</td>
</tr>
<tr>
<td>No. 16</td>
<td>15 – 35</td>
<td>20 – 45</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 – 35</td>
<td>12 – 35</td>
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<tr>
<td>No. 50</td>
<td>5 – 20</td>
<td>5 – 20</td>
</tr>
<tr>
<td>No. 100</td>
<td>1 – 12</td>
<td>2 – 12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 – 5</td>
<td>0 – 5</td>
</tr>
</tbody>
</table>

2.4 WATER

A. Use potable water or water according to ASTM C 1602, including Table 2.

2.5 ADMIXTURES

A. Refer to Section 03055

B. Viscosity Modifying Admixtures (VMA) according to ASTM C 494, Type S.

1. Do not exceed manufacturer recommendations for the use of the viscosity modifying admixture.

2. Show the amount of admixture used on batch tickets.

3. Site-added VMA – Record amount used on batch ticket.

2.6 POZZOLAN

A. Refer to Section 03055.
PART 3 EXECUTION

3.1 PREPARATION

A. Refer to Section 03055.

3.2 FIELD PRODUCTION TEST PLACEMENT

A. Perform a test placement of the designed SCC mix in the presence of all Department and Contractor personnel involved with the placement.

B. Demonstrate appropriate quality tests and associated procedures during test placement including, but not limited to temperature, slump flow, air content, casting strength specimens, and Passing Ability of SCC by J-ring. Refer to AASHTO TP 74. Meet the requirements of this Section, Part 2.

3.3 BATCHING MATERIALS

A. Refer to Section 03055.

3.4 MIX DESIGN

A. Design and proportion mix according to ACI 301 and project specific criteria.

B. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
   1. Use a minimum of 20 percent by weight of the total cementitious system when using fly ash.

C. Use only concrete mixes that have been approved. The Engineer may allow adjustments to sand/aggregate ratios to maintain the combined gradation.

D. Obtain concurrence from the Resident Engineer for the project specific application of an approved mix.

3.5 LIMITATIONS – GENERAL

A. Refer to Section 03055 with the following exception:
   1. Concrete Temperature – Place concrete when the concrete temperature is between 60 and 90 degrees F unless otherwise specified.
3.6 CYLINDER STORAGE DEVICE

A. Refer to Section 03055.

END OF SECTION
SECTION 03139

CONCRETE BRIDGE DECK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for bridge deck removal, use of reinforcing and shear connectors in conjunction with the planned replacement of the bridge deck, materials, and equipment to complete the work as shown on the plans.

B. Requirements for protecting adjacent travelways, property, and the environment.

C. This specification does not apply to bridge deck removal where the supporting structure is not salvaged.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

1.3 REFERENCES

A. AASHTO/AWS D1.5 Bridge Welding Code

B. AASHTO LFRD Bridge Construction Specifications

C. AASHTO Manual for Bridge Evaluation

1.4 DEFINITIONS

A. Minor dents – Less than ½ inch deep.

B. Minor nicks – Less than ¼ inch deep.

C. Minor spalls – Less than 1½ inch deep.

D. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.

1. Working drawings do not supersede the contract drawings.
E. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings

1. Detailed demolition plan depicting the proposed methods of deck removal for approval before starting the deck removal.
   a. Include the following:
      1) A written sequence of the specific steps for demolition.
      2) A work area plan depicting items such as utilities overhead and below the work area, drainage inlet structures, and protective measures.
      3) Details of all equipment that will be used for the deck removal. Pay special attention to the methods of removing the deck directly over the girders and adjacent to the remaining expansion joints so that no damage occurs during the removal.
      4) Details of all equipment used to lift large portions of the deck such as cranes, excavators, lifting slings, sling hooks, and jacks. Include crane locations, operation radii, and lifting calculations.
      5) Details of debris shields used to protect adjacent travel ways, property, utilities, and areas of the environment specified for protection.
      6) Details of debris protection and containment including calculations for containment structures.
      7) Calculations that demonstrate the satisfactory stability and strength of the bridge under all anticipated loads and removal methods. Account for the loss of composite action as the bridge deck is being removed.
      8) Procedures for repairing the girder top flange if damage such as nicks, dents, and spalls occurs. Refer to this Section, article 3.5 for guidelines.
      9) Weld repair procedure that meets the requirements of AASHTO/AWS D1.5 Bridge Welding Code, including weld testing requirements and grinding requirements.
     10) Methods of debris disposal from the deck removal including final disposal site.
b. Comply with all requirements of applicable environmental permits, local, state, and federal requirements.

c. Comply with all construction timeframes specified in Section 01544.

d. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.

e. Include supporting engineering calculations.

f. Do not begin work until receiving approval of the demolition plan.

2. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number

   b. Revise and resubmit drawings when directed by the Department.

   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

3. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number

   b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.

   c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
4. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

5. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

PART 2 PRODUCTS

2.1 ACCEPTABLE EQUIPMENT

A. Sawcutting
   1. Use saws capable of cutting through concrete and reinforcing steel.
   2. Use water to facilitate the cutting operation.

B. Hydraulic Breakers
   1. Do not use a hydraulic breaker with a blunt tip in the vertical direction within six inches of a bridge girder or underlying structure walls that will remain.
   2. Use wide, cross-cut chisel bits oriented on a flat angle over steel girder flanges to remove concrete and shear connectors if it will not cause damage to the girder.
   3. Specialized pavement removal buckets may be used to lift sections of slabs that have been pre-cut.

C. Pneumatic Hammer
   1. Pneumatic hammers may be used to remove concrete over beams if they will not cause damage to the girder.

D. Hand Held Cutting Tools
   1. Use cutting torches of varying types to cut existing reinforcing and shear connectors that are specified to be removed as applicable.
   2. Use hand-held grinding equipment to remove portions of shear connectors.

E. Other Equipment
   1. Do not use other equipment unless stated in the demolition plan and approved by the Engineer.
PART 3 EXECUTION

3.1 BRIDGES OVER ROADWAYS AND RAILROADS

A. Provide the necessary workers, materials, and equipment at the site to complete the removal work in an expeditious manner before closing the roadway to traffic to accommodate the deck removal.

B. Comply with all Maintenance of Traffic specifications.

C. Coordinate all work with Railroad. Provide railroad flaggers as required.

D. Pursue work promptly without interruptions while the roadway is closed to public traffic. Protect the pavement and structures below the deck removal operations from falling debris.

E. Install protective debris shields as shown in the demolition plan.

F. Repair damage to girders, framing, utilities, adjacent travel ways, and property at no additional cost to the Department.

3.2 BRIDGES OVER ENVIRONMENTALLY SENSITIVE AREAS

A. Provide the necessary equipment and shielding to prevent debris from falling into the area below the bridge. This includes the collection of water used during deck removal.

B. Locate cranes away from sensitive areas as specified in the project environmental documents.

C. Install protective debris shields as shown in the demolition plan.

D. Repair damage to girders, framing, utilities, adjacent travelways, property, and environmental areas specified for protection at no additional cost to the Department.

3.3 DECK REMOVAL

A. Saw cut through the full thickness of the deck after bridge closure.
   1. Continuously monitor the extension of the saw blade from under the deck during the cutting operation to prevent cutting into the top of the flange of the girders.
   2. Maintain radio or visual contact between the monitoring personnel and the cutting crew.
B. Limit the depth of longitudinal and transverse saw cuts above the girder top flange to just below the bottom mat of reinforcing steel but no closer than 2 inches to the flange.

C. Lift slab sections using cranes or pavement removal buckets mounted on hydraulic excavators.

D. Remove the concrete over the girder flange on steel girder bridges with hand operated pneumatic hammers or hydraulic breakers equipped with a wide cross cut chisel bit set to a flat angle to shear off the shear connectors.
   1. Provide alternate methods of concrete removal over the girders to the Engineer for approval.
   2. Modify the removal process if any damage occurs to the top flange.

E. Remove the concrete over the girder on concrete girder bridges with hand operated pneumatic hammers.
   1. Use 50 lb or smaller chipping hammers within six inches of the girder flange edge.

F. Be careful to not damage the top flanges during full-depth concrete deck removal over steel beams or girders that are to remain.
   1. Repair any damage to the top flange according to the demolition plan at the Contractor’s expense.

3.4 REPAIR DAMAGED FLANGES

A. Repair damaged girder top flanges according to the demolition plan. Use the following to develop the repair procedures:
   1. Simple Span Steel Girder Bridges
      a. Do not repair minor dents and nicks in the top flange as defined in this Section, article 1.4.
      b. Repair the following according to the method described in the demolition plan.
         1) Bent flanges if damaged beyond defined limits.
         2) Nicks and gouges if damaged beyond defined limits.
      c. Repair any bent transverse vertical stiffeners of connection plates.
      d. Remove a sufficient amount or all of the connectors to allow placement of the new deck.
      e. Repair sawcuts according to the method defined in the demolition plan.
      f. Develop special repair procedures for situations not defined in the demolition plan and obtain approval before starting the repair procedure.
2. Continuous Multi-span Steel Girder Bridges
   a. Show negative moment regions and positive moment regions on the plans.
   b. Treat the positive moment region areas as simple span bridges.
   c. Treat negative moment regions as follows:
      1) Do not repair minor dents.
      2) Repair bent flanges if damaged beyond defined limits.
      3) Repair any bent transverse vertical stiffeners of connection plates.
      4) Repair all nicks, gouges, and sawcuts in the top flange in negative moment regions.
         a) Grind out nicks that are less than ¼ inch deep by grinding in a direction parallel to the girder span.
         b) Repair deeper nicks, gouges, and sawcuts by procedures defined in the demolition plan.
      5) Remnants of the shear connectors may be left in place.
      6) Remove a sufficient amount or all of the connectors to allow for placement of the new deck.
      7) Develop special repair procedures for situations not defined in the demolition plan and obtain approval before starting the repair procedure.

3. Concrete Girder Bridges
   a. Do not repair minor spalls in the top flange provided that the area is to be filled with concrete or grout in the completed bridge deck.
   b. Repair large spalls using an approved patching material.
   c. Repair any cracks in the top flange using epoxy injection crack repair methods.
   d. Do not repair saw cuts that are less than ¼ inch deep.
   e. Repair saw cuts that are deeper than ¼ inch by chipping out the area and patching with an approved patching material.
   f. Report any damage beyond these limits to the Engineer.
      1) Develop special repair procedures for situations not defined in the demolition plan and obtain approval before starting the repair procedure.

END OF SECTION
SECTION 03152
CONCRETE JOINT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joint Filler and Joint Sealer
B. Waterstops

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
B. AASHTO M 213: Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
C. AASHTO M 324: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
D. AASHTO LRFD Bridge Construction Specifications
E. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete
F. ASTM C 509: Elastomeric Cellular Preformed Gasket and Sealing Material
G. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
H. ASTM D 794: Practice for Determining Permanent Effect of Heat on Plastics
I. ASTM D 1084: Viscosity of Adhesives
J. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
K. ASTM D 1622: Apparent Density of Rigid Cellular Plastics
L. ASTM D 1623: Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

M. ASTM D 2240: Rubber Property-Durometer Hardness

N. ASTM D 2628: Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

O. ASTM D 3569: Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements

P. ASTM D 5329: Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt and Portland Cement Concrete Pavements

Q. Federal Specifications

R. Military Specifications (MIL)

1.4 DEFINITIONS  Not Used

1.5 SUBMITTALS

A. Manufacturer’s certifications of compliance, product data, specifications, and recommended installation instructions.

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 before submitting the individual production lot.

C. Department evaluation requirements for any joint seal geometry are:
   1. Overall width of sealer – minimum \( \frac{7}{16} \) inch.
   2. Overall depth of sealer – maximum 1 inch when compressed to \( \frac{7}{32} \) inch.
   4. Maintain the force-deflection requirements in Table 1.
Table 1  

<table>
<thead>
<tr>
<th>Force Deflection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection Condition</td>
<td>Force Requirement</td>
</tr>
<tr>
<td>Seal compressed to $\frac{3}{4}$ inch width</td>
<td>2 lb/inch minimum</td>
</tr>
<tr>
<td>Seal compressed to $\frac{7}{32}$ inch width</td>
<td>12 lbs/inch maximum</td>
</tr>
</tbody>
</table>

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 meet the requirements in Table 2.

Table 2  

<table>
<thead>
<tr>
<th>Force Deflection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection Condition</td>
<td>Force Requirement</td>
</tr>
<tr>
<td>Seal compressed to $\frac{3}{4}$ inch width</td>
<td>1 lb/inch minimum</td>
</tr>
<tr>
<td>Seal compressed to $\frac{7}{32}$ inch width</td>
<td>12 lbs/inch maximum</td>
</tr>
</tbody>
</table>

D. Use a one-component, polychloroprene, 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, and date of manufacture.

E. Department may sample and test materials after delivery to the project site.

2.2 HOT Poured Joint Sealant

A. Refer to AASHTO M 324 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. Silicone joint sealer and special category for self-leveling.
   1. Both made of low-modulus silicone specifically formulated to seal portland cement concrete pavement joints.

B. Furnish in a one-part, non-acid curing formulation. Refer to ASTM C 309.

C. Meet the 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.

D. Meet the test requirements in Tables 3 and 4.
<table>
<thead>
<tr>
<th>Test Requirement</th>
<th>Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Stress –150 percent max elongation, 7-day cure at 77 ± 3 degrees F and 45-55 percent relative humidity (rh).</td>
<td>45 psi ASTM D 412 (DIE C)</td>
</tr>
<tr>
<td>Flow</td>
<td>0.3 inch maximum MIL-S-8802</td>
</tr>
<tr>
<td>Extrusion Rate 100 degrees to 0 degrees F</td>
<td>0.2 - 0.6 lbs/min MIL-S-8802</td>
</tr>
<tr>
<td>Tack-Free Time</td>
<td></td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.01 - 1.515 MIL-S-8802</td>
</tr>
<tr>
<td>Durometer Hardness, shore A – cured 7 days at 77 ±3 degrees F and 45-55 percent relative humidity (rh).</td>
<td>10-25 (0 degrees F) ASTM D 794 Method A</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>6 month minimum from date of shipment from plant or point of manufacture. ASTM D 2240</td>
</tr>
<tr>
<td>Ozone and Ultraviolet (UV) Resistance</td>
<td>No chalking, cracking, or bond loss after 5000 hours</td>
</tr>
<tr>
<td>Bond to concrete mortar concrete briquette air cured 14 days 77 ±3 degrees F.</td>
<td>50 psi minimum</td>
</tr>
<tr>
<td>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.</td>
<td>+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.</td>
</tr>
</tbody>
</table>
Table 4

<table>
<thead>
<tr>
<th>Test Requirements for Self-Leveling (Silicone Joint Sealer)</th>
<th>Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow, sag, or slump</td>
<td>Self-leveling</td>
</tr>
<tr>
<td>Extrusion Rate</td>
<td>6-12 lbs/min.</td>
</tr>
<tr>
<td>Elongation, percent minimum</td>
<td>800 at 21 days</td>
</tr>
<tr>
<td>Modulus at 150 percent elongation</td>
<td>30 psi maximum after 21 days</td>
</tr>
<tr>
<td>Tensile Adhesion +0 Concrete (minimum percent elongation)</td>
<td>+600 after 21 days</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>No chalking, cracking, or bond loss after 5000 hours</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>Six month min. from date of shipment from plant or point of manufacture.</td>
</tr>
<tr>
<td>Durometer Hardness, Shore OO – cured 14 days at 77 ±3 degrees F and 45-55 percent, rh</td>
<td>20-80 (0 degrees F)</td>
</tr>
<tr>
<td>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</td>
<td>+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.</td>
</tr>
</tbody>
</table>

E. Sealant must be delivered in the manufacturer’s original sealed container, displaying the lot number, expiration date of the shelf-life warranty, and the sealer trade name.

2.5 BACKER ROD

A. Use closed-cell, polyethylene-foam rods that meet the requirements in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Backer Rod Requirements and Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
</tr>
<tr>
<td>Density</td>
</tr>
<tr>
<td>Tensile Strength</td>
</tr>
<tr>
<td>Absorption</td>
</tr>
<tr>
<td>Compression</td>
</tr>
<tr>
<td>Deflection</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Physical Properties of Joint Sealer (Structures) and Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus of Elasticity at 100 percent Elongation</td>
</tr>
<tr>
<td>Hardness (Shore A)</td>
</tr>
<tr>
<td>Elongation (at break)</td>
</tr>
<tr>
<td>Recovery</td>
</tr>
<tr>
<td>Tensile Strength</td>
</tr>
<tr>
<td>Adhesive in Peel</td>
</tr>
<tr>
<td>Service Range</td>
</tr>
<tr>
<td>Initial Cure, Tack Free (Depending on Temperature and Humidity)</td>
</tr>
<tr>
<td>Final Cure</td>
</tr>
<tr>
<td>Staining Characteristics</td>
</tr>
<tr>
<td>Color</td>
</tr>
</tbody>
</table>

2.7 WATERSTOPS

A. Provide waterstops as specified.

B. Meet requirements of AASHTO LRFD Bridge Construction Specifications.

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, steel welded wire reinforcement, adhesive dowelled anchors, T-headed bars, grouted splice sleeves, and pavement dowel bars.

B. Coating for reinforcing steel, steel welded wire reinforcement, and pavement dowel bars.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. AASHTO M 55: Steel Welded Wire Reinforcement, Plain, for Concrete

C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO M 235: Epoxy Resin Adhesives

E. AASHTO M 284: Epoxy Coated Reinforcing Bars – Materials and Coating Requirements

F. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in Cube Specimens)

G. ASTM A 108: Steel Bar, Carbon and Alloy, Cold-Finished

H. ASTM A 706: Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

I. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

J. ASTM A 970: Headed Steel Bars for Concrete Reinforcement.
K. ASTM E 1512: Testing Bond Performance of Bonded Anchors
L. American Welding Society (AWS) Standards
M. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice
N. UDOT Quality Management Plans (QMP)

1.4 DEFINITIONS

A. Continuous Butt Welded Hoops – Individual reinforcing steel bars that are formed into a circular shape with ends connected by a resistance butt welding process.
   1. The hoops are used to provide transverse column reinforcing by confining the vertical column reinforcing.

B. Grouted Splice Coupler – Mechanical devices used to splice reinforcing steel within precast concrete elements.
   1. These couplers are proprietary devices that are comprised of a combination of a steel sleeve and a high strength cementitious grout.
   2. Some couplers combine a threaded connection for the bar that is cast into the element combined with a grouted portion that is used to make the connection in the field.
   3. The grout used for the coupler is part of the proprietary system and is supplied by the coupler manufacturer.

C. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

D. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, or the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings for approval of the following:
a. Field bending procedure if required. Provide the seal of a Professional Engineer (PE) or Professional Structure Engineer (SE) licensed in the State of Utah.
b. Mechanical butt splice shop drawings when proposed details differ from the plans and specifications.
   1) Show number and location of mechanical butt splices.
   2) Obtain approval before ordering when splice locations or number differ from the plans and specifications.
   3) Provide two samples of mechanical butt splices and test to destruction in the presence of the Engineer.
c. Welded Splice Shop Drawings
   1) Show number and location of welded splices.
   2) Obtain approval before ordering when splice locations or number differ from the plans and specifications.
   3) Provide two samples of welded splices and test to destruction in the presence of the Engineer.

2. Prepare drawings according to the following:
a. Submit drawings electronically in PDF format, 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
   1) State Project Designation
   2) State Project Name
   3) State Structure Number
   4) Contractor, Fabricator, or Erector Name
   5) Contractor, Fabricator, or Erector Drawing Number
   6) Contractor, Fabricator, or Erector Sheet Number
b. Revise and resubmit drawings when directed by the Department.
c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower left corner of each sheet when required.

3. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
b. This review period applies each time the drawings and calculations are submitted.

4. Do not deviate from the approved drawings unless authorized in writing. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
1. Certificates of Compliance from the manufacturer.
2. Supplier Certifications – Refer to this Section, article 2.11 A.
3. Continuous butt welded reinforcing hoops.
   a. Manufacturer’s Quality Control (QC) procedures for the hoop fabrication. Include the following information as a minimum:
      1) The pre-production procedures for the qualification of material and equipment.
      2) The methods and frequencies for performing QC procedures during production.
      3) The calibration procedures and calibration frequency for all equipment.
      4) The welding procedure specification (WPS) for resistance welding.
      5) The method for identifying and tracking lots.
   b. Two samples of welded splices and tested to destruction in the presence of the Engineer.

4. Grouted Splice Couplers
   a. Independent test report confirming the compliance of the coupler with the following requirements:
      1) Develop 150 percent of the specified yield strength of the connected bar.
      2) Determine by testing the amount of time and grout compressive strength required to provide 100 percent of the specified minimum yield strength of the attached reinforcing bar. Use this value to determine when to release bracing.
   b. Independent test report that includes data for each supplied coupler size.
   c. Use the same grout in the testing that will be used in the construction.
   d. Requirements for the grout including required strength gain to develop the specified minimum yield strength of the connected reinforcing bar.

1.6 QUALITY ASSURANCE

A. The Department may witness coating processes for project work and obtain random samples by heat number and manufacturer to conduct verification testing.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

A. Refer to AASHTO M 31, Grade 60 for deformed or plain carbon steel bars.

B. Refer to ASTM A 706 for deformed or plain low-alloy steel bars.
2.2 EPoxy AND GAItANIZED COATINGS

A. Refer to 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 according to ASTM A 767.
   3. Coat bars after bending unless the fabricator can show that satisfactory results can be obtained by coating before bending.
   4. Reject any bent bars with visible cracks or damage in the coating.

2.3 WIRE AND WIRE REINFORCement

A. Refer to AASHTO M 55 for cold drawn steel wire.

B. Refer to AASHTO M 55 for steel welded wire reinforcement.

C. Use 16 gauge coated tie wires.

2.4 PAVEMENT Dowel bars

A. Refer to AASHTO M 31, Grade 60 for smooth steel rod.

B. Use epoxy coated unless otherwise specified.

C. Use a bond breaking compound approved by the Engineer.

2.5 ADHESIVE For Doweled Anchors

A. Refer to AASHTO M 235 for epoxy resin adhesive.

2.6 T-HEADED BARS

A. Use T-headed bars consisting of deformed rebar with steel plates friction welded to one end of the rebar. Friction welding conforms to the approved quality control manual and AWS C6.2, Friction Welding of Metals.
   1. Headed Bars that meet the requirements of ASTM A 970 may be substituted.

B. Use deformed rebar according to ASTM A 706, Grade 60.

C. Cut plate heads for T-headed bars from flats of hot-rolled steel according to ASTM A 108.
D. Use an approved epoxy grout to develop minimum pullout strength in T-headed bar anchorage as shown on the plans.

2.7 BAR SUPPORTS

A. Provide epoxy coated, galvanized, plastic coated, or plastic bar supports that meet the following requirements:
   1. Meet the requirements of Table 2.
   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 according to AASHTO M 111.
   6. Maintain the thickness of epoxy or plastic coatings of at least 5 mils with no maximum.
   7. Use patching material according to the manufacturer’s recommendation to repair damaged coating.
      a. Use patching material that is compatible with the coating and that is inert in concrete.
      b. Do not repair hanger marks on the coated bar supports that result from the coating application process. Hanger marks are not considered damaged coating.

B. Provide basket assemblies for load transfer dowels in concrete pavement that meet the following requirements:
   1. Use epoxy coated basket assemblies.
   2. Use a U-shape leg for the assembly frame.
   3. Use a minimum 0.306 inch diameter wire.
   4. Provide a minimum clearance of ½ inch between the bottom of the bar and the surface upon which the basket assembly is placed.

C. Precast concrete block bar supports that conform to the following:
   1. Provide minimum 28-day compressive strength of 2,500 psi.
   2. Use three inch thick supports with sides ranging from 4 to 6 inches with a minimum soil contact area of 24 in².

2.8 MECHANICAL SPLICE COUPLER

A. Meet the following requirements for service strength bars:
   1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 125 percent of the specified yield strength of the reinforcing bar without damage to the concrete.
B. Meet the following requirements for ultimate strength bars:
   1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 150 percent of the specified yield strength of the reinforcing bar without damage to the concrete.
   2. Use for bars designated as ultimate strength bars on the plans.

C. Use the same coating system as used for the reinforcing steel.

2.9 GROUTED SPLICE COUPLERS

A. Use grouted splice couplers to join precast elements as shown on the plans.
   1. Provide couplers that use cementitious grout placed inside a steel casting. Grout is part of the proprietary system and is provided by the coupler manufacturer.
   2. Use threaded connections at the Contractor’s option for the portions of the coupler that are placed within the precast element if the strength of the coupler meets or exceeds the requirements of this Section.

B. Use one of the following grouted splice coupler manufacturers according to the requirements of this Section. Refer to http://www.udot.utah.gov/go/standardsreferences for information on the following providers:
   1. NMB Splice Sleeve
      Splice Sleeve North America, Inc.
      192 Technology Drive, Suite J
      Irvine, CA  92618-2409
   2. Sleeve-Lock Grout Sleeve System
      Dayton Superior
      Corporate Headquarters
      7777 Washington Village Drive, Suite 130
      Dayton, OH  45459
   3. Erico Lenton Interlok
      ERICO United States
      34600 Solon Road
      Solon, OH  44139

C. Use the same coating system as used for the reinforcing steel. Use grouted splice couplers that are epoxy coated and can join the reinforcing steel without removal of the epoxy coating on the spliced bar when using epoxy coated reinforcing steel.

D. Use grouted splice couplers that provide 150 percent of the specified yield strength of the connected bar.
E. Use grout supplied by the manufacturer of the coupler and that matches the certified test report for the coupler.

### 2.10 CONTINUOUS BUTT WELDED HOOPS

A. Weld only reinforcing steel conforming to ASTM A 706 as specified on the plans.
   1. Use butt welded splices for continuous hoops.
   2. Do not use welding for any other splice.

B. Refer to AWS D1.4: Structural Welding Code - Reinforcing Steel.

C. Do not allow field welding without written approval of the Engineer.

D. Perform welding only by an AWS certified welder.

E. Change welding procedures to reflect chemical composition of the steel.
   1. Welders must have correct mill test report (chemical analysis) from the heat in which the steel was made.

F. Do not allow welding near pre-stressing or post-tensioning strands without protecting the cable from welding splatter.

G. Use only a welded splice capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other.

H. Apply coating after all welding has been completed.

### 2.11 FABRICATION

A. Use Department Certified Suppliers for all reinforcing steel products.
   1. Reinforcing Steel Suppliers. Refer to UDOT QMP 504: Reinforcing Steel.
   2. Epoxy Coating Suppliers. Refer to UDOT QMP 503: Reinforcing Steel Epoxy Coating.

B. Bend reinforcement to the shapes specified. Refer to CRSI Manual of Standard Practice.

C. Do not heat the bars during the bending operations.

D. Complete all bending before coating except as specified on the contract plans.
PART 3 EXECUTION

3.1 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 for the following bar types.
   1. Epoxy Coated
      a. Meet requirements of AASHTO M 284 Appendix A.2 for repair material.
      b. Follow manufacturer recommendations for repairs.
      c. Reject bars with total damaged surface area of epoxy coating greater than 2 percent in any 1 ft section.
      d. Reject any bars with 5 percent or greater damaged surface area in any 1 ft section during all stages of work.
   2. Galvanized
      a. Use Inorganic Zinc Rich Paint with 65 to 69 percent zinc by weight or greater than 92 percent by weight metallic zinc in dry film for repair material.
      b. Follow manufacturer recommendations for repairs.
      c. Reject bars with total damaged surface area of coating greater than 2 percent in any 1 ft section.
      d. Reject any bars with 5 percent or greater damaged surface area in any 1 ft section during all stages of work.

C. Store bars above the ground surface on wooden or padded supports.
   1. Place timbers between bundles when stacking is necessary.
   2. Space the supports close enough to prevent sags in the bundles.

D. Cover epoxy coated reinforcing steel with an opaque covering upon delivery to the project site.
   1. Protect epoxy coated reinforcing steel that has been partially embedded in concrete or placed in formwork and not covered by concrete by covering with an opaque covering before 30 days exposure to sunlight.
   2. Place the opaque coverings to provide air circulation and prevent condensation on the reinforcing steel.
3.2 PLACEMENT

A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.

B. Bend all bars accurately.

C. Place all reinforcement in designated position and securely hold in position while placing and compacting concrete.
   1. Placing Tolerances
      a. Decks or members 10 inches or less in thickness
         1) Cover -1/8 inch, + ¼ inch.
         2) Longitudinal spacing for individual bars ±1 inch but not less than 1½ inches or 1½ bar diameters or 1½ times the maximum aggregate size.
         3) Average spacing for 10 bars +1/16 inch. Do not use to decrease number of bars or increase bar spacing.
      b. Members 10 to 20 inches in thickness
         1) Cover ±1/4 inch.
         2) Longitudinal spacing for individual bars, stirrups, or ties ±1 inch but not less than 1½ inches or 1½ bar diameters or 1½ times the maximum aggregate size.
         3) Average spacing for 10 bars +1/16 inch. Do not use to decrease number of bars or increase bar spacing.
      c. Members greater than 20 inches in thickness
         1) Cover -1/4 inch, + ½ inch.
         2) Spacing for stirrups or ties ±3 inches but not less than 1½ inches or 1½ bar diameters or 1½ times the maximum aggregate size.
         3) Longitudinal bar spacing ±3 inches but not less than 1½ inches or 1½ bar diameters or 1½ times the maximum aggregate size.
         4) Average spacing for 20 bars +¼ inch. Do not use to decrease number of bars or increase bar spacing.
      d. Length of bar laps -1 inch
      e. Embedment length -1 inch

D. Tie bars together with ties at all intersections except when spacing is less than 9 inches in each direction, in which case tie at alternate intersections.
   1. Tie all bundled bars together at not more than 6 ft centers.

E. Maintain the specified distance from the forms and between layers of reinforcement with prefabricated chairs, ties, hangers, or other approved devices.
F. Use precast concrete block bar supports only when the concrete is placed in contact with the soil and then only as the support for the bottom mat of bars.

G. Do not tack weld reinforcing bars in place.

H. Overlap at least one panel of welded wire reinforcement sheets to each other and fasten at the ends and edges.

I. Support reinforcing steel for concrete “T” beams, pier caps, approach slabs, and deck slabs on metal chairs or slab bolsters according to this Section article 2.7.

J. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 4 ft on center of the bar in each direction.

K. Tie deck steel to beams or forms at regular intervals of not more than 5 ft on center along the beams to prevent steel movement during concrete placement.

L. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate or use precast concrete block supports according to this Section, article 2.7.

M. Obtain Engineer approval for placing and fastening reinforcement in each section of work before any concrete is placed.

N. Limit deviations in dowel bar alignment to ± ¼ inch in the length of the dowel.

3.3 FIELD CUTTING

A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.

B. Repair the sawed or sheared end using the specified patching or repair material.

3.4 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 allow lap splices in vertical column reinforcing bars unless specifically noted on the plans.

F. Do not lap splice No. 14 and No. 18 bars.
   1. Use mechanical splice couplers when splicing No. 14 or No. 18 bars.
      a. Determine the number and location of the splices with the following limitations:
         1) Extend bars a minimum of 10 ft above the top of footing or past no splice zone indicated in the plans.
         2) Stagger splices so that no particular bar designation is spliced more than 50 percent in 5 ft.
      b. Use a splice capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other.
      c. Splice according to the manufacturer’s recommendations using the manufacturer’s hardware and required accessories.

G. Use mechanical splice coupler for bar sizes No. 3 through No. 11 when designated on the plans. Follow the manufacturer’s published recommendations for equipment and splicing procedures.

3.5 FIELD BENDING

A. Do not field bend unless detailed on the plans or with written approval of the Engineer.

B. Do not heat the bars during the bending operations.

C. Do not bend bars partially embedded in concrete except as shown in plans or pre-approved by the Engineer. Do not field straighten or re-bend fabricated bent bars.

3.6 INSTALLATION OF DOWELED ANCHORS

A. Use adhesive doweled anchors according to the following:
   1. Use items such as reinforcing bar dowels, reinforcing bars, threaded rods, and bolts as shown in the plans.
   2. Weld heads on bars according to the requirements of the AWS D1.1, Structural Welding Code - Steel. Headed bars that meet the requirements of ASTM A 970 may be substituted.
3. Drill, brush, and clean all holes and install all anchors according to manufacturer’s published recommendations and all applicable specifications.

4. Obtain the approval of the Engineer before installation of reinforcement or threaded rods.

5. Install adhesive anchors and test according to the Epoxy Anchor Test Schedule and as follows:
   a. Testing through the precast deck panel blockout is at the contractor’s risk. Repair damaged beams, girders, and panels as instructed by the Engineer. Panel may be rejected if not repaired as instructed.
   b. Test 25 percent of the first 40 anchors installed and 10 percent of all anchors installed thereafter.
   c. Test the previous ten installed anchors and the next five installed anchors if any failures occur.
   d. Allow anchor adhesives to cure 48 hours before testing.
   e. Tension test according to ASTM E 1512.
   f. Provide minimum capacity as defined in Table 1.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
</table>

<p>| Epoxy Anchor Test Schedule For Anchors Installed in Hard Rock Concrete (2,000 psi min. Strength) |
|---|---|---|</p>
<table>
<thead>
<tr>
<th>Bar size</th>
<th>Tension test load (0.9fy) lbs.</th>
<th>Anchor diameter</th>
<th>Tension test load lbs. see note 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4</td>
<td>10,800</td>
<td>⅛ inch</td>
<td>3,384</td>
</tr>
<tr>
<td>#5</td>
<td>16,700</td>
<td>¼ inch</td>
<td>5,400</td>
</tr>
<tr>
<td>#6</td>
<td>23,800</td>
<td>⅜ inch</td>
<td>9,390</td>
</tr>
<tr>
<td>#7</td>
<td>32,400</td>
<td>⅜ inch</td>
<td>13,530</td>
</tr>
<tr>
<td>#8</td>
<td>42,700</td>
<td>½ inch</td>
<td>18,417</td>
</tr>
<tr>
<td>#9</td>
<td>54,000</td>
<td>1 inch</td>
<td>24,050</td>
</tr>
<tr>
<td>#10</td>
<td>68,600</td>
<td>1¼ inch</td>
<td>37,580</td>
</tr>
<tr>
<td>#11</td>
<td>84,200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1. Minimum embedment is as according to manufacturer’s recommendations.
2. Allowable load equals ½ test load values.

### 3.7 CONNECTION PROCEDURE USING GROUTED SPLICE COUPLERS

A. Use personnel familiar with installation and grouting splice couplers and have completed at least two successful projects in the last two years.
1. Train new personnel within three months of installation by a manufacturer’s technical representative as an acceptable substitution for the experience.

B. Remove and clean all debris from the joints before grout application.

C. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, or any contaminants other than water.

D. Check the lengths of rebar anchor dowels to make sure they meet the minimum coupler embedment specified in the manufacturer’s manual.

E. Saturate Surface Dry (SSD) all joint surfaces before connecting the elements.

F. Monitor shim thickness between the precast elements to ensure that the reinforcing extensions are within the manufacturers recommended tolerance.

G. Maintain a minimum grout and sleeve temperature of 50 degrees F. Monitor the temperature of the covered grouted slice couplers until the temporary bracing is removed.

H. Monitor the grout mixing, water to grout ratio, mixing time, and shelf life of the grout for conformance with the manufacturer’s written instructions.

I. Mix structural grout and coupler grout just before use according to the manufacturer’s instructions.

J. Follow the manufacturer’s recommendations for coupler installation and grouting.

K. Monitor the grouting operation to verify that all sleeves have been filled.

L. Verify that all sleeves are protected from any vibration, shock, or other excessive movement until temporary bracing is removed.

M. Conform to the following when installing couplers above a horizontal joint:
   1. Determine the thickness of shims to provide the specified elevation within tolerance.
   2. Follow non-shrink grout manufacturer’s recommendations for mixing, joint surface preparation, and application.
3. Place non-shrink grout on the interface between the two elements being joined before setting the element.
   a. Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.
   b. Take precautions to prevent the grout from entering the coupler above elements such as grout dams or seals.
4. Set the element in place.
   a. Engage all couplers in the joint.
   b. Allow the grout to seep out of the joint.
5. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
   a. Pack grout into any voids around the joint perimeter.
6. Flush out the coupler with clean potable water.
7. Mix the special coupler grout according to the manufacturer’s recommendations for methods and proportions of mix and water.
8. Make four sets of three 2 inch cube specimens for testing.
   a. Cure the specimens according to AASHTO T 106.
   b. Test one set of cubes for compressive strength to determine when to release bracing. Refer to this Section, article 1.5 B, paragraph 4.a.2.
   c. Test one set of cubes at 28 days for acceptance.
   d. Store extra sets for longer term testing if necessary.
9. Pump the coupler grout into the coupler that is cast into the element.
   a. Start from the lower port.
   b. Pump until the grout is flowing freely from the upper port.
   c. Cap the upper port first and then remove the nozzle to cap the lower port.
10. Cure the joint according to the grout manufacturer’s recommendations.

N. Conform to the following when installing couplers below a horizontal joint:
1. Determine shim thickness to provide the specified elevation within tolerance.
2. Before setting the element:
   a. Mix the coupler grout paying strict attention to the manufacturer’s recommendations for methods and proportions of mix and water.
   b. Clean debris from the interior using compressed air.
      1) Remove any rain water using a vacuum that can remove water from the confined space in the coupler.
   c. Place the coupler grout into the coupler by pouring or pumping.
d. Place grout on the interface between the two elements being joined.
   1) Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.

e. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
   1) Pack grout into any voids around the joint perimeter.

O. Conform to the following when installing couplers in vertical joints (horizontal bar/coupler connection):
   1. Establish a method to provide the specified elevations, alignment, and spacing within tolerance.
   2. Use washers or seals to prevent mixing the joint grout and the coupler grout.
   3. Apply epoxy adhesive to the interface between the two elements being joined.
   4. Set the element in place.
      a. Engage all couplers in the joint.
   5. Flush out the couplers with clean potable water once the element is set, plumbed, and aligned.
   6. Mix the coupler grout paying strict attention to the manufacturer’s recommendations for methods and proportions of mix and water.
   7. Pump the coupler grout into the coupler that is cast into the element.
      a. Start from the port closest to the joint.
      b. Pump until the grout is flowing freely from the other port.
      c. Cap the port farthest from the joint first and then remove the nozzle to cap the other port.
   8. Form the edges of the joint and place grout into the joint.
   9. Cure the joint according to the grout manufacturer’s recommendations.

3.8 FIELD QUALITY CONTROL

A. Inspect coated bars for damage to the coating after the bars are in place and immediately before concrete placement.

B. Repair all visible defects using the specified method recommended by the coating manufacturer.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Bar Support Illustration</th>
<th>Type of Support</th>
<th>Standard Sizes</th>
<th>Nominal Height</th>
<th>Carbon Steel</th>
<th>Geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB¹</td>
<td><img src="image1" alt="Slab Bolster Illustration" /></td>
<td>Slab Bolster</td>
<td>¾, 1 ⅛, and 2 inch heights in 5 ft and 10 ft lengths</td>
<td>All</td>
<td>4 ga. Corrugated</td>
<td>Legs Spaced 5 inches on Center, Vertical Corrugations Spaced 1 inch on Center (See Note 3)</td>
</tr>
<tr>
<td>BB¹</td>
<td><img src="image2" alt="Beam Bolster Illustration" /></td>
<td>Beam Bolster</td>
<td>1, 1 ¼, and 2 inch; over 2 inch to 5 inch heights in increments of ¼ inch lengths of 5 ft.</td>
<td>Up to 1½ inch incl.</td>
<td>7 ga.</td>
<td>7 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 1½ inch to 2 inches incl.</td>
<td>7 ga.</td>
<td>7 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 2 inches to 3½ inches incl.</td>
<td>4 ga.</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 3½ inch</td>
<td>4 ga.</td>
<td>4 ga.</td>
</tr>
<tr>
<td>BC</td>
<td><img src="image3" alt="Individual Bar Chair Illustration" /></td>
<td>Individual Bar Chair</td>
<td>¾, 1 ⅛, and 1 ¼ inch heights</td>
<td>All</td>
<td>-----</td>
<td>7 ga. (See Note 3)</td>
</tr>
<tr>
<td>JC</td>
<td><img src="image4" alt="Joist Chair Illustration" /></td>
<td>Joist Chair</td>
<td>4, 5, and 6 inch widths and ¾, 1, and 1 ½ inch heights</td>
<td>All</td>
<td>-----</td>
<td>6 ga. (See Note 3)</td>
</tr>
<tr>
<td>HC or HPC*</td>
<td><img src="image5" alt="Individual High Chair Illustration" /></td>
<td>Individual High Chair</td>
<td>2 inch to 15 inch heights in increments of ¼ inch.</td>
<td>2 inches to 3½ inches incl.</td>
<td>-----</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 3½ inches to 5 inches incl.</td>
<td>-----</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 5 inches to 9 inches incl.</td>
<td>-----</td>
<td>2 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 9 inches to 15 inches incl.</td>
<td>-----</td>
<td>0 ga.</td>
</tr>
<tr>
<td>CHC</td>
<td><img src="image6" alt="Continuous High Chair Illustration" /></td>
<td>Continuous High Chair</td>
<td>Same as HC in 5 ft and 10 ft lengths</td>
<td>2 inches to 3½ inches incl.</td>
<td>2 ga.</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 3½ inches to 5 inches incl.</td>
<td>2 ga.</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 5 inches to 9 inches incl.</td>
<td>2 ga.</td>
<td>2 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 9 inches to 15 inches incl.</td>
<td>2 ga.</td>
<td>0 ga.</td>
</tr>
</tbody>
</table>

Notes and Bar Supports Table, see next page.
Notes:

1. Provide top wire on continuous supports, not otherwise designated as corrugated, which may be straight or corrugated at the option of the manufacturer.

2. Provide minimum wire sizes that are American steel and wire gauges.

3. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 70 percent of the nominal height.

4. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 55 percent of the nominal height.

5. Provide adequate stability against overturning and adequate load capacity. The leg spread measured between points of support on the minor axis must not exceed the minimum and maximum percentages of the nominal height as shown.

<table>
<thead>
<tr>
<th>Nominal Height (inches)</th>
<th>Support Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance Between Supports as a Percent of Nominal Height</td>
</tr>
<tr>
<td>Under 4</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>65</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>55</td>
</tr>
<tr>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>Over 12</td>
<td>50</td>
</tr>
</tbody>
</table>
Part 1 General

1.1 Section Includes

A. Materials and procedures for constructing structural concrete.
B. High Early Strength Concrete.

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 03056: Self-Consolidating Concrete
F. Section 03152: Concrete Joint Control
G. Section 03211: Reinforcing Steel and Welded Wire
H. Section 03390: Concrete Curing
I. Section 05822: Bearings
J. Section 05832: Expansion Joints
K. Section 07105: Waterproofing Membrane

1.3 References

A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
B. AASHTO M 235: Epoxy Resin Adhesives
C. AASHTO T 23: Making and Curing Concrete Test Specimens in the Field.
D. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

E. AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works)

F. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

G. American Concrete Institute (ACI) Standards

H. UDOT Quality Control/Quality Assurance (QC/QA) Procedures

1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work. Working drawings do not supersede the contract drawings.

B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

C. Temporary Works – Facilities that are generally designed by the Contractor and employed by the Contractor in the execution of the work and whose failure to perform properly could adversely affect the character of the contract work or endanger the safety of adjacent facilities, property, workers, or the public. Such facilities include but are not limited to falsework, forms and form travelers, cofferdams, shoring, water control systems, and temporary bridges.

D. Concrete Surface Finishing Classifications – Refer to this Section, article 3.12.

1.5 SUBMITTALS

A. Working Drawings
   1. Drawings for Temporary Works for approval when specified in the contract or requested by the Engineer.
      a. Include detailed plans for items such as falsework, concrete forms, cofferdams, shoring, and temporary bridges.
      b. Include design calculations and supporting data.
c. Design temporary works according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
d. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
e. Submit falsework drawings when the height of falsework exceeds 14.0 ft or whenever traffic, other than workers involved in constructing the bridge, will travel under the bridge.
f. Do not begin work until receiving the Engineer’s approval of the drawings and calculations.

2. Prepare drawings to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

3. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
   c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
4. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.
5. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
1. Design a High Early Strength Concrete mix design and submit to the Engineer for approval according to Section 03055 when specified. Submit the design and trial batch results including:
   a. 24 hour compressive strength.
   b. Shrinkage results according to AASHTO T 160.
2. Portland cement concrete mix design according to Section 03055 or 03056.
3. Cold weather plan according to Section 03055.
4. Surface evaporation plan according to this Section, article 3.9. paragraph G.

1.6 ACCEPTANCE

A. Refer to Section 03055

PART 2 PRODUCTS

2.1 CONCRETE

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

B. Self-Consolidating Concrete – Refer to Section 03056.

C Concrete Slope Protection – Class A(AE). Refer to Section 03055

D. High Early Strength Concrete
   1. Class AA(AE) Concrete according to Section 03055.
   2. Minimum 24 hour compressive strength 3,000 psi.
   3. Maximum shrinkage 0.04 percent at 28 days. Refer to AASHTO T 160.
2.2 REINFORCING STEEL AND WELDED WIRE
   A. Refer to Section 03211.

2.3 JOINTS AND SEALERS
   A. Premolded and Preformed Joint Filler – Refer to Section 03152.
   B. Concrete Slope Protection – Refer to Section 03152.

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. 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. Refer to ASTM C 578.

2.7 CURING COMPOUND
   A. Refer to Section 03390.

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.

2.10 EPOXY ADHESIVE
   A. Refer to AASHTO M 235, Type II.
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 \( \frac{1}{8} \) inch over 10 feet or \( \frac{1}{270} \) 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 element surfaces of a concrete structure with the same forming material or with materials that produce a concrete surface that is uniform in texture, color, and appearance.
6. Clean the inside surface 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 — Do not place parapet forms or parapet for at least seven days and until it has attained required design strength 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 — first to the top of the girder stems and second to completion, unless otherwise indicated in plans.
2. Obtain a bond between the stem and slab that is positive and mechanical and secured by means of shear keys or roughened surface in the top of the girder stem.

D. Concrete in Columns
1. Allow footing concrete to set until it has attained 75 percent of its design strength based on field cure compressive strength before placing column forms when column is being placed on a footing.
2. Place concrete in one continuous operation.
3. Allow concrete to set at least two days and until it has attained 75 percent of its design strength based on field cure compressive strength 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 cure compressive strength.

3.3 BOX CULVERTS

A. Allow base slab and footing to cure for 24 hours before constructing the remainder of the culvert.
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. Construct shear keys in the top of the side walls for anchoring the top slab when side walls and top slab are not placed monolithically.
D. Construct wingwalls monolithically.
E. Do not backfill until the concrete has been in place at least 7 days and has attained 100 percent of its required design strength based on field cure compressive strength.
F. Apply a waterproofing membrane to the top slab and side walls of all concrete box culverts for the full length of the structures. Refer to Section 07105.

3.4 HEADWALLS

A. Allow apron and pipe collar to attain 75 percent of their design strengths based on field cure compressive strength before the remainder of the headwall is constructed.
B. Construct wingwalls monolithically.
C. Do not backfill until all concrete has attained 100 percent of its required design strength based on field cure compressive strength.
3.5 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. Obtain the Engineer's approval for all surfaces before placing concrete.

B. Placing Concrete
1. Do not place concrete upon spongy, frozen, or unstable surfaces.
2. Provide concrete of a consistency that it can be placed on the slopes without deformation.
3. Complete all scoring as shown in 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 rigid plastic foam 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 method.
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 according to this Section, article 3.5, 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.

3.6 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 so the concrete fills 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. Adjust and support reinforcing steel that does not meet the placement tolerances defined in Section 03211 before placing the concrete.
10. Firmly support screed rails for bridge deck slabs to prevent movement during concrete placement. Support the machine rails on the bridge beams when using a finishing machine. 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.

3.7 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. Re-plug the end and refill the tube with concrete if the concrete seal around the tube is lost.

3.8 PUMP CONCRETE

A. Place concrete with a concrete pump in good operating condition.
   1. Replace pump that causes excessive or erratic loss of air entrainment.
   2. Use a pump that produces a continuous stream of concrete without air pockets.
   3. Do not add water to the concrete in the pump hopper.

B. Do not allow pump vibrations to damage freshly placed concrete.

C. Do not use concrete contaminated by priming or cleaning the pump.
3.9 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. High-early strength concrete that is used in deck and approach slab closure pours may be opened to traffic after reaching 3,000 psi based on field cure compressive strength.

D. Cold Weather – Refer to 03055:

E. Hot Weather – Refer to 03055.

F. 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.

G. Surface Evaporation
   1. Surface evaporation requirements apply 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.
      a. 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.

### 3.10 EXPANSION JOINTS AND BEARINGS

A. Expansion joints – Refer to Section 05832
B. Bearings – Refer to Section 05822
C. Adjust bearing positions and joint widths as shown on plans.

### 3.11 CONSTRUCTION JOINTS

A. Make construction joints where shown on plans.

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 that are to be treated architecturally.
   5. Make a straight line joint across the face of the pour for the full width of the bridge deck.
   6. Leave a rough surface to increase the bond with the concrete placed later.
   7. Form tapered sections with an insert so that the succeeding layer of concrete ends in a section at least 6 inches thick.
   8. Place a bulkhead from the surface to the top mat of steel to establish a straight vertical face. Shape the concrete below the top steel to a near vertical face in line with the bulkhead.
   9. Establish a straight vertical face by saw cutting to a minimum depth of 1 inch when a bulkhead cannot be placed. Shape the concrete below the saw cut to a near vertical face.

C. Meet the following before resuming concrete placement:
   1. Re-tighten forms.
   2. Roughen the surface of hardened concrete without leaving loosened particles or damaged concrete.
   3. Clean off concrete surface of foreign matter and laitance by sandblasting.
   4. Saturate concrete surface with water.
5. Apply epoxy adhesive as specified to face of construction joints.

3.12 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.

3.13 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.

3.14 CONCRETE SURFACE FINISHING PROCEDURES

A. Ordinary Surface Finish
   1. Remove all fins and projections after removing forms.
      a. Clean, point, and true all honeycomb spots, broken corners or edges, cavities made by form ties, and other holes and defects.
      b. Keep all areas to receive mortar saturated with water for at least 30 minutes before mortar placement.
   2. Use a mortar of cement and fine aggregate for pointing, not more than one hour old, mixed in the proportions used in the grade of concrete being finished.
   3. Cure the mortar patches and rub to blend with surrounding concrete.
4. Tool and free all joints of mortar and concrete. 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 three days then rub lightly with a fine carborundum stone until smooth.
   2. Use a mechanically operated carborundum stone to finish the surface of hardened concrete at least four days after placing.
      a. Finish in the same manner as ordinary surface finish. Refer to this Section, article 3.14, paragraph A. Let the lather set for at least 7 days before lightly rubbing with a fine carborundum stone until smooth.
   3. Commercial grade rubbing mortar may be used if approved by Engineer.

C. Wire Brush or Scrubbed Finish
   1. Scrub the surface with stiff wire or fiber brushes using a solution of muriatic acid – one part acid, four parts water after the forms are removed and the concrete is green.
   2. Wash the entire surface once the scrubbing produces the desired texture.
      a. Use water mixed with 5 percent by volume ammonium hydroxide to remove all traces of the acid.

D. Floated surface finish on flat work other than bridge decks and approach slabs:
   1. Striking Off
      a. Carefully rod and strike off the surface with a strike board following the cross sections and grades shown on the plans after compaction.
      b. Allow for camber as required.
      c. Operate the strike board longitudinally or transversely and move it forward with a combined longitudinal and transverse motion so that neither end is raised from the side forms during the process.
      d. Keep a slight excess of concrete in front of the cutting edge at all times.
   2. Floating
      a. Use longitudinal or transverse floating or both to create a uniform surface.
b. Longitudinal floating is required except in places where it is not feasible.

3. Longitudinal Floating
   a. Work the longitudinal float operated from foot bridges with a sawing motion while holding it parallel to the road centerline.
   b. Pass gradually from one side of the pavement to the other.
      1) Move the float forward ½ of its length and repeat operation.
   c. Substitute machine floating if equivalent results are produced.

4. Transverse Floating
   a. Operate the transverse float across the concrete surface by starting at the edge and slowly moving to the center and back again to the edge.
      1) Move the float forward ½ of its length and repeat the operation.
   b. Preserve the crown and cross section of the concrete surface.

5. Straightedging
   a. Test the concrete surface for trueness with a straightedge after the longitudinal floating has been completed and the excess water has been removed 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. Adjust and support reinforcing steel that does not meet the placement tolerances defined in Section 03211 before placing concrete.
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. Obtain approval for the strike-off method and equipment.
   b. Use equipment capable of finishing concrete within the surface tolerances specified.
   c. Maintain satisfactory consolidation and surface tolerance to prevent shutdown and rejection of the equipment.
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 $\frac{1}{8}$ 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 waterproofing membrane system.
2. Use a texture process that produces regular \( \frac{1}{8} \) inch wide transverse grooves spaced randomly from \( \frac{1}{2} \) inch to \( \frac{3}{4} \) inch on centers and \( \frac{1}{8} \) inch deep.
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 \( \frac{1}{8} \) inch from a 10 ft straightedge. Refer to Section 02752.

3.15 CURE

A. Refer to Section 03390.

3.16 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. Always remove forms before removing shoring from beneath beams and girders to determine the condition of columns.
G. Removing Falsework
   1. Do not remove falsework supporting the deck of rigid frame structures until the fill has been placed in back of the vertical legs.
   2. Keep falsework and forms in place under slabs, beams, and girders for 14 days after the day of last concrete placement. Slab forms with a clear space of less than 10 ft may be removed after seven days.
      a. Coat with curing compound if forms are removed before 14 days when approved by the Engineer.
   3. Keep forms and falsework in place in cold weather 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. Obtain a solid uniform surface by chipping away coarse or broken material to patch larger holes or honeycombs.
      a. Cut away feathered edges to form faces perpendicular to the surface.
      b. Apply epoxy adhesive to patch area. Follow manufacturer's recommendations.
      c. Fill the cavity with stiff mortar composed of one part portland cement to two parts sand thoroughly tamped into place.
      d. Pre-shrink the mortar by mixing it approximately 20 minutes.
         1) Vary the time according to manufacturer’s recommendations, temperature, humidity, and other local conditions.
      e. Float the surface of this mortar with a wooden float before initial set.
      f. Keep the patch wet for five days.
      g. Rub patches on exposed surfaces to blend them with surrounding concrete after curing.
      h. Add coarse aggregate to the patching material when patching large or deep areas.
      i. Make a dense, well-bonded, and properly cured patch.

I. Areas with extensive honeycombing will be rejected.
   1. Remove and rebuild the structure in part or wholly as specified after receiving written notice of rejection and 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 1 inch below the face of slab and repair according to 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.
3.17 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 shown in the plans.

B. Anchor Bolts
   1. Securely and accurately set all necessary anchor bolts in piers, abutments, or pedestals as the concrete is being placed.
   2. Use templates to maintain location and plumbness.

C. Bearing Plate Areas
   1. Finish bridge seat bearing areas high and rub or grind to grade level within an allowable tolerance of $\pm \frac{1}{16}$ inch and within a tolerance of $\pm \frac{1}{8}$ inch of the elevation shown on the plans.
   2. Do not grout under bearing plates.

3.18 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. Materials and procedures for removing asphalt surfacing, deck and parapet concrete, joint armor steel, and reinforcing steel at existing joint area.

B. Materials and procedures for the placement of new reinforcing steel and recasting the joint area.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Compliance
B. Section 03055: Portland Cement Concrete
C. Section 03211: Reinforcing Steel and Welded Wire
D. Section 03310: Structural Concrete

1.3 REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
B. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Concrete mix design for Engineer’s approval.
B. Hot and cold weather plan.
C. Manufacturer’s certificate of compliance for reinforcing steel.
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 gauge.
D. Rigid Plastic Foam – Type 9, density of 2 lbs/ft$^3$. Refer to ASTM C 578.
E. Epoxy Sand Grout – Refer to ASTM C 1107.

PART 3 EXECUTION

3.1 PREPARATION

A. Debris Containment
   1. Prevent debris from falling into streams and onto pedestrian areas, traffic areas, and railroad tracks. Refer to Section 01355.

B. Asphalt Removal
   1. Make saw cuts full depth, parallel to existing joints, and to the dimensions shown on the plans to define removal area.
   2. Do not damage concrete deck when removing asphalt surfacing.

C. Concrete Saw Cuts
   1. Saw cut in concrete deck 1 inch deep, parallel to existing joints, and to the dimensions shown on the plans to define the work area.
   2. Note that the length of the joint closure is the width of the bridge deck, including parapets, adjusted for the skew of the individual structure.

3.2 REMOVE CONCRETE

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal of Concrete Slab – Use 30 pound class, hand-operated 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. Protect the conduit from damage where an existing electrical conduit is encountered.

### 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
   1. 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 the cleaned surfaces before placing concrete.

C. Restrict traffic on the joint closure areas until the concrete has reached a compressive strength of 3,000 psi. The Engineer may take additional concrete samples.

### 3.5 DAMAGE

A. Repair or replace any existing materials that have been damaged and are to remain in place to the satisfaction of the Engineer at no additional cost to the Department.

END OF SECTION
SECTION 03338

PRECAST SUBSTRUCTURE ELEMENTS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. This work consists of furnishing, erecting, and installing all precast concrete elements for bridge substructures including all necessary materials and equipment to complete the work as shown on the plans. Substructures in general include footings, columns, pier caps, abutment stems, and wall stems. The use of cast-in-place concrete will not be considered for substitution.

B. Procedures for installing elements and placing structural non-shrink grout.

1.2  RELATED SECTIONS

A. Section 00515: Contract Award and Execution

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 03056: Self-Consolidating Concrete (SCC)

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03310: Structural Concrete

F. Section 03575: Flowable Fill

1.3  REFERENCES

A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. AASHTO M 36: Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains

C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
E. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

F. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing

G. AASHTO LRFD Bridge Construction Specifications

H. ASTM A 706: Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

I. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

J. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

K. ASTM D 2240: Rubber Property – Durometer Hardness

L. PCI Design Handbook

M. UDOT Quality Management Plan

1.4 DEFINITIONS

A. Continuous Butt Welded Hoops – Individual reinforcing steel bars that are formed into a circular shape with ends connected by a resistance butt welding process.
   1. The hoops are used to provide transverse column reinforcing by confining the vertical column reinforcing.

B. Grouted Splice Coupler – Mechanical devices used to splice reinforcing steel within precast concrete elements.
   1. These couplers are proprietary devices that are comprised of a combination of a steel sleeve and a high strength cementitious grout.
   2. Some couplers combine a threaded connection for the bar that is cast into the element combined with a grouted portion that is used to make the connection in the field.
   3. The grout used for the coupler is part of the proprietary system and is supplied by the coupler manufacturer.
C. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

D. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

E. Temporary Works – Facilities that are generally designed by the Contractor and employed by the Contractor in the execution of the work, and whose failure to perform properly could adversely affect the character of the contract work or endanger the safety of adjacent facilities, property, workers, or the public. Such facilities include but are not limited to falsework, forms and form travelers, cofferdams, shoring, water control systems, and temporary bridges.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for approval.
      a. Include the following:
         1) Locations and details of all lifting inserts, hardware, or devices.
         2) Type and amount of any additional reinforcing required for lifting.
         3) Minimum compressive strength attained before handling the precast elements.
         4) Details of vertical adjusting hardware.
      b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
      c. Include supporting engineering calculations.
      d. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.
   2. Erection Drawings for all precast concrete members.
      a. Include the following:
         1) A work area plan depicting items such as utilities overhead and below the work area, drainage inlet structures, and protective measures.
2) Equipment to be used to lift substructure elements including cranes, excavators, lifting slings, sling hooks, and jacks. Include crane locations and operation radii.

3) All equipment that will be used for the assembly of the substructure.

4) Methods of providing temporary support of the elements. Include methods of adjusting and securing the element after placement.

5) Procedures for controlling both horizontal and vertical tolerance limits. Include details of any alignment jigs including bi-level templates for reinforcing anchor dowels.

6) Methods for placement of flowable bedding concrete for spread footings. Add grout ports in the footings to facilitate the bedding process if required.

7) Method, sequence, and equipment for forming grout voids and installing the structural non-shrink grout.

8) Methods of forming closure pours including the use of backer rods. Do not assume that the backer rods will restrain the pressure from the grout in vertical grout joints. Provide additional forming to retain the backer rod.

9) Methods for curing grout and closure pour concrete.
   b. Include supporting engineering calculations.
   c. Provide the seal of a PE or SE licensed in the State of Utah.
   d. Obtain the Department’s approval when specified on the plans.
   e. Submit 10 days before beginning erection when approval is not required.
   f. Do not begin erection before receiving approval of the erection drawings when approval is required.

3. Drawings for Temporary Works for approval when specified in the contract or requested by the Engineer.
   a. Include detailed plans for items such as falsework, concrete forms, cofferdams, and shoring.
   b. Include design calculations and supporting data.
   c. Design temporary works according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
   d. Provide the seal of a PE or SE licensed in the State of Utah.
   e. Submit falsework drawings when the height of falsework exceeds 14.0 ft or whenever traffic, other than workers involved in constructing the bridge, will travel under the bridge.
f. Do not begin work until receiving approval of the drawings and calculations.

4. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

5. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
   c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.

6. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

7. Revise the drawings and calculations and re-submit for review and approval before beginning any work if site conditions change from the time any drawings or calculations were approved.
8. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Materials
   1. Grouted Splice Couplers
      a. Refer to Section 03211.
   2. Resistance Butt Welded Reinforcing Hoops
      a. Refer to Section 03211.
   3. Structural Non-Shrink Grout
      a. Certificate of Compliance to Engineer.
      b. Warranty letter to the Engineer before acceptance is given stating that the structural non-shrink grout manufacturer and the Contractor jointly guarantee the grout against all bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
         1) The warranty period starts on the date of owner acceptance, typically the date traffic is allowed on the bridge.
      c. Manufacturer Warranty Bond for the total price of the installed structural non-shrink grout.
         1) Calculate the total price by using the volume of structural non-shrink grout shown on the plans and the average installed price for grout obtained from the manufacturer.
         2) Warranty period covers the period of time specified in the Warranty letter submitted to the Engineer.
         3) 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.
         4) Proof of bond to the Engineer before placing the grout.
   4. Concrete
      a. Refer to Section 03056 or Section 03310.

C. Repair Procedure
   1. Written procedure for defects and breakage of precast elements for approval.

D. Casting Schedule
   1. Provide the Engineer a tentative casting schedule at least two weeks in advance to make inspection and testing arrangements. A similar notification is required for the shipment of precast elements to the job site.
PART 2   PRODUCTS

2.1 MATERIALS

A. Concrete
   1. Precast elements – use Class AA(AE) structural concrete according to Section 03310 or Section 03056 and the plans.
   2. Bedding under elements – use flowable fill conforming to the requirements of Section 03575 or free draining granular backfill conforming to the requirements of Section 02056.
   3. High Early Strength Concrete – only allowed in closure pours as shown on plans.

B. Reinforcing Steel
   1. Refer to Section 03211.
   2. Use reinforcing steel according to ASTM A 706 (weldable) for vertical reinforcing in the pier columns, transverse reinforcing in the pier columns, and any bar passing from the columns into the footing or pier cap. Use reinforcing steel according to AASHTO M 31 for all other substructure elements.

C. Structural Non- Shrink Grout
   1. Use structural non-shrink grout for joints between precast elements as shown in the plans.
      a. Use gray, non-shrink grout concrete, containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
      b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
      c. Meet all the requirements of AASHTO T 160 with the exception that the Contractor supplied cube molds will remain intact with a top firmly attached throughout the curing period.
      d. Refer to Table 1 for structural non-shrink grout requirements.
Table 1

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</tbody>
</table>

* Certified test results from an AASHTO accredited testing laboratory will suffice for acceptance.

D. Grouted Splice Couplers
   1. Refer to Section 03211.

E. Corrugated Steel Pipe
   1. Refer to AASHTO M 36.

F. Leveling Devices
   1. Refer to the plans for fabricated steel leveling devices. Alternate devices may be used provided the devices can support the anticipated loads.

G. Vertical Joint Seals
   1. Use natural rubber or neoprene sheet with a durometer of 50-60 according to ASTM D 2240.

H. Lifting Devices
   1. Use lifting devices that can support the required vertical and horizontal forces with the applicable safety factors according to the Component Handling and Erection Bracing requirements in the PCI Design Handbook.

I. Miscellaneous Steel Items
   1. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.
2.2 FABRICATION

A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all the materials in the precast elements.

C. Construct precast elements to the tolerances shown in the plans.

D. Finish the precast elements according to Section 03310. Trowel finish the top surface of all precast concrete elements.

E. Maintain a minimum compressive strength of 500 psi before stripping the form.

F. Permanently mark each precast element with date of casting and supplier identification. Stamp markings in fresh concrete.

G. Wet cure elements for 14 consecutive days. Begin cure immediately after performing the final finish.
   1. Wet cure by covering all exposed surfaces with wet burlap, cotton mats, or both, and plastic sheets.
   2. Maintain a saturated condition for the burlap and cotton for the entire duration.
   3. The duration of the wet cure may be reduced to 7 days at a 10 percent pay disincentive.

2.3 QUALITY ASSURANCE

A. Precast Substructure Elements
   1. Prevent cracking or damage of precast elements during handling and storage.
   2. Replace defects and breakage of precast elements.
      a. Members that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review or rejection.
      b. Obtain approval before performing repairs.
      c. Repair work must reestablish the elements’ structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
      d. Determine the cause when damage occurs and take corrective action.
e. Failure to take corrective action leading to similar repetitive damage can be cause for rejection of the damaged element.

f. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.

g. Full depth cracking and breakage greater than 1 ft are cause for rejection.

3. Document all test results. The quality control file will contain at least the following information:

a. Element identification
b. Date and time of cast
c. Concrete cylinder test results
d. Quantity of used concrete and the batch printout
e. Form stripping date and repairs if applicable
f. Location/number of blockouts and lifting inserts
g. Temperature and moisture of curing period
h. Lifting device details, requirements, and inserts

B. Continuous Butt Welded Hoops

1. Refer to Section 03211.

C. Grouted Splice Couplers

1. Make four sets of three 2 inch cube specimens for testing.
   a. Cure the specimens according to AASHTO T 106.
   b. Test one set of cubes for compressive strength to determine when to release bracing. Refer to Section 03211.
   c. Test one set of cubes at 28 days for acceptance.
   d. Store extra sets for longer term testing if necessary.

D. Structural Non-Shrink Grout

1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.
   a. Refer to this Section, article 1.5 B.3.

2. Repair or refund at the Department's option any bonding failures that occur during the warranty period.

PART 3 EXECUTION

3.1 GENERAL PROCEDURE FOR ALL INSTALLATION OF ELEMENTS

A. Review the approved erection drawings.

1. Resubmit the drawings for review and approval if changes are warranted due to varying site conditions.
B. Dry fit adjacent elements in the shop if noted on the plans.
   1. The fabricator may opt to dry fit elements in any case.

C. Establish working points, working lines, and benchmark elevations before placement of all elements.

D. Check the condition of the receiving bonding surface before connecting elements and take any necessary measures to remove items such as dust, rust, and debris to provide the satisfactory bonding required between the protruding reinforcing bars element and the grouted couplers.

E. Place elements in the sequence and according to the methods outlined in the assembly plan.
   1. Adjust the height of each element by means of leveling devices or shims.

F. Mix structural non-shrink grout just before its use according to the manufacturer's instruction.

3.2 CONNECTION PROCEDURE USING GROUTED SPLICE COUPLERS

A. Refer to Section 03211.

3.3 FOOTINGS

A. Lift footing segments as shown in the erection drawings using lifting devices as shown in the shop drawings.

B. Set footing in the proper horizontal location.
   1. Check for proper alignment within specified tolerances.

C. Adjust vertical leveling devices before full release of the element from the crane to facilitate the vertical adjustment process.
   1. This will reduce the amount of torque required to turn the bolts in the leveling devices.
   2. Check for proper grade within specified tolerances.

D. Check the spacing of dowels or grouted splice couplers between adjacent footings that are to support common elements in future stages of construction.
   1. Use bi-level templates and jigs.
   2. Adjust the location of the footing if required.
E. Pour flowable bedding concrete through the ports for spread footings supported on soil or rock.
   1. Start from the center of the footing and proceed toward the outside edges.
   2. Verify that bedding concrete is filling the entire void between the footing and the subgrade.

F. Place concrete around pile tops as shown on the plans for footings supported on drilled shafts or piles.
   1. Allow this concrete to flow partially under the footing.
   2. The entire underside of the footing need not be filled with concrete.

G. Do not remove the installation bolts or proceed with the installation of elements above the footing until the compressive test result of the cylinders for bedding concrete or pile connection concrete has reached the specified minimum values.

3.4 BENT COLUMNS

A. Lift column element as shown in the erection drawings using lifting devices as shown on the shop drawings.

B. Survey the elevation of the element directly below the column.
   1. Provide shims to bring the bottom of the column to the required elevation.

C. Measure the elevation of the top of the shim stack and the top of the projecting dowels.
   1. Verify that the elevations and dowel extensions are within specified tolerances.

D. A dry fit of the column is recommended until work crews become more familiar with the process.
   1. Set column in the proper horizontal location.
   2. Check for proper horizontal and vertical alignment within specified tolerances.
   3. Remove and adjust the shims and reset the column if the column is not within tolerance.

E. Check the dowel spacing or grouted splice couplers between adjacent columns that will support common elements in future stages of construction.
   1. Use bi-level templates and jigs.
   2. Adjust the location of the footing if required.
      a. Slight tilting of the column within tolerances is permitted.
F. Set the column and install the couplers according to this Section, article 3.3 once the connection geometry is established and checked.

G. Install temporary bracing if specified in the erection drawings.

H. Allow the grout in the coupler to cure until the coupler can resist 100 percent of the specified minimum yield strength of the bar before removing the bracing and proceeding with installation of components above the pier column.
   1. The required grout strength is based on the certified test report. Refer to Section 03211.
   2. Verify the strength of the grout by testing cube samples. Refer to this Section, article 2.3C.

3.5 BENT CAPS

A. Lift pier cap element as shown in the erection drawings using lifting devices as shown on the shop drawings.

B. Survey the elevation of the column directly below the cap.
   1. Provide shims to bring the bottom of the cap to the required elevation.
   2. Measure the elevation of the top of the shim stack and the top of the projecting dowels.
   3. Verify that the elevations and dowel extensions are within specified tolerances.

C. A dry fit of the cap is recommended until work crews become more familiar with the process.
   1. Set cap in the proper horizontal location.
   2. Check for proper horizontal and vertical alignment within specified tolerances.
   3. Remove and adjust the shims and reset the cap if the cap is not within tolerance.

D. Set the cap and install the couplers according to this Section, article 3.2 once the connection geometry is established and checked.

E. Install temporary bracing if specified in the erection drawings.

F. Allow the grout in the coupler to cure until the coupler can resist 100 percent of the specified minimum yield strength of the bar before removing the bracing and proceeding with installation of components above the pier cap.
   1. The required grout strength is based on the certified test report. Refer to Section 03211.
2. Verify the strength of the grout by testing cube samples. Refer to this Section, article 2.3C.

### 3.6 WALL PANELS

A. Wall panels consist of the following:
   1. Cantilever Abutment Stems
   2. Wingwall stems
   3. Integral abutment pile cap stems
   4. Abutment backwalls and cheekwalls

B. Lift wall panel element as shown in the erection drawings using lifting devices as shown on the shop drawings.

C. Wall panels supported on precast concrete elements (footing or stem).
   1. Survey the elevation of the base directly below the panel.
      a. Provide shims to bring the bottom of the panel to the required elevation.
      b. Measure the elevation of the top of the shim stack and the top of the projecting dowels.
      c. Verify that the elevations and dowel extensions are within specified tolerances.
   2. A dry fit of the panel is recommended until work crews become more familiar with the process.
      a. Set panel in the proper horizontal location.
      b. Check for proper horizontal and vertical alignment within specified tolerances.
      c. Remove and adjust the shims and reset the panel if the panel is not within tolerance.
   3. Set the panel and install the couplers according to this Section, article 3.3 once the connection geometry is established and checked.
   4. Install temporary bracing if specified in the erection drawings.
   5. Allow the grout in the coupler to cure until the coupler can resist 100 percent of the specified minimum yield strength of the bar before removing the bracing and proceeding with installation of components above the panel.
      a. The required grout strength is based on the certified test report. Refer to Section 03211.
      b. Verify the strength of the grout by testing cube samples. Refer to this Section, article 2.3C.
   6. Place concrete inside the blockouts and cure if the panels contain corrugated pipe blockouts.
   7. Place structural non-shrink grout in joints between precast abutment and backwall segments after any leveling jacks and temporary supports are removed.
8. Do not apply superimposed dead loads or live loads to the precast abutment segments until the structural non-shrink grout has reached a strength of 500 psi based on manufacturer's published data.

D. Wall panels supported on piles or drilled shafts (integral abutments).
   1. Lift wall panel as shown in the erection drawings using lifting devices as shown on the shop drawings.
   2. Set the panel in the proper horizontal location.
      a. Check for proper alignment within specified tolerances.
   3. Adjust the devices before full release from the crane if vertical leveling devices are used.
      a. This will reduce the amount of torque required to turn the bolts in the leveling devices.
      b. Check for proper grade within specified tolerances.
   4. Check the spacing of dowels or grouted splice couplers between adjacent panels that will support common elements in future stages of construction.
      a. The use of bi-level templates and jigs is recommended.
      b. Adjust the location of the panel if required.
   5. Place concrete around pile tops as shown on the plans.
      a. Allow concrete to flow partially under the panel.
      b. The entire underside of the panel need not be filled with concrete.
   6. Do not remove the installation bolts, if used, or proceed with the installation of elements above the panel until the compressive test result of the cylinders for the pile connection concrete has reached the specified minimum values.
   7. Place structural non-shrink grout in joints between precast abutment and backwall segments after any leveling jacks and temporary supports are removed.
   8. Do not apply superimposed dead loads or live loads to the precast abutment segments until the structural non-shrink grout has reached a strength of 500 psi based on manufacturer's published data.

3.7 PRECAST BEAM SEATS

A. Lift the precast beam seats as shown in the erection drawings using lifting devices as shown on the shop drawings.

B. Set beam seat in the proper horizontal location.
   1. Check for proper alignment within specified tolerances.

C. Adjust vertical leveling devices.
   1. Check for proper grade within specified tolerances.
D. Install temporary bracing if specified in the erection drawings.

E. Pour or pump grout through the blockouts in the seat.
   1. Start from the center of the seat and proceed toward the outside edges.
   2. Verify that grout is filling the entire void between the seat and the substructure element below.

F. Grind beam seat to achieve the specified seat elevation tolerance if required.
   1. Grind to a maximum depth of \( \frac{3}{8} \) inch.

END OF SECTION
SECTION 03339

PRECAST CONCRETE DECK PANEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work consists of furnishing, erecting, and installing full-depth, precast concrete deck panels including all necessary materials and equipment to complete the work as shown on the plans.
   1. The use of cast-in-place concrete is not an acceptable alternative for precast panels.

B. Procedures for preparing and installing structural non-shrink grout into the girder camber strips, filling the shear stud blockouts, and filling all other blockouts in the bridge precast concrete deck panels to produce a finished deck.
   1. This is not for post-tensioning.

C. Procedures relating to installing new shear studs on top flanges of existing steel girders and installing shear connectors to the top flanges of existing concrete or pre-stressed beams as shear studs.

1.2 RELATED SECTIONS

A. Section 00515: Contract Award and Execution
B. Section 02982: Bridge Concrete Grinding
C. Section 03055: Portland Cement Concrete
D. Section 03056: Self-Consolidating Concrete (SCC)
E. Section 03211: Reinforcing Steel and Welded Wire
F. Section 03251S: Post Tensioning Concrete
G. Section 03310: Structural Concrete
E. Section 03412: Prestressed Concrete
1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 169: Steel Bars, Carbon and Alloy, Cold-Finished

C. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives

D. AASHTO M 270: Structural Steel for Bridges

E. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)

F. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

G. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing

H. AASHTO/AWS D1.5 Bridge Welding Code

I. ASTM A 109: Steel, Strip, Carbon (0.25 Maximum Percent), Cold Rolled

J. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

K. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

L. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

M. PCI Design Handbook

N. UDOT Quality Management Plan

1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.

1. Working drawings do not supersede the contract drawings.
B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings

1. Detailed shop drawings of all fabricated materials for approval.
   a. Include the following:
      1) Locations and details of all lifting inserts, hardware, or devices.
      2) Type and amount of any additional reinforcing required for lifting.
      3) Locations and details of vertical adjusting hardware.
      4) Type and size of longitudinal post-tensioning anchorage assembly, ducts, and local zone reinforcement.
      5) Minimum compressive strength attained before handling the precast elements.
   b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
   c. Include supporting engineering calculations.
   d. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.

2. Erection Drawings for all precast concrete members.
   a. Include the following:
      1) Crane charts
      2) Crane and pick locations
      3) Cables and lifting equipment
      4) Load distribution
      5) Panel erection and sequence
      6) Sequence used to level panel
      7) Method, equipment, and sequence for forming the camber strips and installing the structural non-shrink grout.
      8) Method of forming closure pours at joints between precast panels.
   b. Include supporting engineering calculations.
   c. Provide the seal of a PE or SE licensed in the State of Utah.
   d. Obtain the Department’s approval when specified on the plans.
e. Submit 10 days before beginning erection when approval is not required.
f. Do not begin erection before receiving approval of the erection drawings when approval is required.

3. Additional Calculations
   a. Design local zone reinforcing for post-tensioning assembly.
   b. Show that tensile stresses on both faces do not exceed the modulus of rupture during the handling, fabrication, shipping, and erection of the panel.

4. Prepare Drawings
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

5. Prepare Engineering Calculations
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
   c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
6. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

7. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Materials

1. Structural Non-Shrink Grout
   a. Certificate of Compliance to Engineer.
   b. Proposed method, sequence, and equipment for forming grout voids and installing the structural non-shrink grout to the Engineer for approval 14 days before beginning installation of structural non-shrink grout.
   c. A Warranty letter to the Engineer before acceptance is given stating that the structural non-shrink grout manufacturer and the Contractor jointly guarantee the grout against all bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
      1) The warranty period starts on the date of owner acceptance, typically the date traffic is allowed on the bridge.
   d. Manufacturer Warranty Bond for the total price of the installed structural non-shrink grout.
      1) Calculate the total price by using the volume of structural non-shrink grout shown on the plans and the average installed price for grout obtained from the manufacturer.
      2) Warranty period covers the period of time specified in the Warranty letter submitted to the Engineer.
      3) 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.
      4) Proof of bond to the Engineer before placing the grout.

2. Concrete
   a. Refer to Section 03056 or Section 03310.

C. Repair Procedures

1. Written procedure for defects and breakage of precast elements for approval.
D. Casting Schedule
1. Provide the Engineer a tentative casting schedule at least two weeks in advance to make inspection and testing arrangements. A similar notification is required for the shipment of precast elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete
1. Mild Reinforced Panel – Use Class AA(AE) structural concrete for precast concrete deck panels according to Section 03310 or Section 03056 and on the plans.
2. Prestressed Panel – Use Class AA(AE) or self-consolidating pre-stressed concrete according to Section 03412.
3. High Early Strength Concrete – Only allowed in closure pours as shown on plans.

B. Reinforcing Steel
1. Refer to Section 03211.

C. Vertical Adjusting Hardware
1. The plans show fabricated steel vertical adjusting hardware. Alternate devices may be substituted with approval from the Engineer.

D. Embedded Blind Pocket Blockouts
1. Use cold formed rectangular steel tubing according to ASTM A 500 Grade B.
2. Use a steel top plate according to AASHTO M 270 Grade 36. Higher strength grades of steel may be substituted with approval from the Engineer.
3. Galvanize the steel assembly after fabrication according to AASHTO M 111.
4. Use plastic pipe for grout ports and vents.

E. Lifting Devices
1. Use devices that can support the required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
2. Use a device that will have 2¾ inch top cover and 1 inch bottom cover after installation. This may require partial removal of the device after installation.
F. Structural Non-Shrink Grout
   1. Use for girder camber strips, shear stud blockouts, keyway blockouts, and other blockouts shown on the plans.
      a. Use gray non-shrink grout concrete containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
      b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
      c. Use a mix design according to Section 03055 if adding more than 15 lb of coarse aggregate (size No. 8) or larger per 50 lb bag of structural non-shrink grout.
      d. Meet 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.
      e. Refer to Table 1 for structural non-shrink grout requirements.

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G. Pre-stressing Strand and Post Tensioning Hardware
   1. Refer to Section 03412 for pre-tensioned concrete.
   2. Refer to Section 03251S for post-tensioning.

H. Shear Connectors
   1. Use headed anchor studs for shear connectors according to dimensions showing on the plans.
   2. Use steel according to AASHTO M 169.
   3. Use a low carbon grade steel suitable for welding according to ASTM A 109 for the caps if steel flux-retaining caps are used.
I. T-Headed Bars  
   1. Refer to Section 03211.

J. Adhesive for Doweled Anchors  
   1. Refer to AASHTO M 235 for epoxy resin adhesive.

K. Miscellaneous Steel Items  
   1. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

2.2 FABRICATION

A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all materials in the deck panels.

C. Construct panels to tolerances shown on the plans or in the specifications.

D. Perform pre-stressing according to Section 03412 Prestressed Concrete.

E. Finish the precast concrete deck panels following Section 03310. Texture the top surface of the elements according to the requirements of Section 03310 for final texturing of bridge decks.

F. Permanently mark each precast unit with date of casting and supplier identification. Stamp markings in fresh concrete.

G. Maintain a minimum compressive strength of 500 psi before stripping the form.

H. Wet cure the deck panels for 14 consecutive days before placing on the superstructure. Begin cure immediately after performing the final finish.  
   1. Wet cure panels by covering all exposed surfaces with wet burlap, cotton mats, or both and plastic sheets.  
   2. Keep the burlap and cotton saturated throughout the wet cure.  
   3. The wet cure may be reduced to 7 days at a 10 percent pay disincentive.
2.3 QUALITY ASSURANCE

A. Precast Deck Panels
   1. Prevent cracking or damage during handling and storage of precast units.

   2. Defects and Breakage of Prestressed and Non-stressed Elements
      a. Elements that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review and rejection.
      b. Write proposed repair procedures and obtain approval before performing repairs.
      c. Repair work must reestablish the element’s structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
      d. Determine the cause of any damage and take corrective action.
      e. Failure to take corrective action leading to similar repetitive damage is cause for rejection of the damaged elements.
      f. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.
      g. Full depth cracking and breakage greater than 12 inches long are cause for rejection.

   3. Document all test results. The quality control file will contain at least the following information:
      a. Element identification
      b. Date and time of cast
      c. Concrete cylinder test results
      d. Quantity of used concrete and the batch printout
      e. Form-stripping date and repairs if applicable
      f. Location/number of blockouts and lifting inserts
      g. Temperature and moisture of curing period
      h. Lifting device details, requirements, and inserts

B. Structural Non-Shrink Grout
   1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.
      a. Refer to this Section, article 1.5 B.1.
   2. Repair or refund at the Department's option any bonding failures that occur during the warranty period.
PART 3  EXECUTION

3.1 INSTALL WELDED SHEAR CONNECTORS ON EXISTING STEEL GIRDERS, NEW STEEL GIRDERS, AND NEW CONCRETE BEAMS

A. Install welded shear connectors at the locations shown in the plans.

B. Weld shear studs to steel girders or plates embedded in pre-stressed concrete according to AASHTO/AWS D1.5.
   1. Adjust studs as necessary to provide clearance for bolts in existing bolted splices.
   2. Use method and equipment recommended by the manufacturer of the studs and approved by the Engineer.
   3. Field weld studs using automatic end welding
   4. Use equipment with adequate capacity for the size of stud welded.

3.2 INSTALL NEW ADHESIVE DOWELED ANCHORS IN EXISTING CONCRETE OR PRESTRESSED CONCRETE BEAMS

A. Field drill holes in the top flange of existing concrete and pre-stressed concrete beams.
   1. Locate all internal beam reinforcing before drilling holes.
   2. Avoid drilling through reinforcing steel.

B. Install anchors according to manufacturer’s recommendations. Refer to Section 03211.

3.3 PLACE PRECAST CONCRETE DECK PANELS

A. Fully brace concrete beams or steel girders before placing panels.

B. Place the precast concrete deck panels as shown on the plans.

C. Check the grade of the deck panels after all deck panels are placed and adjusted to provide the elevations shown on the plans.
   1. Check the grade before any post-tensioning of the deck panels, if applicable.

D. Adjust leveling devices in the sequence defined in the erection plan to bring panels to the elevations shown on the plans.
   1. Torque all leveling devices to within 15 percent of each other to provide proper distribution of panel weight to the supporting beams.

E. Prevent shifting of the precast concrete deck panels during the joining of all the deck panels after the proper grade is achieved.
3.4 LONGITUDINAL POST-TENSIONING

A. Cure precast panels 28 days before tensioning any post-installed cables or rods unless otherwise noted in the plans.

B. Design and show in the shop drawings all post-tensioning hardware and blockouts if required.
   1. Manufacturer designed proprietary hardware is acceptable with the Engineer’s approval.

C. Clean and remove all debris from blockouts.

D. Grout shear keyway between panels.

E. Do not begin stressing operations until the concrete reaches the strength and age designated on the plans.
   1. Stress strands within 72 hours of transverse joint grouting.

F. Do not post-tension until the shear key grout has attained a compressive strength of 1,000 psi (based on manufacturer’s data).

G. Install strands as shown on the plans.

H. Fully tension strand and grout all ducts according to Section 03251S.
   1. Complete post-tensioning before grouting girder camber strips and shear connector grout pockets.

3.5 INSTALLATION OF HEADED T BARS AND ANCHORS

A. Refer to Section 03211.

3.6 PREPARATION AND INSTALLATION OF STRUCTURAL NON-SHRINK GROUT

A. Clean and remove all debris from the camber strips and blockouts before placing 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. Form the girder camber strips as shown in the working drawings after installing shear connectors at the locations shown in the plans.
D. Pre-test grout material installation under field conditions in a grout pocket and camber strip mock-up to determine grout flowability and whether subsequent cracking will occur. Include in the mock-up at least two shear connector pockets and a camber strip that is the same configuration as the actual bridge.
   1. The Engineer will determine the required corrective action.
   2. Proceed with grouting process at the Engineer’s direction.

E. Saturate surface dry (SSD) all surfaces receiving structural non-shrink grout.

F. Mix and place product following manufacturer’s recommendations for preparation and installation.
   1. Mix structural non-shrink grout just before use according to the manufacturer’s instructions.

G. Grout the girder camber strips using structural non-shrink grout.
   1. Place structural non-shrink grout in the girder camber strips in a continuous operation within a panel.

H. Grout the shear stud blockouts using structural non-shrink grout.
   1. Structural non-shrink grout in the shear stud blockouts can be placed as part of the placement of the structural non-shrink grout in the girder camber strips.

I. Do not allow voids in the grout for the girder camber strips and shear stud blockouts.

J. Do not apply superimposed dead loads or live loads to the precast concrete deck panels until the structural non-shrink grout in the shear stud blockouts and the girder camber strips has reached a strength of 1,000 psi based on manufacturer’s published data.

K. Fill all surface voids with non-shrink grout including lifting device blockouts and grout ports.

L. Texture top surface of all grouted blockouts and voids according to Section 03310 for bridge decks.

M. Cure structural non-shrink grout according to 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.
N. Finish grout flush or a maximum of ¼ inch above adjacent panels.
   1. Correct blockout and void profiles in excess of ¼ inch higher than the adjacent panel through surface grinding.
   2. Correct blockout and void profiles below the top of the adjacent panels through removal and replacement of the blockout or void at no cost to the Department.

3.7 DECK GRINDING

A. Profile grind the deck and approaches according to Section 02982 after all panels are in place, grouting and closure pours are complete, and design strength is achieved.

END OF SECTION
SECTION 03340

PRECAST APPROACH SLABS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Procedures for furnishing, erecting, and installing precast concrete approach slab elements for bridges including all necessary materials and equipment to complete the work as shown on the plans. The use of cast-in-place concrete will not be considered for substitution.

B. Procedures for installing elements, placing structural non-shrink grout, and placing high early strength concrete at closure pours.

1.2  RELATED SECTIONS

A. Section 00515: Contract Award and Execution

B. Section 02056: Embankment, Borrow and Backfill

C. Section 02982: Bridge Concrete Grinding

D. Section 03056: Self-Consolidating Concrete (SCC)

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03310: Structural Concrete

G. Section 03575: Flowable Fill

1.3  REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)

C. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

D. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
E. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
F. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
G. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
H. ASTM D 4635: Polyethylene Films Made from Low-Density Polyethylene for General Use and Packaging Applications
I. PCI Design Handbook
J. UDOT Quality Management Plan

1.4 DEFINITIONS

A. Approach Slab – A structural slab that is designed to span from the rear face of the abutment to the sleeper slab. The purpose of approach slabs is to span over any potential settlement of the abutment backfill. The soil under the slab is not intended to support the slab. Support is provided by the abutment and the sleeper slab.

B. Sleeper Slab – A structural slab that is designed as a transition from the approach slab to the approach roadway pavement. The sleeper slab bears directly on the subgrade and supports the end of the approach slab. The joint between the sleeper slab and the approach slab is used to accommodate the thermal movement of the bridge. This is accomplished with a structural expansion joint.

C. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

D. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.
1.5 SUBMITTALS

A. Working Drawings
1. Detailed shop drawings of all fabricated materials for approval.
   a. Include the following:
      1) Locations and details of all lifting inserts, hardware, or devices.
      2) Type and amount of any additional reinforcing required for lifting.
      3) Locations and details of vertical adjusting hardware.
      4) Minimum compressive strength required before handling the precast elements.
   b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
   c. Include supporting engineering calculations.
   d. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.
2. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.
3. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or at the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
4) Contractor, Fabricator, or Erector Name
5) Contractor, Fabricator, or Erector Drawing Number
6) Contractor, Fabricator, or Erector Sheet Number

b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.

c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.

4. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

5. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Materials

1. Structural Non-Shrink Grout
   a. Certificate of Compliance to the Engineer.
   b. Proposed method, sequence, and equipment for forming grout voids and installing the structural non-shrink grout to the Engineer for approval 14 days before beginning installation of structural non-shrink grout.
   c. Warranty letter to the Engineer before acceptance is given stating that the structural non-shrink grout manufacturer and the Contractor jointly guarantee the grout against all bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
      1) The warranty period starts on the date of owner acceptance, typically the date traffic is allowed on the bridge.
   d. Manufacturer Warranty Bond for the total price of the installed structural non-shrink grout.
      1) Calculate the total price by using the volume of structural non-shrink grout shown on the plans and the average installed price for grout obtained from the manufacturer.
      2) Warranty period covers the period of time specified in the Warranty letter submitted to the Engineer.
      3) 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.
4) Proof of bond to the Engineer before placing the grout.

2. Concrete
   a. Refer to Section 03056 or Section 03310.

C. Repair Procedure
   1. Written procedure for defects and breakage of precast elements, for approval.

D. Casting Schedule
   1. Provide the Engineer a tentative casting schedule at least two weeks in advance to make inspection and testing arrangements. A similar notification is required for the shipment of precast elements to the job site.

PART 2   PRODUCTS

2.1 MATERIALS

A. Concrete
   1. Precast elements – Use Class AA (AE) structural concrete as specified in Section 03310 or Section 03056 and on the plans.
   2. Bedding under sleeper slabs – Use flowable fill conforming to the requirements of Section 03575 or free draining granular backfill conforming to the requirements of Section 02056.
   3. High Early Strength Concrete
      a. High Early Strength Concrete will only be allowed in closure pours as shown on plans.

B. Reinforcing Steel
   1. Refer to Section 03211.

C. Structural Non-Shrink Grout
   1. Use structural non-shrink grout for bedding under the approach slab at the sleeper slab support as shown on the plans.
      a. Use gray, non-shrink grout concrete containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
      b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
      c. Use a grout that is flowable.
d. Meet 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.

e. Refer to Table 1 for structural non-shrink grout requirements.

<table>
<thead>
<tr>
<th>*Properties</th>
<th>Requirements</th>
<th>ASTM</th>
<th>AASHTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated Weathering</td>
<td>Tested Medium</td>
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<tr>
<td>Accepted Weight Loss</td>
<td>&lt;3% White Utah Road Salt</td>
<td></td>
<td>T 161</td>
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<td></td>
<td>&lt;15% @ 300 Cycles</td>
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<tr>
<td>Compressive Strength</td>
<td>≥3,000 psi @ 24 hours</td>
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<td>T 106</td>
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<tr>
<td></td>
<td>&gt;5,000 psi @ 7 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accepted Bond Strengths</td>
<td>&gt;1,000 psi @ 24 Hours</td>
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<td>C 882</td>
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<tr>
<td>Length Change</td>
<td>No expansion after 7 days</td>
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</tbody>
</table>

* Certified test results from an AASHTO accredited testing laboratory will suffice for acceptance.

D. Bond Breaker Material
1. Provide low density polyethylene sheet according to ASTM D 4635 that will allow sliding of the structural concrete after placement.
   a. Supply sheets that are ⅛ inch thick.
   b. Two layers are required at each interface.

E. Steel Bearing Plate
1. Provide a steel bearing plate as shown in the plans.

F. Polystyrene Forming Material
1. Provide expanded polystyrene sheet according to ASTM C 578.

G. Lifting Devices
1. Use devices that can support the required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
   2. Use a device that will have 2¾ inch top cover and 1 inch bottom cover after installation. This may require partial removal of the device after installation.

H. Miscellaneous Steel Items
1. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.
I. High Density Polyurethane Foam
   1. Use water based formulation of expanding high-density polyurethane that will set to full compressive strength within 15 minutes after injection.
   2. Polyurethane properties – Refer to Section 02755.

2.2 FABRICATION

A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all the materials in the precast elements.

C. Finish the precast elements according to Section 03310. Texture the top surface of the elements according to the requirements of Section 03310 for final texturing of approach slabs.

D. Construct precast elements to the tolerances shown on the plans.

E. Maintain a minimum compressive strength of 500 psi before stripping the form.

F. Permanently mark each precast element with the date of casting and supplier identification. Stamp markings in fresh concrete.

G. Wet cure elements for 14 consecutive days. This cure is to begin immediately after performing the final finish.
   1. Wet cure by covering all exposed surfaces with wet burlap, cotton mats, or both, and plastic sheets.
   2. Maintain a saturated condition for the burlap and cotton for the entire duration.
   3. The duration of the wet cure may be reduced to 7 days at a 10 percent pay disincentive.

2.3 QUALITY ASSURANCE

A. Precast Approach Slab Elements
   1. Prevent cracking or damage of precast elements during handling and storage.
   2. Replace defects and breakage of precast elements.
      a. Members that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review or rejection.
b. Obtain approval before performing repairs.

c. Repair work must reestablish the elements’ structural integrity, durability, and aesthetics to the satisfaction of the Engineer.

d. Determine the cause when damage occurs and take corrective action.

e. Failure to take corrective action leading to similar repetitive damage can be cause for rejection of the damaged element.

f. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.

g. Full depth cracking and breakage greater than 1 ft are cause for rejection.

3. Document all test results. The quality control file will contain at least the following information:

a. Element identification

b. Date and time of cast

c. Concrete cylinder test results

d. Quantity of the used concrete and the batch printout

e. Form-stripping date and repairs if applicable

f. Location or number of blockouts and lifting inserts

g. Temperature and moisture of curing period

h. Lifting device details, requirements, and inserts.

B. Structural Non-Shrink Grout

1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.

a. Refer to this Section, article 1.5 B.1.

2. Repair or refund at the Department's option any bonding failures that occur during the warranty period.

PART 3 EXECUTION

3.1 INSTALLATION OF SLEEPER SLABS AND APPROACH SLABS

A. Establish working points, working lines, and benchmark elevations before placing of all elements.

B. Check the condition of the receiving bonding surface before connecting elements and take any necessary measures to remove items such as dust, rust, and debris to provide the satisfactory bonding required.

C. Place elements as shown on the plans.

1. Adjust the height of each element with leveling devices or shims.
D. Lift sleeper slab segments using lifting devices as shown on the shop drawings.

E. Set sleeper slab in the proper horizontal location.
   1. Check for proper alignment and grade within specified tolerances.

F. Adjust sleeper slabs before full release from the crane to facilitate the vertical adjustment process. This will reduce the amount of torque required to turn the bolts in the leveling devices.
   1. Check for proper grade within specified tolerances.

G. Pour or pump flowable bedding concrete through the ports.
   1. Start from the center of the sleeper slab and proceed toward the outside edges.
   2. Verify that bedding concrete is filling the entire void between the sleeper slab and the subgrade.

H. Do not remove the installation bolts or proceed with the installation of the approach slab until the compressive test result of the cylinders for bedding concrete has reached the specified minimum values.

I. Install bond breaker materials in two layers as shown on the plans.
   1. Seal the edges and joints to prevent concrete or mortar from penetrating the interface between the two sheets. Duct tape is acceptable for this purpose.

J. Lift approach slab using lifting devices as shown on the shop drawings.

K. Set approach slab in the proper horizontal location.
   1. Check for proper alignment and grade within specified tolerances.

L. Survey the top elevation of the approach slab.

M. Adjust vertical leveling devices before full release of the approach slab from the crane. This will reduce the amount of torque required to turn the bolts in the leveling devices.
   1. Check for proper grade within specified tolerances.

N. Prevent shifting of the precast approach slab panels during installation.

O. Clean and remove all debris from the areas that will be grouted before placing the approach slab.

P. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, or any contaminant other than water.
Q. Mix structural non-shrink grout just before use according to the manufacturer's instructions.

R. Pre-test grout material installation under field conditions in a similar void mock-up before construction of the approach slab to determine grout flowability. Include in the mock-up at least two fill ports that are of the same configuration as the actual bridge.
   1. The Engineer will determine the required corrective action.
   2. Proceed with grouting process at the Engineer’s direction.

S. Saturate Surface Dry (SSD) all surfaces receiving structural non-shrink grout.

T. Mix and place product following manufacturer’s recommendations for preparation and installation.
   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.

U. Texture top surface of grouted blockouts according to Section 03310 for approach slabs.

V. Do not apply superimposed dead loads or live loads to the precast approach slabs until the structural non-shrink grout has reached a strength of 500 psi based on manufacturer’s published data.

W. Cure structural non-shrink grout according to manufacturer’s recommendation.

X. Pump high density polyurethane foam under the end of the approach slab if shown on the plans.
   1. Start from the center of the approach slab and proceed toward the outside edges or start from one end and proceed continuously to the other end.
   2. Check that high density polyurethane foam is filling the entire void between the approach slab and the sleeper slab.

Y. Set prefabricated joint extrusions as shown on the plans.

Z. Cast closure pours as shown on the plans.
   1. Apply broom finish to top surface.

AA. Cure closure and pour concrete.
3.2  DECK GRINDING

A. Profile grind the deck and approaches according to Section 02982 after all panels are in place, grouting is complete, and design strength is achieved.

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 co-polymer (Type 1)
   or a modified epoxy polymer (Type 2) with a broadcast aggregate wearing
   surface.

B. Procedures for removing polymer overlay from concrete deck.

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 566: Total Evaporable Moisture Content of Aggregate by Drying

C. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars,
   Grouts, Monolithic Surfacings, and Polymer Concretes

D. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete

E. ASTM D 570: Water Absorption of Plastics

F. ASTM D 638: Tensile Properties of Plastics

G. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics
   and Electrical Insulating Materials

H. ASTM D 2240: Rubber Property – Durometer Hardness

I. ASTM D 4263: Indicating Moisture in Concrete by the Plastic Sheet
   Method

J. ASTM D 4285: Indicating Oil or Water in Compressed Air

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January 1, 2012
K. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

L. ASTM E 965: Measuring Pavement Macrotexture Depth Using a Volumetric Technique

M. American Concrete Institute (ACI)

N. International Concrete Repair Institute (ICRI)

1.4 DEFINITIONS

A. Polymer Overlay System – A two-part polymer resin system applied as a wearing surface 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. The name of the polymer overlay manufacturer and the name and phone number of the manufacturer’s Technical Support Representative at the Pre-Construction Meeting.

B. Certificate of Compliance
   1. A certificate of compliance from an independent nationally recognized laboratory stating that the polymer overlay materials meet the requirements contained in this specification, to the Engineer for approval at least 10 days before placement. Additional approval needed for any substitutes.

C. Furnish at least a one quart sample of each component from each lot to the Department laboratory to verify material supplied.

D. A warranty letter to the Engineer and the Department Bridge Operations Engineer before 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 skid resistance less than 40, as measured according to AASHTO T 242.
   1. The guarantee period starts on the date of owner acceptance, typically the date traffic is allowed on the surface.
E. Warranty Bond
1. Provide a manufacturer warranty bond for the total bid price of the installed material.
   a. Calculate the total bid price by using the quantity of polymer overlay material listed in the Engineers Estimate and the average unit bid price for the material obtained from the Construction Division’s Project Development Business System (PDBS).
   b. The quantity will be the actual area of the deck and approach slabs in the absence of a quantity specified in the Engineers Estimate.
2. Warranty period covers the period of time specified in the warranty letter submitted to the Engineer.
3. 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.
4. Proof of bond to the Engineer before placing the material.

PART 2 PRODUCTS

2.1 POLYMER OVERLAY SYSTEM

A. Use a thin bonded polymer bridge deck overlay system using either an epoxy-urethane co-polymer (Type 1) or modified epoxy polymer (Type 2) as specified on the plan or detail sheets that meet the requirements of Table 1 and includes all materials, penetrating crack filler when required by the manufacturer, and polymer resin broadcast that chemically cures to provide an impervious wearing surface.

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<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tr>
<td>Compressive Strength, min. psi</td>
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<td>ASTM C 579</td>
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<tr>
<td>Tensile Strength, min. psi</td>
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<td>ASTM D 638</td>
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<tr>
<td>Tensile Elongation, min. percent</td>
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<td>ASTM D 638</td>
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<td>Water Absorption, max. percent by wt.</td>
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<td>Shore D Hardness, min. 77°F</td>
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</tr>
<tr>
<td>Gel Time, minutes</td>
<td>15-45</td>
<td>ASTM C 881</td>
</tr>
<tr>
<td>Adhesion to Concrete</td>
<td>100% failure in concrete</td>
<td>ACI-503-R, Pull Out Test</td>
</tr>
<tr>
<td>Flexural Yield Strength, min. psi</td>
<td>3,000</td>
<td>ASTM D 790</td>
</tr>
<tr>
<td>Percent Solids</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
1. 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 this Section.
   b. Provide a polymer overlay free of any fillers and volatile solvents. The use of external/conventional flexibilizers is not permitted.
   c. Provide penetrating crack filler system as required by the manufacturer.
   d. Use metered mixing equipment as outlined in this Section with the use of this material.

2. Type 2 – Modified Epoxy Polymer
   a. Provide polymer resins consisting of modified epoxy materials that meet the physical requirements outlined in this Section.
   b. Use of additives, fillers, volatile solvents, and flexibilizers to modify the physical properties of the epoxy to meet physical requirements is 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. A Type 1 epoxy-urethane co-polymer may be substituted for the Type 2 polymer for projects specifying a Type 2 modified epoxy polymer.

B. Provide a penetrating crack filler system as required by the manufacturer.

C. Aggregate
   1. Clean and free of surface moisture according to the requirements in this Section.
   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 according to ASTM D 5821.
   4. Thoroughly washed and kiln dried to maximum moisture content of 0.2 percent by weight according to ASTM C 566.
   5. Use aggregate with the properties shown in Table 2 or with the aggregate with the properties shown in Table 3 with manufacturer’s and Engineer’s approval.
   6. Provide aggregate gradation according to the requirements of Table 4.
Table 2

GLACIAL GRAVEL AGGREGATE PROPERTIES
(BASALT QUARTZITE GRANITE)

<table>
<thead>
<tr>
<th>Properties/Materials</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>75.03</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>11.49</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>3.57</td>
</tr>
<tr>
<td>CaO</td>
<td>2.84</td>
</tr>
<tr>
<td>MgO</td>
<td>1.59</td>
</tr>
<tr>
<td>Na₂O</td>
<td>2.58</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.99</td>
</tr>
<tr>
<td>Combined Alkali</td>
<td>1.11</td>
</tr>
<tr>
<td>Ignition Loss</td>
<td>0.72</td>
</tr>
<tr>
<td>Mohs Scale Hardness</td>
<td>6.50</td>
</tr>
<tr>
<td>ASTM 566 (water absorption)</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Table 3

ABRASIVE FLINT AGGREGATE PROPERTIES

<table>
<thead>
<tr>
<th>Properties/Materials</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>97.70</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>0.45</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.30</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Table 4

AGGREGATE GRADATION

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.187 inch; No.4</td>
<td>100</td>
</tr>
<tr>
<td>0.078 inch; No.10</td>
<td>10 – 35</td>
</tr>
<tr>
<td>0.033 inch; No.20</td>
<td>0 – 10</td>
</tr>
</tbody>
</table>

PART 3 EXECUTION

3.1 STORAGE AND HANDLING

A. Job Site Polymer Material Storage
   1. Transport to and store on the job site in a dry, weather protected facility away from moisture and within the maintained temperature range of 60 to 100 degrees F or according to manufacturer’s recommendations.

B. Handling Liquid Materials on the Job
   1. Use protective gloves, clothing, boots, and goggles when directly exposed to the material.
2. Provide product safety data sheets obtained from the manufacturer to all workers and inspectors.

C. Aggregate
1. Store all aggregate in a dry, moisture-free atmosphere.
2. Fully protect the aggregate from any contaminants on the job site and store so it will not be exposed to rain or other moisture sources.

D. 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

3.2 SURFACE PREPARATION

A. Deck Repair
1. Repair any minor deck surface defects before installing the polymer system using a patch material that meets manufacturer’s recommendations and is compatible with the polymer system being used.
2. Provide patch materials free of magnesium phosphate.
3. Verify moisture content of patch meets other requirements of this Section before applying overlay.

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.
2. Use sandblasting equipment or mechanical grinders with approval of the manufacturer and Engineer in areas that cannot be reached with the steel shot-blasting.
   a. Perform this operation before shot-blasting whenever practical.
3. Produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 5-7 or ASTM E 965 Pavement Macro-Texture Depth of 0.04 to 0.08 inch.
C. Traffic
1. Do not allow traffic on any portion of the deck that has been shot-blasted.
2. Only allow overlay equipment on cleaned surfaces with manufacturer’s supervision.

D. Weather
1. Verify that all treated surfaces are 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 of application unless otherwise approved by manufacturer and Engineer.
3. Verify the moisture content in the concrete substrate does not exceed 4.5 percent when measured by an electronic meter and that it is completely dry according to the method in ASTM D 4263.
4. Apply the polymer overlay system only when the deck and ambient air temperature is a minimum 50 degrees F.

3.3 APPLICATION

A. Concrete Surface
1. Clean the concrete surface and apply a penetrating crack filler system as required by the manufacturer.

B. Use Metered Mixing Equipment for Type 1 Co-Polymers (optional for Type 2 Polymers)
1. Use special equipment capable of metering, mixing, and distributing the polymer.
2. Use machinery that is approved by the manufacturer.
3. Use an application machine that features positive displacement volumetric metering pumps controlled by a hydraulic power unit.
4. Use motionless, in-line mixing so as to not overly shear the material or entrap air in the mix.
5. Maximize material working time by mixing it immediately before dispensing.

C. Thickness of Individual Layers
1. Provide the number of layers and application rates of the liquid in the various layers according to the manufacturer’s recommendations to achieve a minimum overlay thickness of 0.375 inch.

D. Penetrating Crack Filler System (when required by manufacturer)
1. Install according to manufacturer’s recommendations.
E. First and Second Layers of Overlay
1. Completely remove any excess or loose aggregate by vacuum or with compressed air before the application of each layer.
2. Manually or mechanically measure and mix the components as recommended by the manufacturer 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 after application of liquid before broadcasting the aggregate unless directed otherwise by the manufacturer.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Maximum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 90°F</td>
<td>10 minutes</td>
</tr>
<tr>
<td>80°F to 90°F</td>
<td>15 minutes</td>
</tr>
<tr>
<td>70°F to 80°F</td>
<td>20 minutes</td>
</tr>
<tr>
<td>60°F to 70°F</td>
<td>25 minutes</td>
</tr>
<tr>
<td>50°F to 60°F</td>
<td>35 minutes</td>
</tr>
</tbody>
</table>

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 according to Tables 2 or 3 and Table 4 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 layers using a power vacuum or other method.

I. Longitudinal Joints in the Overlay
1. Stagger and overlap joints between successive layers so that no ridges appear between two adjacent lanes.

J. Traffic
1. Do not allow any vehicles on the overlay while it is curing.
2. Allow traffic on the final layer or in between layers after the resin has cured, as determined by the manufacturer, and after removal of all excess and loose aggregate.

3.4 QUALITY CONTROL

A. Technical Support Representative
   1. Manufacturer’s representative must be 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 for at least two years from the time of placement.
   2. Products without a two 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.

3.5 POLYMER OVERLAY REMOVAL

A. Remove existing polymer overlay as required by drawings, specifications, manufacturer, or Engineer.
   1. Remove existing thin bonded polymer overlay from deck with a diamond-tipped grinder.
   2. Do not damage concrete deck or underlying rebar when removing thin bonded polymer overlay.
   3. Repair any damage to bridge concrete or reinforcing steel resulting from polymer overlay removal operations.
      a. Repair concrete at the Contractor’s expense.
      b. Meet the requirements of Section 03934.

END OF SECTION
SECTION 03390

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete curing materials and methods.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO LRFD Bridge Construction Specifications

B. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete

C. ASTM C 1315: Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.

PART 2 PRODUCTS

2.1 CURING COMPOUND FOR STRUCTURAL, ARCHITECTURAL CONCRETE, CURB, GUTTER, FLATWORK, SIDEWALK, DRIVEWAY, CONCRETE SLOPE PROTECTION, AND OTHER CONCRETE ITEMS

A. Refer to ASTM C 309, Type I D, Class A.

2.2 CURING COMPOUND FOR PORTLAND CEMENT CONCRETE PAVEMENT

A. Refer to ASTM C 309, 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 ASTM C 309, 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 ft²/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 area of newly placed concrete damp continuously for 14 days after placement. Do not erode or damage the surface.
B. Other newly placed concrete using 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 14-day curing expires.

3.3 CURE CURB, GUTTER, FLATWORK, SIDEWALK, DRIVEWAY, CONCRETE SLOPE PROTECTION, AND OTHER CONCRETE ITEMS

A. Refer to this Section, article 3.2, paragraph B.

3.4 CURE PRESTRESSED CONCRETE

A. Cure according to this Section, article 3.2, or article 3.10, until concrete has reached a strength of 4,000 psi or as specified in 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. Remove cover after final finishing operations cover and immediately apply curing compound.
   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 curing compound film 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 ft²/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
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  Not Used

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.

B. A random sample may be taken for testing at the Engineer's discretion to verify manufacturer’s product compliance using infrared techniques for the penetrating concrete 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 release agents, 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.

G. Coat only when the outside air temperature will remain between 45 and 90 degrees F for 24 hours.

3.2  APPLICATION

A. Application Rate
   1. Apply according to manufacturer’s recommendations for each of the following surfaces:
      a. Horizontal
      b. Vertical
      c. Overhead

B. Application Drying Time – Select a sealer with maximum drying time of 1½ hours.

C. Apply the concrete sealer evenly at an application rate recommended by the manufacturer.

D. Do not apply sealer to portland cement concrete pavement (PCCP) or other roadway surface.

END OF SECTION
SECTION 03393

CONCRETE HEALER/SEALER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, procedures, and equipment for preparing concrete surfaces and applying a concrete healer/sealer system to bridge decks and approach slabs.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Compliance

B. Section 03934: Structural Pothole Patching

1.3 REFERENCES

A. AASHTO M 92: Wire-Cloth Sieves For Testing Purposes

B. AASHTO T 242: Frictional Properties of Paved Surfaces Using a Full-Scale Tire

C. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete

D. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

E. ASTM D 93: Flash Point by Pensky-Martens Closed Cup Tester

F. ASTM D 638: Tensile Properties of Plastics

G. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer

1. Name and phone number of the Manufacturer’s Technical Support Representative at the Preconstruction Meeting.

2. Furnish at least one-quart sample of each component from each lot to the Department Materials Laboratory to verify material supplied.
B. A warranty letter to the Engineer and the Department Bridge Operations Engineer before final acceptance is given stating that the concrete healer/sealer manufacturer and the Contractor jointly guarantee the concrete healer/sealer surface for three years against skid resistance reduction to less than 40 as measured according to AASHTO T 242.

1. The guarantee period begins on the date of work acceptance, typically the date traffic is allowed on the surface.

PART 2 PRODUCTS

2.1 CONCRETE HEALER/SEALER MATERIALS

A. Use approved low viscosity, low modulus, two component, epoxy based system.

1. Refer to Table 1 for concrete healer/sealer properties.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity (Mixed)</td>
<td>ASTM C 881</td>
<td>&lt; 100 cps</td>
</tr>
<tr>
<td>Tensile Elongation</td>
<td>ASTM D 638</td>
<td>≥ 30%</td>
</tr>
<tr>
<td>Slant Shear Bond Strength</td>
<td>ASTM C 882</td>
<td>&gt; 1500 psi (Moist Cure)</td>
</tr>
<tr>
<td>Flash Point</td>
<td>ASTM D 93</td>
<td>&gt; 140 Degrees F</td>
</tr>
</tbody>
</table>

B. Use dry silica sand for the crack filling and broadcast aggregate according to the following gradation requirements. Refer to AASHTO M 92.

<table>
<thead>
<tr>
<th>Gradation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve</td>
</tr>
<tr>
<td>No. 8</td>
</tr>
<tr>
<td>No. 20</td>
</tr>
</tbody>
</table>

C. Use materials to prevent the system from leaking through the underside of the deck as recommended by the manufacturer and approved by the Engineer.
PART 3 EXECUTION

3.1 DELIVERY AND STORAGE OF MATERIALS

A. General Requirements
   1. Store sufficient material to perform the entire application within the project limits before beginning surface preparation to prevent delays.
   2. Protect materials from the elements to maintain their quality.
      a. Keep the storage space clean and dry.
      b. Keep the storage space temperature within the manufacturer's recommendations. Measure the temperature with a high-low thermometer in the storage space.
   3. Have the manufacturer inspect and verify that the stored materials meet contract requirements immediately before their use even if inspected before storage.
   4. Immediately replace materials rejected because of damage or failure to meet required tests at no additional cost to the Department.

B. Two Component Systems
   1. Deliver materials to the project in their original containers bearing the manufacturer's label specifying the date of manufacturing, batch number, trade name brand, quantity, and mixing ratio.

3.2 SURFACE PREPARATION

A. Debris Containment
   1. Prevent debris from falling into waterways, pedestrian areas, traffic areas, and onto railroad tracks. Refer to Section 01355.

B. Pothole Patching
   1. Repair any minor, visible potholing of the deck or approach slab surface before installation of the concrete healer/sealer system.
   2. Use pothole patching materials that are approved by the manufacturer.
   3. Refer to Section 03934.

C. Clean the surface by automatic shot-blasting before placing concrete healer/sealer.
   1. Use a cleaning unit equipped with a dust collector that recycles the abrasives.
      a. Use a cleaning unit capable of cleaning a minimum of 5 yd²/hr.
   2. Do not gouge the surface during shot-blasting operations.
   3. Collect and dispose of the removed concrete surfacing.
D. Clean the surface and cracks with oil free compressed air. Refer to ASTM D 4285.
   1. Provide a clean, sound, and dry concrete surface before applying the concrete healer/sealer.

E. Perform additional surface preparation if recommended by the concrete healer/sealer manufacturer and approved by the Engineer.

F. Do not allow traffic on any portion of the surface that has been cleaned or on any phase of the application of the concrete healer/sealer system without the written approval of the Engineer.

G. Weather
   1. Keep all surfaces dry at the time of application.
   2. Do not apply concrete healer/sealer when it has rained within 24 hours or is expected to rain within 8 hours or as recommended by the manufacturer.
   3. Do not exceed 4.5 percent moisture content in the concrete substrate when measured by an electronic meter.
   4. Do not apply when the temperature is below 50 degrees F or without written approval of the Engineer.

3.3 APPLICATION

A. Use equipment according to the manufacturer's requirements and approved by the Engineer before beginning any work.
   1. Do not allow oil or other contaminants from the equipment to come in contact with the deck surface.

B. Seal the underside of the deck, as needed, with a patching material to prevent leakage of the concrete healer/sealer.

C. Handle and mix according to the manufacturer's recommendations.
   1. Mix components with a 600-rpm variable speed drill with attached paddle mixer for three to five minutes.
   2. Do not place materials when weather or surface conditions prevent the material from being properly handled, placed, and cured.

D. Apply the concrete healer/sealer to the entire prepared concrete surface.
   1. Completely cover or flood the deck with the material at a rate of approximately 80 ft^2/gal.
      a. Sweep, squeegee, pour, or spray the area with the sealer allowing it to flow into the cracks.
   2. Place all material within five minutes of mixing.
3. Repeat this procedure until all cracks are completely filled and a uniform coating covers the deck.
4. Sweep excess sealer with a broom from tined surfaces after the cracks have been filled and before the material begins to gel.
5. Do not allow excess sealer to plug the tined surfaces of the bridge deck and approach slabs.

E. Broadcast the dry sand aggregate at an amount recommended by the manufacturer.
   1. Broadcast the sand after the final application of the concrete healer/sealer and before the material sets up as determined by the manufacturer’s representative, taking into account specific product properties, deck temperature, and atmospheric conditions.
   2. Apply the sand a maximum of 15 to 20 minutes after application of the concrete healer/sealer.
   3. Avoid excessive broadcasting that can cause the concrete healer/sealer to wick into the sand rather than staying in the cracks.

F. Reapply the concrete healer/sealer and the broadcast sand at no additional cost to the Department if the broadcast sand did not adhere sufficiently to the concrete healer/sealer coating.

G. Remove all excess sand before opening the deck to traffic.

H. Clean or repair any damage or defacement resulting from this work at no additional cost to the Department.

3.4 QUALITY CONTROL

A. Technical Support Representative
   1. Have a technical representative from the concrete healer/sealer manufacturer present during surface preparation and application of the system on the initial structure and for the first day the concrete healer/sealer is used on the project.
      a. The representative is responsible for instructing the workers in proper mixing, application technique, safety precautions, traffic opening time, and environmental requirements.
      b. The representative must be available for consultation but not necessarily present at the job site for the remaining structures.

END OF SECTION
SECTION 03412

PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-tensioning, fabricating, curing, transporting, storing, and erecting pre-stressed concrete members.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete
B. Section 03056: Self-Consolidating Concrete
C. Section 03211: Reinforcing Steel and Welded Wire
D. Section 03310: Structural Concrete
E. Section 03390: Concrete Curing
F. Section 05120: Structural Steel
G. 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
1.4 DEFINITIONS

A. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

B. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

C. Temporary Works – Facilities generally designed and employed by the Contractor in the execution of the work and whose failure to perform properly could adversely affect the character of the contract work or endanger the safety of adjacent facilities, property, workers, or the public. Such facilities include but are not limited to falsework, forms and form travelers, cofferdams, shoring, water control systems, and temporary bridges.

D. Working Force – The force remaining in the prestressing steel after all prestressing losses have either taken place or been provided for. These losses include concrete creep and shrinkage, concrete elastic compression, steel creep, and anchorage take ups.

E. Working Stress – The stress remaining in the prestressing steel after all prestressing losses have either taken place or been provided for. These losses include concrete creep and shrinkage, concrete elastic compression, steel creep, and anchorage take ups.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for approval.
a. Include the following:
   1) 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) 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.

b. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.

2. Erection drawings for all precast, prestressed concrete members.
   a. Fully illustrate the proposed method of erection. Provide complete details of the process including but not limited to the following:
      1) Temporary supports, bracing, guys, dead-men, lifting devices, connection details, and attachments to bridge members.
      2) 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 items such as primary members, secondary members, and connections that must be installed, braced, and properly connected to provide structural integrity and stability.
      5) Incorporate into the plan the requirements from this Section, article 3.9.

b. Include supporting engineering calculations.

c. Provide the seal of a PE or SE licensed in the State of Utah.
   1. The PE or SE must approve all changes to the erection drawings before implementation.

d. Obtain the Department’s approval when specified on the plans.

e. Submit 10 days before beginning erection when approval is not required.

f. Do not begin erection before receiving approval of the erection drawings when approval is required.
3. Drawings for Temporary Works for approval when specified in the contract or requested by the Engineer.
   a. Include detailed plans for items such as falsework, concrete forms, cofferdams, shoring, and temporary bridges.
   b. Include design calculations and supporting data.
   c. Design temporary works according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
   d. Provide the seal of a PE or SE licensed in the State of Utah.
   e. Submit falsework drawings when the height of falsework exceeds 14.0 ft or whenever traffic, other than workers involved in constructing the bridge, will travel under the bridge.
   f. Do not begin work until receiving approval of the drawings and calculations.

4. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

5. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ inch by 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.

c. Certify that engineering calculations have been checked according to the UDOT QC/QA Procedures.

6. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

7. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
   1. Certifications
      a. Certification stating the manufacturer’s minimum guaranteed ultimate tensile strength for each sample of prestressing steel.
      b. AISC Simple Steel Bridge Structures (SBR) Certification for structural steel fabrication.
      c. The certified calibration chart required by this Section, article 3.2, paragraph A.
   
   2. Pre-stressing Steel
      a. 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.
      b. Testing may require 14 calendar days after the date of receipt.

1.6 ACCEPTANCE

A. Girders may be accepted at a reduced price when the average compressive strength is at least 94 percent of the specified strength.
   1. Price reduction factor is as follows:

   \[
   \text{Price Reduction Factor} = 1.00 - 0.30 \left( \frac{f'c - \text{AVG}}{0.06f'c} \right)^2
   \]

   Where:
   \(f'c\) = specified 28-day compressive strength in psi.
   \(\text{AVG}\) = 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. Class AA(AE) concrete according to Section 03055, except as modified below:
   1. Portland Cement – Type I or Type II, or Type III, low alkali.
      a. Type III cement – according to ASTM 150, Table 2, for moderate sulfate resistance.
   2. Minimum compressive strength 5,000 psi at 28 days or as shown in the plans.
   3. Minimum compressive strength for transfer of prestressing force is 4,000 psi or as shown in the plans.
   4. Maximum slump is 7 inches.
   5. Use coarse aggregate gradation meeting the ¾ inch No. 4 sieve according to Section 03055.

B. Self-Consolidating Concrete. Refer to Section 03056

C. 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. Refer to AASHTO M 203. Use 0.5 or 0.6 inch diameter, Grade 270.

2.3 REINFORCING STEEL

A. Use coated reinforcing steel according to Section 03211.

2.4 ELASTOMERIC BEARING PADS

A. Refer to Section 05822.

2.5 ZINC RICH PAINT

A. Refer to US Military Specification MIL-P-24441/20.

2.6 MISCELLANEOUS STEEL ITEMS

A. Threaded Rods – Refer to AASHTO M 270, Grade 36.

B. Carbon-Steel Shapes and Plates – Refer to AASHTO M 270, Grade 36.

D. Welding – Refer to AASHTO/AWS D1.5.

E. Galvanize all structural steel items permanently cast into concrete according to AASHTO M 111.

2.7 QUALITY ASSURANCE

A. Use a Department prequalified supplier of precast concrete products according to the UDOT Quality Management Plan 505: Precast/Pre-stressed Concrete Structures.

PART 3 EXECUTION

3.1 FABRICATION

A. Comply with camber and dimensional tolerances of PCI MNL 135.

B. Fabricate structural steel according to 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 so 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. Maximum temporary tensile stress (jacking stress) in prestressing steel must not exceed 75 percent of the specified minimum ultimate tensile strength.

E. Anchor the prestressing steel at stresses (initial stress) that result in the ultimate retention of working forces not less than those shown.

F. The stress loss in pretensioned, prestressing steel due to creep and concrete shrinkage, steel creep, and concrete elastic compression is as shown in the plans.

G. 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.

H. Re-tension all strands that show a loss of prestress in excess of three percent.
I. 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.

J. 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 approval.

K. 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.

L. 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 at least 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 according to 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 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 according to 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 will 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
   1. Seven days before placement.

B. Trial Batch
   1. Certified test results or conduct laboratory trial batch to verify strength before placement.

PART 2  PRODUCTS

2.1 MATERIALS
A. Cement – Refer to Section 03055.
B. Pozzolan – Refer to Section 03055.
C. Sand
D. Coarse aggregate – Determine a suitable aggregate size and gradation for the intended application.

E. Admixtures
   1. Water reducers and set accelerators. Refer to AASHTO M 194.
   2. Air entrainment. Refer to 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.
   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. Procedure, material, and equipment for raising an approach slab by pumping cement grout or injecting polyurethane underneath.

1.2 RELATED SECTIONS

A. Section 02755: Concrete Slab Jacking
B. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM C 1107: Packed Dry, Hydraulic-Cement Grout (Nonshrink)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Certification
   1. Provide compliance certifications for the mix design materials conforming to the requirements of the referenced specifications.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish all equipment necessary to perform this work.

B. 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.

C. Provide water storage tank and a pump to deliver water to the grout mixer.

D. Grout Device
   1. Cement injection pump.
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.

E. Elevation measuring devices with an accuracy of ¼ inch.

2.2 NON-SHRINK GROUT

A. Use packaged dry, hydraulic-cement grout (non-shrink) according to ASTM C 1107.

2.3 HIGH DENSITY POLYURETHANE

A. Use water based formulation of expanding high-density polyurethane that will set to full compressive strength within 15 minutes after injection for raising slabs.

B. Polyurethane properties – Refer to Section 02755.

PART 3 EXECUTION

3.1 PREPARATION

A. Establish a final target pavement profile using elevation measuring device or string lines.

B. Locate structural steel with ferroscanning or other methods approved by the Engineer. Do not damage any existing rebar. The Department does not allow for additional compensation for repair of damaged rebar. Develop a repair procedure to be approved by the Engineer if rebar is damaged.

C. Drill a minimum of four evenly spaced holes into each half of every approach slab where required to obtain uniform grout or polyurethane placement. Drill vertical holes that are round.

3.2 INSTALLATION

A. Pump, in a pattern, the amount required to completely fill the voids underneath the slab. Raise the approach slab to within plus or minus ¼ inch from a longitudinal string line grade.

B. Remove polyurethane material from the drill holes at the completion of the pumping operation and clean the circumference of the hole.
C. Seal the holes with at least 4 inches of non-shrink grout. Refer to ASTM C 1107.

D. Grind the material used to fill the holes flush with the top of the approach slab.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, procedures, and equipment for the repair of columns, pedestals, bent and pier caps, diaphragms, wingwalls, abutment backwalls, beam ends, and parapets.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Compliance
B. Section 03055: Portland Cement Concrete
C. Section 03310: Structural Concrete
D. Section 03390: Concrete Curing
E. Section 03392: Penetrating Concrete Sealer

1.3 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives
B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
C. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
D. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
E. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
F. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
G. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
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 two years experience in the methods and materials of the selected system for application of epoxy injection according to 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. Delamination Repair
   1. Rebuild the areas to original shape, ± 1/8 inch.
   2. Remove and repair if the patching fails to bond. Department does not allow additional compensation for repair of failed patches.

B. Epoxy Injection
   1. Penetration of 95 percent of all cracks from $\frac{1}{64}$ inch to $\frac{1}{4}$ 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 ASTM C 882 and C 928.

B. Repair Concrete
   1. Portland Cement Concrete – Class AA(AE). Refer to Section 03055.
   2. Aggregate – $\frac{3}{4}$ 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 required application.

E. Epoxy Injection
   1. Use only products acceptable for vertical crack injection as 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. Penetrating Concrete Sealer – Refer to Section 03392.

2.2 EQUIPMENT REQUIREMENTS

A. Repair Concrete Mixer
   1. Use a small mixer to batch out the repair concrete as approved by the Engineer.

B. Epoxy Injection Machine
   1. Use at least two pumps having the following characteristics:
      a. Electric-powered and portable
      b. Positive displacement
      c. Positive-ratio control of exact proportions of the two components at the nozzle
      d. In-line metering and mixing
   2. Automatic pressure control capable of discharging the mixed adhesive at any preset pressure up to 200 psi ± 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 ± 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. Sandblaster
   1. Supply a sandblaster that meets the requirements in ASTM D 4285 when required.

D. Jackhammer
   1. 30 lb class
   2. 15 lb class

PART 3 EXECUTION

3.1 PREPARATION FOR STRUCTURAL CONCRETE REPAIR

A. Locate the repair areas. 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.
      a. Use 30 lb class jackhammer.
      b. Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface.
      c. Protect any reinforcing steel encountered.
      d. Replace or repair any reinforcing steel damaged at no cost to the Department.
      e. Do not use pneumatic hammers heavier than 15 lb class for removals in areas directly below the top reinforcing steel.
   3. Remove all loose materials by dry sweeping.
   4. Sandblast clean all exposed reinforcing steel and concrete surfaces before placing new concrete.
      a. Protect in place any sound rebar.
      b. Sandblast with an air compressor that meets the requirements in ASTM D 4285.
   5. Prevent sandblasting material and debris from falling into waterways, pedestrian areas, traffic areas, or onto railroad tracks.
   6. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
   7. Repair the surface of damaged rebar before placing concrete.
      b. Galvanized rebar repair – Refer to ASTM A 780.
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 $\frac{1}{64}$ inch to $\frac{1}{4}$ inch wide by epoxy injection and sealing.

B. Repair cracks greater than $\frac{1}{4}$ 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 the next 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 manufacturer’s recommendations. Do not exceed the following times between coats:
Table 1

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<td>77</td>
</tr>
<tr>
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<td>90</td>
</tr>
</tbody>
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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 three 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. Follow 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 according to Sections 03310 and 03390.
   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. Sandblast with an air compressor according to the requirements in ASTM D 4285.

C. Coat concrete surfaces with the manufacturer’s recommended primer for the particular patching concrete.

D. Place concrete within the manufacturer’s prescribed time period after sandblasting and prime coating have 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 if the patch fails and begin the repair process over by starting with sandblasting.

F. Finishing Surfaces
1. Provide a uniform color that matches the 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 treatment, approved by the Engineer, 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 SEALING

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. Refer to 01355.

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 02056: Embankment, Borrow, and Backfill
B. Section 03055: Portland Cement Concrete
C. Section 03152: Concrete Joint Control
D. Section 03211: Reinforcing Steel and Welded Wire
E. Section 03310: Structural Concrete
F. Section 03390: Concrete Curing

1.3    REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
C. 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 Class A(AE) – Refer to Section 03055.
B. Reinforcing Steel and Welded Wire – Refer to Section 03211.
C. Backer Rod – Refer to Sections 03310 and 03152.
D. Rigid Plastic Foam – Refer to ASTM C 578.
   1. Type 9, Density of 2 lbs/ft$^3$.
E. Joint Sealer (Structures) – Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare the subgrade of the area to be paved.
   1. Smooth and shape the berms and slopes. Excavate for cutoff walls where required.
   2. Fill depressions with untreated base course material, grade, and compact.
   3. Firmly compact the subgrade. Refer to Section 02056.
   4. Thoroughly sprinkle the surface with water before placing the concrete. The Engineer will approve all surfaces before concrete is placed.

3.2 PLACE RIGID PLASTIC FOAM

A. Place rigid plastic foam material 1 inch thick against the surface of all structural members before placing the concrete slope protection.
B. Anchor the rigid plastic foam in place with a compatible adhesive.
C. Recess the rigid plastic foam in the joints against structural members so a groove is formed above the rigid plastic foam filler.

3.3 PLACE CONCRETE

A. Place concrete slope protection within 7 days after removing concrete slope protection. Refer to Sections 03055, 03152, 03211, and 03310.
B. Make concrete of a consistency so it can 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.

3.4 **FINISH AND CURE CONCRETE**

A. Use a Floated Surface Finish. Refer to Section 03310.

B. Cure – Refer to Section 03390.

3.5 **SEAL JOINTS AND CLOSURES**

A. Place the backing rod and sealant when the concrete has properly cured.
   1. Provide concrete surfaces in the joints that are 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 joints by sandblasting.

B. Place the sealant with hand or power operated caulking guns in joints after placing the backing rod and in the recess above the rigid plastic foam.
   1. Place sealant when the ambient air temperature is at least 50 degrees F and rising.
   2. Start the sealant placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical joints.
   3. Tool the sealant using a concave pointing tool with soap solution until the joints and recess are sealed over completely.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Methods and materials for modifying existing concrete parapet systems.
   1. Meet current standards.
   2. Prepare the parapet system for attachment of guardrail system or precast concrete barrier.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Compliance
B. Section 01571: Temporary Environmental Controls
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 03392: Penetrating Concrete Sealer
H. Section 09981: Concrete Coating

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
E. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

F. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

G. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer’s product data, specifications, and recommended installation instructions.

B. 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. Reinforcing Steel (Coated) – Refer to Section 03211.

C. Connection Bar
   1. Grade 36 – Refer to AASHTO M 270.
   2. Galvanized – Refer to AASHTO M 111.

D. Guardrail Preset Anchors – According to plans.

E. Penetrating Concrete Sealer – Refer to Section 03392.

F. Preformed Joint Filler – Refer to AASHTO M 213.

G. Epoxy Resin Adhesive
   1. Use an appropriate Epoxy Resin Adhesive according to AASHTO M 235. Select Type and Class for the required application.

H. Tinted Concrete Sealer – Refer to Section 09981.

I. Water Repellent – Refer to Section 09981.
PART 3   EXECUTION

3.1 PREPARATION

A. Debris Containment
   1. Prevent debris from falling into waterways, pedestrian areas, traffic areas, and onto railroad tracks. Refer to Sections 01355 and 01571.

B. Locate existing electric conduit and protect from damage.

C. Carefully remove existing parapet railing and brackets and deliver to the Department maintenance shed designated by the Engineer.

3.2 CONCRETE REMOVAL

A. Parapet Modification
   1. Refer to this Section, article 1.5, paragraph B.
   2. Remove the existing parapet concrete. Prevent damage to wingwalls, deck surface, and existing rebar that will remain.
   3. Remove loose and spalled concrete.
   4. Sandblast clean all concrete surfaces before placing new concrete.

B. Parapet End Modifications
   1. Refer to this Section, article 1.5, paragraph B.
   2. Make saw cuts 1 inch deep to define the work area.
   3. Remove concrete using 90 pound class, hand-held jackhammers or smaller. Prevent damage to wingwall, deck, and existing rebar that will remain.
   4. Remove approach slab curb between the parapet end and the approach slab end.
   5. Remove loose and spalled concrete.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel
   1. Refer to the plans for specific directions.
   2. Thoroughly clean by sandblasting remaining steel of all corrosion and adhering materials. Protect in place any sound rebar.
   3. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
   4. Repair the surface of damaged rebar before placing concrete.
      b. Galvanized rebar repair – Refer to ASTM A 780.
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 CONNECTION BARS
A. Provide two bars for each parapet end modification and each parapet modification except where noted otherwise.

3.5 FORMS
A. Clean forms thoroughly before applying concrete coating.
B. Coat forms with a release agent that does not stain concrete or impair bonding properties of any concrete protective surface coating.

3.6 PLACE CONCRETE
A. Clean concrete and steel surfaces. Dampen existing concrete before placing new concrete.
B. 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.
C. Refer to Sections 03055 and 03310.

3.7 FINISH
A. Refer to Section 03310.

3.8 CURING
A. Refer to Section 03390.

3.9 COAT CONCRETE SURFACES
A. Prepare concrete surface and apply penetrating concrete sealer to the top and traffic face of the parapet according to Section 03392.
B. Prepare concrete surface and apply water repellent to the top and traffic face of the parapet when color is specified. Apply tinted concrete sealer where specified. Refer to Section 09981.
   1. Match color of existing concrete.
   2. Restore to a uniform color when any concrete surface of the structural members becomes stained.

3.10 CLEAN UP

A. Remove sandblasting materials and debris from the deck or approach slab after the work is complete.

END OF SECTION
SECTION 03934

STRUCTURAL POTHOLE PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures, materials, and equipment used for pothole repair and delaminated areas on bridge decks and approach slabs.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Compliance
B. Section 01571: Temporary Environmental Controls
C. Section 03055: Portland Cement Concrete
D. Section 03211: Reinforcing Steel and Welded Wire
E. Section 03310: Structural Concrete
F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives
B. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
C. ASTM C 882: Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
D. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
E. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
F. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS

Not Used
1.5 **SUBMITTALS**

A. A plan for handling water approved by the Engineer before the hydro-demolition 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 – Refer to ASTM C 882 and C 928.

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
   1. 30 lb class
   2. 15 lb class

B. Hydro-Demolition 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 with a 60 degree or less angle of impingement 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 before 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 lb class jackhammer.
         1) Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface.
         2) Protect any reinforcing steel encountered.
         3) Replace any reinforcing steel damaged at the contractor’s expense.
      c. Do not use pneumatic hammers heavier than 15 lb class for removal in areas directly below the top reinforcing steel.
      d. 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 with 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 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 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 lanes.

d. Use the jackhammer method to remove concrete that cannot be removed with the hydro-demolition equipment.

B. Deck Blow Through
   1. Immediately stop the equipment and notify the Engineer and make the necessary adjustments to limit the area of complete concrete removal if removal blows completely through the bridge deck. 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 minimum 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 before placing new concrete. Protect in place any sound rebar. Reblasting will be required if blasted rebar is left overnight.

B. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.

C. Repair the surface of damaged rebar before placing concrete.
2. Galvanized rebar repair – Refer to ASTM A 780.

D. Place concrete within eight hours after sandblasting has been completed.

E. Provide new rebar splices of equivalent size to existing rebar wherever a section loss greater than 50 percent occurs. Refer to Section 03211.

F. Place concrete and strike off level with deck surface. Refer to Sections 03390 and 03310. Cure a minimum of four days using the wet cure method. Follow the manufacturer’s requirements if using Rapid Setting Repair Mortar.

G. Patch failure – Remove the patch completely and repair the pothole again if the patch fails to bond to the existing concrete.

3.5 PROTECTION

A. Prevent debris from falling into waterways, pedestrian areas, traffic areas, or railroad tracks. Refer to Section 01355.
SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for fabricating and erecting structural metals.

1.2 RELATED SECTIONS

A. Section 01455: Materials Quality Requirements
B. Section 05822: Bearings
C. Section 09972: Painting for Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
B. AASHTO M 270: Structural Steel for Bridges
C. AASHTO M 291: Carbon and Alloy Steel Nuts
D. AASHTO M 292: Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both
E. AASHTO M 293: Hardened Steel Washers
F. AASHTO LRFD Bridge Construction Specifications
G. AASHTO LRFD Bridge Design Specifications
H. AASHTO/AWS D1.5 Bridge Welding Code
I. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
J. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
K. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners

L. American Institute of Steel Construction (AISC)

M. Society for Protective Coatings (SSPC)

N. UDOT Quality Management Plan

O. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS

A. Primary Members – A member designed to carry the internal forces determined from an analysis.

B. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

C. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

D. Temporary Works – Facilities that are generally designed by the Contractor and employed by the Contractor in the execution of the work, and whose failure to perform properly could adversely affect the character of the contract work or endanger the safety of adjacent facilities, property, workers, or the public. Such facilities include but are not limited to falsework, forms and form travelers, cofferdams, shoring, water control systems, and temporary bridges.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for approval.
      a. The seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) is not required.
2. Erection Drawings for all structural steel members.
   a. Fully illustrate the proposed method of erection. Provide complete details of the process including, but not limited to:
      1) Temporary supports, bracing, guys, dead-men, lifting devices, connection details and attachments to bridge members.
      2) The schedule and sequence of erection, location of cranes, crane capacities, location of lifting points on the bridge members, member weights, and any other assumed loads.
      3) Complete details for all anticipated phases and conditions during erection.
      4) Minimum number of items such as primary members, secondary members, and connections that must be installed and properly connected to provide structural integrity and stability.
      5) Supporting calculations according to the current edition of the AASHTO LRFD Bridge Design Specifications to demonstrate that factored 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 that meets American Institute of Steel Construction (AISC) Manual of Steel Construction requirements.
   b. Include supporting engineering calculations.
   c. Provide the seal of a PE or SE licensed in the State of Utah.
   d. Obtain the Department’s approval when specified on the plans.
   e. Submit 10 days before beginning erection when approval is not required.
   f. Do not begin erection before receiving approval of the erection drawings when approval is required.
   g. The Department prefers an AISC Advanced Certified Steel Erector (ACSE).
3. Drawings for temporary works for approval when specified in the contract or requested by the Engineer.
   a. Include detailed plans for items such as falsework, concrete forms, cofferdams, shoring, and temporary bridges.
   b. Include design calculations and supporting data.
c. Design temporary works according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).

d. Provide the seal of a PE or SE licensed in the State of Utah.

e. Submit falsework drawings when the height of falsework exceeds 14.0 ft or whenever traffic, other than workers involved in constructing the bridge, will travel under the bridge.

f. Do not begin work until receiving approval of the drawings and calculations.

4. Prepare Drawings
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Revise and resubmit drawings when directed by the Department.
   c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

5. Prepare Engineering Calculations:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1 inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.
   c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
6. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

7. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
   1. Manufacturer’s certificate of compliance for nut, bolt, and washer proof load tests as specified. Refer to ASTM F 606 and ASTM A 235.
      a. Provide Certificate showing corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of the testing.
      b. Include rotational capacity and proof load test results.
   2. Certified mill test reports (MTR) for all fabricated structure materials, seven calendar days before fabrication, including materials manufactured outside of the United States. Clearly indicate country of origin on MTR.
   3. Documentation of AISC Certification when required in this Section, article 2.4.

PART 2 PRODUCTS

2.1 STRUCTURAL METALS
   A. Follow AASHTO LRFD Bridge Construction Specifications, Section 11.3, 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 – Refer to ASTM A 325 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. Refer to AASHTO M 291 or AASHTO M 292.
      2. Use heat-treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are specified.
D. Washers – Refer to AASHTO M 293.

E. Direct Tension Indicator (DTI) Washers – Refer to ASTM F 959.

F. Certification of Bolts and Nuts (Black and Galvanized) – Subject to the Rotational Capacity Test, Section 6.3 ASTM A 325 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. Verify the maximum recorded tensile strength is equal to or greater than 1.15 times the required fastener tension as specified.
   3. Verify the measured torque necessary to produce the required fastener tension does not exceed the value obtained by the following equation:
      \[ \text{Torque} \leq 0.25 \text{ PD} \]
      \[
      \begin{align*}
      \text{Torque} &= \text{Measured Torque (foot-lbs)} \\
      P &= \text{Measured Bolt Tension (lbs)} \\
      D &= \text{nominal diameter (feet)}
      \end{align*}
      \]
   4. Proof load test bolts and nuts according to ASTM F 606, Method 1 (Proof Load).
   5. Wedge test bolts and nuts according to ASTM A 325, Section 6.2.

G. Foreign Materials
   1. Meet the Buy America requirements of Section 01455.
   2. Use foreign manufacturers who have previously established the ability to furnish material uniformly and consistently within the specifications if foreign materials are used.

2.3 BEARINGS

A. Refer to Section 05822.

2.4 FABRICATION

A. Fabricate according to AASHTO LRFD Bridge Construction Specifications Section 18, UDOT Steel and Concrete Construction Manual, UDOT Steel Quality Management Plan, and 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. AISC CBR Certification is 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. Refer to AASHTO M 270, Grade 36.

B. Hot-dip galvanize after fabrication. Refer to 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 material and workmanship inspection 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 DTI washers as specified to tighten high strength bolts.
   1. Refer to 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 regardless of which element is turned for tightening.
   4. Review the DTI compression for each bolt after the first connection. Re-evaluate tightening procedure and make corrections as required if over 50 percent of DTI’s tested are fully compressed.

D. Install bolts according to 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 for all girder field splices. Complete the Bolted Diaphragm and Cross Frame Member Certification form for all primary members.
   2. Place direct-tension indicator washer where the washers will not be embedded in concrete, except at locations where the entire joint is encased 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. Fully tighten 50 percent of bolts for field splices and diaphragms. Verify remaining bolts are 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 according to AASHTO/AWS D1.5, except as modified by the contract.

B. Meet the same requirements as shop welds, including inspection by the Department, for field welds.

C. Perform all field welding under the certification when AISC CBR Certification is required for the fabrication of the element.

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 on 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 its bond to temperatures higher than 400 degrees F.

3.5 **SURFACE PREPARATION STEEL**

A. Refer to Section 09972 for surface preparation for painting 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 and SSPC-SP 6.
3. Commercially blast the following surfaces according to 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. 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 the 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 according to 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 during erection to produce the proper alignment and camber in the completed structure.
   1. Install cross frames and diagonal bracing as necessary to provide stability and 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 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. 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 and Bolted Diaphragm Connection Certification forms follow.
Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of splices. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done according to the specifications.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all bolts are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

Project Number: Structure Number:

<table>
<thead>
<tr>
<th>Splice No.</th>
<th>Top Flange</th>
<th>Web</th>
<th>Bottom Flange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plates were drawn into contact with each other before final tightening of any bolts.</td>
<td>Contr. Initials</td>
<td>Inspect. Initials</td>
<td>Contr. Initials</td>
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<tr>
<td>Bolts are tightened to spec. Gap under direct tension indicator is less than or equal to 0.005 inch.</td>
<td>Contr. Initials</td>
<td>Inspect. Initials</td>
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</table>

Bolted Diaphragm and Cross Frame Member Connection Certification
Consecutively number diaphragm connections looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of connections. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done according to the specifications.

Do not perform final tightening until the inspector certifies that connection plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all bolts are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

Project Number:
Structure Number:

<table>
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SECTION 05125

PREFABRICATED STEEL TRUSS BRIDGES

PART 1          GENERAL

1.1 SECTION INCLUDES

A. Design, fabrication, and erection of a fully engineered, welded, prefabricated, steel truss bridge including bridge bearings and decking according to specifications and plan details.

1.2 RELATED SECTIONS

A. Section 02821: Chain Link Fencing and Gates
B. Section 03211: Reinforcing Steel and Welded Wire
C. Section 03310: Structural Concrete
D. Section 05120: Structural Steel
E. Section 05822: Bearings
F. Section 06055: Timber and Timber Treatment
G. Section 09972: Painting for Structural Steel

1.3 REFERENCES

A. AASHTO M 232: Zinc coating (Hot-Dip) on Iron and Steel Hardware
B. AASHTO M 291: Carbon and Alloy Steel Nuts
C. AASHTO M 293: Hardened Steel Washers
D. AASHTO M 314: Steel Anchor Bolts
E. AASHTO LRFD Bridge Construction Specifications
F. AASHTO LRFD Bridge Design Specifications
G. AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges
H. AASHTO Guide Specifications for LRFD Seismic Bridge Design
I. AASHTO/AWS D1.5 Bridge Welding Code

J. AWS D1.1 Structural Welding Code

K. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

L. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

M. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners

N. American Institute of Steel Construction (AISC)


P. SSPC-10: Near-White Blast Cleaning

Q. UDOT Quality Control/Quality Assurance (QC/QA) Procedures

R. UDOT Structures Design and Detailing Manual

1.4 DEFINITIONS

1.5 SUBMITTALS

A. Refer to and meet submittal requirements of Section 05120.

B. Provide all Procedure Qualification Records, Welder Qualification Test Records, Quality Control Plan, and visual and nondestructive test reports to the Engineer.
   1. All Procedure Qualification Records and Welder Qualification Test Records must be current within three years of the date fabrication begins.

C. Submit Design Calculations to the Engineer for each truss bridge, bridge deck, and substructure separately endorsed with a seal of a Professional Engineer registered in the State of Utah responsible for the design.
   1. Certify that the design has been check according to the UDOT Quality Control/Quality Assurance (QC/QA) Procedures.
D. Submit Geometry Verification stating that the dimensions, elevations, and layout of the substructure shown in the plans are consistent with the truss. Provide any necessary changes to the substructure. Refer to this Section, article 3.1 paragraph B.

E. Submit anchor bolt requirements. Refer to this Section, article 3.2, paragraph A.

1.6 MANUFACTURER EXPERIENCE

A. Minimum of five years experience designing and manufacturing welded prefabricated steel truss bridges for pedestrian and light vehicle loads.

B. Employ an engineer currently registered in the State of Utah.

C. AISC, Major Steel Bridge (CBR) Certification.

PART 2 PRODUCTS

2.1 STRUCTURAL METALS

A. Follow AASHTO LRFD Bridge Construction Specifications, Section 11.3 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
   1. Refer to ASTM A 325 with the following modifications for 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. Refer to AASHTO M 291.
   2. Use heat-treated Grades DH and 2H except use Type DH3 nuts when Type 3 bolts are called for.

D. Washers
   1. Refer to AASHTO M 293.

E. Load Indicator Washers
   1. Refer to ASTM F 959.
F. Certify Bolts and Nuts (Black and Galvanized) – Subject to the Rotational Capacity Test, ASTM A 325 Section 6.3 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 according to ASTM F 606, Method 1 (Proof Load).
5. Bolts and nuts require wedge tests according to ASTM A 325, Section 6.2.

G. Foreign Materials

1. Do not use foreign manufacturers unless the following requirements are met:
   a. The project contract allows foreign manufacturers.
   b. The foreign manufacturer has previously established the ability to furnish material uniformly and consistently within the Department's standard specifications.

2.3 BEARINGS

A. Refer to Section 05822.

2.4 ANCHOR BOLTS

A. Refer to AASHTO M 314.

B. Galvanize according to AASHTO M 232 requirements.

C. Provide two nuts for jamming per anchor bolt or tack weld one nut in place when fully tightened.
2.5 TIMBER DECKING
A. Treated – Refer to section 06055.
B. S4S, Heart Center (HC), Douglas Fir, Grade No. 2 or better.
C. Use of timber decking will only be allowed with Department approval.

2.6 STRUCTURAL CONCRETE DECKING
A. Refer to section 03310.

2.7 REINFORCING STEEL AND WELDED WIRE
A. Coated – Refer to section 03211.

2.8 CHAIN LINK FENCE
A. Coated – Refer to section 02821.

PART 3 EXECUTION

3.1 DESIGN

B. Verify that the dimensions, elevations, and geometry in the plans are consistent with the truss bridge to be used at the site. Submit Geometry Verification to the Engineer for approval before starting construction of the substructure.

C. Use two parallel trusses consistent with the concept, clear width, and span as shown in the plans with at least one diagonal per panel. The trusses must be main load-carrying members of the bridge. Set camber to offset dead load so the deck follows profile grade. Detail vertical truss members so they appear perpendicular to the grade (horizon) after the bridge is erected and dead loads are applied.

D. Design and detail the bridge to accommodate a “Cold Climate” temperature differential as specified in the AASHTO LRFD Bridge Design Specifications, article 3.12.2.1.
E. Design the safety railing according to AASHTO LRFD Bridge Design Specifications loading requirements.

F. Refer to Section 9, Decks and Deck Systems of the AASHTO LRFD Bridge Design Specifications for the design of the deck.

G. Refer to AASHTO Guide Specifications for LRFD Seismic Bridge Design.

H. Refer to UDOT Bridge Design and Detailing Manual.

3.2 FABRICATION

A. Submit anchor bolt requirements to the Engineer before beginning fabrication.

B. Fabricate the members of each truss (upper and lower chords, diagonals, end posts, and vertical posts) from square and rectangular structural steel tubing.

C. Fabricate the floor beams and stringers from structural steel shapes or square and rectangular structural steel tubing.

D. Fabricate the structure to the clear span, clear width, and railing requirements shown on the plans.

E. Provide a minimum thickness of structural steel limited to ⅜ of an inch.

F. Provide drilled ½ inch diameter weep holes (flame cut holes are prohibited) at the low points of all steel tubing members as oriented in the in-place, completed structure. Provide one weep hole at each end in members that are level or flat. Show weep holes and weep hole locations on the Shop Drawings.


H. Timber Decking
   1. Pre-drill timber deck for all connections to floor beams. Smooth all exposed edges with ⅛ inch radius.
I. Concrete Decking
   1. Provide 6 inch thick minimum concrete deck.
   2. Use shear studs that extend to the center of the deck at a minimum.
   3. Provided a 2 inch minimum clear cover to the top mat of reinforcing steel and shear studs.

J. Horizontal Safety Rails
   1. Provide safety rails to a minimum of 3 ft - 0 inches above the deck surface.
   2. Space horizontal safety rails to prevent a 4 inch sphere from passing through the pickets.

K. Provide chain link fence as shown on the plans.

3.3 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 in plans.

   D. Place bearing so that identification mark is visible after completion of the bridge.

   E. Do not weld exterior plates of bearings unless at least 1½ 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.

3.4 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. Refer to SSPC-SP 6.
3. Commercially blast the following surfaces to meet SSPC-SP 10:
   a. Top chord, diagonals, and top bracing.
   b. Exposed surfaces of bottom chord, floor beams, and bottom bracing.
   c. All welded surfaces.
4. Develop even patinas at completion of welding repair and after surface has been accepted by Engineer.
5. Clean members of any debris after deck concrete is placed.
6. Re-develop patina as needed.

3.5 ERECTION

A. Maintain responsibility for all aspects of structure erection during all stages of construction including the protection of structural steel members, the workers, and the traveling public.

B. Erect structure in compliance with the Erection Plan and in a manner that prevents damage to all elements of the structure.

C. Accurately assemble all parts as specified in the contract documents or erection drawings. Follow any match-marks.

D. Provide any additional materials that are required to keep both the temporary and final stresses within the allowable limits used in design.

E. Carefully handle materials so that no parts will be bent, broken, or otherwise damaged.
   1. Do not injure or distort the members when hammering.

F. Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.

G. 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.

3.6 WARRANTY

A. Provide a warranty bond against defects in design, material, and workmanship for a period of 5 years from the date of delivery. Warranty the timber decking and attachments for a period of 5 years against rot, termite damage, or fungal decay.

END OF SECTION
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: Structural Steel for Bridges

B. AASHTO LRFD Bridge Construction Specifications

C. ASTM A 240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

D. ASTM D 6412: Epoxy (Flexible) Adhesive for Bonding Metallic and Nonmetallic Materials

E. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Refer to Section 05120.

B. Manufacturer’s certificate of compliance for Polytetraflouroethylene (PTFE) coefficient of friction as specified in this Section and AASHTO LRFD Bridge Construction Specifications.

1. Certificate must show corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of all testing.

1.6 PAYMENT PROCEDURES

A. Bearings are included in the contract lump sum price for Structural Steel, Structural Concrete, or Prestressed Concrete.
PART 2  PRODUCTS

2.1  POLYTETRAFLUROETHYLENE (PTFE)

A. Refer to AASHTO LRFD Bridge Construction Specifications, Section 18.

B. Use material composed of either filled or unfilled virgin PTFE sheets as specified.

C. Limit unfilled sheets to a minimum thickness of 0.03 inch and filled sheets to 0.10 inch ± 0.01 inch thick.

2.2  STAINLESS STEEL PLATE

A. Refer to ASTM A 240, Type 304.

B. Limit minimum thickness to 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. Refer to ASTM D 6412.

B. Use epoxy resin, fluorinated ethylene propylene (FEP) film or approved equal.

2.4  ELASTOMERIC BEARING PAD

A. Refer to AASHTO LRFD Bridge Construction Specifications, Section 18.

B. Place so markings are visible.

2.5  PAINTED STRUCTURAL STEEL

A. Painted Structural Steel – Refer to AASHTO M 270, Grade 36.

2.6  MANUFACTURE – PTFE EXPANSION BEARINGS

A. Bond the lower bearing plate 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 stainless steel sliding plate.
   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, 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. Do not exceed 0.10 at 2,000 psi bearing pressure for the coefficient of friction between the PTFE and the stainless steel.

2.7 ANCHOR BOLTS

A. Refer to ASTM F 1554.

2.8 FABRICATION

A. Fabricate according to AASHTO LRFD Bridge Construction Specifications Section 18.1.4.

PART 3 EXECUTION

3.1 ELASTOMERIC BEARING PAD

A. Install according to AASHTO LRFD Bridge Construction Specifications Section 18.1.7 and Section 18.2.6.
3.2  **PTFE BEARING**

A.  Install according to AASHTO LRFD Bridge Construction Specifications Section 18.1.7 and Section 18.8.5.

3.3  **ANCHOR BOLTS**

A.  Install according to AASHTO LRFD Bridge Construction Specifications Section 18.9.3.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing new expansion joint systems.
B. 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

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B. AASHTO M 235: Epoxy Resin Adhesives
C. AASHTO M 270: Structural Steel for Bridges
D. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
E. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures
F. ASTM D 5973: Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing
G. 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.

B. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

C. Approval of Working Drawings – Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for approval.
      a. Include the following:
         1) Joint seal assembly, anchorage components, and method of installation.
         2) Concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel, or other components.
      b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
      c. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.
   2. Prepare drawings according to the following:
      a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
         1) State Project Designation
         2) State Project Name
         3) State Structure Number
         4) Contractor, Fabricator, or Erector Name
         5) Contractor, Fabricator, or Erector Drawing Number
         6) Contractor, Fabricator, or Erector Sheet Number
b. Revise and resubmit drawings when directed by the Department.
c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

3. Allow the Engineer 14 calendar days to review and approve working drawings.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings are submitted.

4. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Materials Submittals
   1. Mill Test Report (MTR) for all structural steel. Provide item number and name on all material submittals. Refer to Section 05120.
   2. Manufacturer’s AISC Simple Steel Bridge Structure (SBR) certificate of compliance.
   3. Welding procedure specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete, Class AA(AE). Refer to Section 03055.

B. 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

C. Lubricating Material – Follow manufacturer’s recommendation and ASTM D 4070.

D. Epoxy Resin Adhesive – AASHTO M 235
   1. Type II.
   2. Choose class rating consistent with the application temperature.

E. Reinforcing Steel (Coated) – Refer to Section 03211.
F. Rigid Plastic Foam – Refer to ASTM C 578.
   1. Any preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less.

G. Neoprene Gland – Refer to ASTM D 5973.
   1. Single layer strip type.
   2. Continuous with no splices unless approved by the Engineer.

2.2 JOINT SYSTEMS LIST

A. The following systems are acceptable and are detailed in the plans.
   1. Watson Bowman Acme Strip Seal System
   2. D. S. Brown Strip Seal System

B. Use only one strip seal system on any single project.

2.3 FABRICATION – EXPANSION JOINT

A. Refer to Section 05120, except AISC, Simple Steel Bridge Structures (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 or necessary construction joint end.

C. Shop Tolerances – Do not deviate in straightness by more than $\frac{1}{8}$ inch for steel surfaces. Do not deviate more than $\frac{3}{32}$ inch for surfaces when string line is stretched between ends and the point of maximum departure from true.

PART 3 EXECUTION

3.1 EXPANSION JOINT MODIFICATION PREPARATION

A. Asphalt Removal
   1. Make saw cuts parallel to existing joints to define the removal area.
   2. Remove asphalt surfacing in such a manner that the concrete deck is not damaged. Repair damage at no additional cost to the Department.

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.

3.2 CONCRETE REMOVAL FOR EXPANSION JOINT MODIFICATION

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 FOR EXPANSION JOINT MODIFICATION

A. Existing Reinforcing Steel – Clean corrosion and adhering materials from remaining steel by sandblasting.
   1. Repair any damage to epoxy coated reinforcing steel at no additional cost to the Department.

B. New Reinforcing Steel – Place coated reinforcing steel after sandblasting operations are complete.

3.4 EXPANSION JOINT SYSTEM INSTALLATION

A. Install expansion joint system using manufacturer’s recommendations.

B. A factory-trained representative must be present during setting of the system, placement of concrete, and installation of the neoprene seal element.

3.5 JOINT WIDTH

A. Form the joint width using rigid plastic foam as shown on the plans. Anchor securely.

B. Maintain separation of sections by placing rigid plastic foam between sections of the concrete parapet.
3.6 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.

C. Place concrete not to impede free movement of expansion joint.

3.7 INSTALL JOINT GLAND

A. Joint glands installed by manufacturer before shipping unless field splices of expansion joint are required.

B. Install joint glands in the field after construction is complete if field splices are necessary.

C. Lubricate the steel extrusion cavity before installing the neoprene gland.

D. Remove the foam used to form the joint opening and any other objects that may interfere with the installation and operation of the gland so the gland convolution hangs freely after installation.

3.8 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

A. Test expansion system in the presence of the Engineer to verify that joint areas can hold a minimum depth of 3 inches of water for one hour without leakage.

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.
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 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. AASHTO M 235: Epoxy Resin Adhesives

D. AASHTO M 270: Structural Steel for Bridges

E. AASHTO M 291: Carbon and Alloy Steel Nuts

F. AASHTO M 293: Hardened Steel Washers

G. AASHTO/AWS D 1.5: Bridge Welding Code (Joint Publication)
H. AASHTO LRFD Bridge Design Specifications

I. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

J. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

K. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures

L. ASTM D 5973: Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing

M. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

A. Modular Expansion Joint System – An extruded joint with two or more neoprene seals held in place by edgebeams that are anchored to the structural elements such as decks and abutment and one or more transverse centerbeams parallel to the edgebeams.

B. Working Drawings – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but required to fabricate, erect, transport or temporarily support the structure or structural elements in the completion of the work.
   1. Working drawings do not supersede the contract drawings.

C. Approval of Working Drawings: Acceptance by the Department for use on the project. The Department will review working drawings for general conformance with the design concept and compliance with the contract documents. Review and approval do not relieve the Contractor from responsibility for errors, correctness of details, conformance to the contract, and the successful completion of the work.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for approval.
      a. Include the following:
         1) Joint seal assembly, anchorage components, and method of installation.
         2) Concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel, or other components.
b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.

c. Include supporting engineering calculations according to the AASHTO LRFD Bridge Design Specifications for all components of the modular expansion joint system.

d. Do not begin work until receiving approval of the shop drawings. The Department will reject units fabricated before shop drawing approval.

2. Temporary bridging plan for any modular expansion joint for approval where construction traffic is anticipated following installation.

3. Prepare drawings according to the following:
   a. Submit drawings electronically in PDF format. Use 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Place the following information in the title block in the lower right corner of each sheet:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   
b. Revise and resubmit drawings when directed by the Department.

c. Provide the seal of a PE or SE licensed in the State of Utah when required in the contract. Place the seal in the lower right corner of each sheet when required.

4. Prepare engineering calculations according to the following:
   a. Submit calculations electronically in PDF format. Use 8½ x 11 inch sheets with a 1-inch blank margin on the left edge or 11 x 17 inch sheets with a 1½ inch blank margin on the left edge. Title block location is at the top of 8½ x 11 inch sheets or the lower right corner of 11 x 17 inch sheets. Place the following information in the title block:
      1) State Project Designation
      2) State Project Name
      3) State Structure Number
      4) Contractor, Fabricator, or Erector Name
      5) Contractor, Fabricator, or Erector Drawing Number
      6) Contractor, Fabricator, or Erector Sheet Number
   
b. Provide the seal of a PE or SE licensed in the State of Utah on all engineering calculations. Place the seal on the calculation cover sheet.

c. Certify that engineering calculations have been checked according to the Department QC/QA Procedures.
5. Allow the Engineer 14 calendar days to review and approve working drawings and supporting calculations.
   a. The Engineer may grant an increase in the number of working days for the project when that time is exceeded.
   b. This review period applies each time the drawings and calculations are submitted.

6. Do not deviate from the approved drawings unless authorized in writing by the Engineer. Assume the responsibility for costs incurred due to faulty detailing or fabrication.

B. Material Submittals
1. Mill Test Report (MTR) for all structural steel. Provide item number and name on all material submittals. Refer to Section 05120.
2. Manufacturer’s AISC Simple Steel Bridge Structures (SBR) certificate of compliance.
3. Welding procedure specifications.

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 according to 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 according to AASHTO M 232.
   1. Bolts ASTM A 325
   2. Nuts AASHTO M 291
   3. Washers AASHTO M 293

E. Lubricating Material – Follow manufacturer’s recommendation and ASTM D 4070.

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 – Refer to ASTM C 578.

   1. Single layer strip type.
   2. Continuous with no splices unless approved by the Engineer.

2.2 JOINT SYSTEMS

A. Use only one modular expansion joint system on any single project.

B. The following systems are acceptable:

C. Design and test according to the current edition of the AASHTO LRFD Bridge Design Specification.

2.3 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. Do not deviate from the string line by more than 1/8 inch for steel surfaces.
   2. Do not deviate more than 3/32 inch for any surface when the string line is stretched between either end or crown point and the point of maximum departure from true.

PART 3 EXECUTION

3.1 MODULAR EXPANSION JOINT MODIFICATION PREPARATION

A. Asphalt Removal
   1. Make saw cuts parallel to existing joints to define the removal area.
   2. Remove asphalt surfacing in such a manner that the concrete deck is not damaged. Repair damage to concrete deck at no additional cost to the Department.
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.

3.2 CONCRETE REMOVAL FOR MODULAR EXPANSION JOINT MODIFICATION

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.

3.3 REINFORCING STEEL FOR MODULAR EXPANSION JOINT MODIFICATION

A. Existing Reinforcing Steel – Clean thoroughly by sandblasting any steel that remains in place of all corrosion and adhering materials.
   1. Repair damage to epoxy coated reinforcing steel at no additional cost to the Department.

B. New Reinforcing Steel – Place coated reinforcing steel after sandblasting operations are complete.

3.4 SYSTEM INSTALLATION

A. Install expansion joint system according to the manufacturer's recommendations.

B. 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.
3.5 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.

3.6 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.

D. Place concrete not to impede free movement of expansion joint.

3.7 INSTALL JOINT GLANDS

A. Install joint glands before shipping unless field splicing modular expansion joint is necessary.

B. Install the joint glands in the field after construction is complete if field splice is necessary.

C. Lubricate the steel extrusion cavity before installing the neoprene gland.

D. Remove the foam used to form the joint opening and any other objects before watertight integrity test. Gland convolution must hang freely after installation.

3.8 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

A. Refer to Section 05832.

3.9 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 LRFD Bridge Construction Specifications
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
A. Manufacturer’s product data, specifications, and recommended installation instructions.

PART 2 PRODUCTS

2.1 STRUCTURAL TIMBER AND LUMBER
A. Refer to AASHTO M 168.
B. Treat, if required, using preservative. Refer to AASHTO M 133.
2.2 POSTS

A. Pressure treated wood posts that comply with the current WWPA Standard Grading Rules or SPIB Grading Rules.

B. Temporary Use Sign Posts
   1. Use only one type of wood species on any one project.
   2. S4S, 80 percent FOHC, Douglas Fir-Larch, Grade No. 2 or better.
   3. Hem-fir, Lodgepole Pine, or Ponderosa Pine, Grade No. 1 or better.

C. Guardrail Post
   1. Use only one species of wood on any one project.
   2. Surfaced or rough-sawn posts and offset blocks.
   4. Grade No. 1 or better.

D. Steel Post with Wood Block
   1. Routed wood offset block of Southern Yellow Pine.
   2. Surfaced or rough-sawn blocks.
   3. Grade No. 1.

2.3 TREATMENT

A. Meet requirements of AASHTO LRFD Bridge Construction Specifications.

B. Treat according to AWPA Standard U1 to the requirements of Use Category 2 (UC2).

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. Procedures for preparation of concrete deck and approach slabs or specified structure joint areas for waterproofing membrane.

B. Materials and procedures for placement of 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 surface is dry.

1.7 SCHEDULE

A. Notify the Engineer at least one week before installing the membrane.

PART 2 PRODUCTS

2.1 RUBBERIZED ASPHALT MEMBRANE

A. Characteristics
   1. Laminate form
   2. Heat resistant
   3. Self-adhesive surface protected by special release paper

B. Mechanical Properties – Refer to Table 1:

Table 1

<table>
<thead>
<tr>
<th>Property</th>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, inch, minimum</td>
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<td>0.065</td>
</tr>
<tr>
<td>Permeance-Perms, grains/sq ft·hr·inhg</td>
<td>ASTM E 96, Method B</td>
<td>0.10</td>
</tr>
<tr>
<td>Tensile Strength, psi</td>
<td>ASTM D 882, modified for 1 inch opening</td>
<td>50</td>
</tr>
<tr>
<td>Elongation, percent</td>
<td>ASTM D 882, modified for 1 inch opening</td>
<td>75</td>
</tr>
<tr>
<td>Puncture Resistance (Mesh), lb</td>
<td>ASTM E 154</td>
<td>200</td>
</tr>
<tr>
<td>Pliability, at -15 degrees F</td>
<td>ASTM D 146</td>
<td>No cracks in mesh or rubberized asphalt when bent 180 degrees over a ¼ inch mandrel</td>
</tr>
</tbody>
</table>

2.2 PATCHING CONCRETE

A. Refer to Section 03934.
2.3 FIBERGLASS MATTING

A. Weight = 1.5 lb/yd²

2.4 BINDER

A. Compatible with the matting material and conforming to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration, 0.1 mm</td>
<td>ASTM D 5</td>
<td>40-82</td>
</tr>
<tr>
<td>Softening point, min.</td>
<td>ASTM D 36</td>
<td>155 degrees F</td>
</tr>
<tr>
<td>380 degrees F. viscosity, cps</td>
<td>ASTM D 3236</td>
<td>1,000 - 1,800</td>
</tr>
</tbody>
</table>

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. Joints and Cracks – Bond a 12 inch wide strip of woven fiberglass reinforcing to the deck over cracks and joints greater than \(\frac{3}{16}\) inch wide using a compatible binder.

3.2 APPLY MEMBRANE

A. Rubberized asphalt membrane – Follow membrane manufacturer’s recommendations for application temperatures, equipment, and procedures.
   1. Primer – 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 or as required by the Manufacturer. 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 plus 1 inch.

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. Materials and procedures for primer and seal coat application to dampproof concrete surfaces.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES
A. ASTM D 41: Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
B. ASTM D 449: Asphalt Used in Dampproofing and Waterproofing
C. ASTM D 1227: Emulsified Asphalt Used as a Protective Coating for Roofing
D. ASTM D 4263: Indicating Moisture in Concrete by the Plastic Sheet Method
E. ASTM D 4479: 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 according to ASTM D 41.

2.2 SEAL COAT

A. Use one of the following:
   1. Hot-Applied Asphalt Seal Coat. Refer to ASTM D 449, Type I.
   2. Cold-Applied Asphalt Seal Coat. Refer to ASTM D 4479, Type I.
   3. Cold-Applied Emulsified Asphalt Seal Coat. Refer to ASTM D 1227, Type III.

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 primary material manufacturer.
   2. Scrub the surface with water and a stiff brush where necessary and as directed by the Engineer.
   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 in the contract.

B. Comply with manufacturer’s written recommendations unless more stringent requirements are indicated or required by project conditions to provide 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 according to the primary material manufacturer’s recommendations before applying subsequent coats.
   3. Allow drying time before backfilling according to the primary material manufacturer’s recommendations.

C. Apply dampproofing to provide a continuous plane of protection on specified concrete surfaces.
   1. Overlap 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 F 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 ft².
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 ft\(^2\) for first coat and 1 gal/100 ft\(^2\) for second coat or 1 trowel coat at not less than 4 gal/100 ft\(^2\).

3.6 COLD-APPLIED EMULSIFIED ASPHALT SEAL COAT

A. Apply two brush or spray coats at not less than 1.5 gal/100 ft\(^2\) for first coat and 1 gal/100 ft\(^2\) for second coat, 1 fibered brush or spray coat at not less than 3 gal/100 ft\(^2\), or 1 trowel coat at not less than 4 gal/100 ft\(^2\).

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
C. Section 03211: Reinforcing Steel and Welded Wire
D. Section 03310: Structural Concrete
E. Section 03390: Concrete Curing
F. Section 03932: Concrete Slope Protection Repair

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
C. Federal Specifications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS
A. Certificates of compliance and sealant material test results for each lot of materials supplied.
PART 2  PRODUCTS

2.1  MATERIALS

A. Portland Cement Concrete: Class A(AE) – Refer to Section 03055.
B. Reinforcing Steel and Welded Wire: Refer to Section 03211.
C. Backer Rod: Refer to Sections 03310 and 03152.
D. Rigid Plastic Foam
   1. Refer to ASTM C 578
   2. Type 9, density of 2 lb/ft$^3$
E. Joint Sealer (Structures) – Refer to Section 03152.

PART 3  EXECUTION

3.1  GROOVE, JOINT, AND CRACK LOCATIONS

A. Mark the existing grooves, joints and cracks, and their limits in the presence of the Engineer. This applies to all grooves, joints, and cracks that require sealing. Refer to Section 03932.

3.2  PREPARE GROOVES, JOINTS, AND CRACKS

A. Remove the existing joint or groove material and all other debris from the designated grooves, joints, and cracks. Remove curing compounds, oil, grease, dirt, and any other foreign materials from the groove, joint, or crack concrete surfaces by sandblasting.

B. Keep concrete surfaces in the grooves, joints, or cracks clean and dry at the time the new backing rod, sealant, or concrete are placed.

C. Re-establish the original joint design by filling vertical or horizontal joints with concrete when joint widths are greater than 2 inches.

D. Fill vertical or horizontal grooves and cracks with concrete when separation widths are greater than 2 inches.

E. Do not place backing rod and sealant until any newly placed concrete has properly cured. Refer to Section 03390.
3.3 SEAL HORIZONTAL GROOVES AND JOINTS
A. Use a backer rod when the joint width is greater than ⅜ inch.
B. Seal the horizontal grooves and joints as field marked.
C. Start at one side and proceed to the other side on horizontal joints.

3.4 SEAL VERTICAL JOINTS
A. Use a backer rod when the joint width is greater than ⅜ inch.
B. Seal the vertical joints as field marked.
C. Work from top to bottom.

3.5 SEAL CRACKS
A. Use a backer rod when the crack width is greater than ⅜ inch.
B. Seal the cracks as field marked.
C. Start on one side and proceed to the other side in horizontal cracks.
D. Work from top to bottom in the vertical cracks.

3.6 SEAL WINGWALLS AND BACKWALL JOINTS
A. Place the rigid plastic foam against the surface of all structural members before placing the joint sealant.
B. Anchor the rigid plastic foam in place with a compatible adhesive.
C. Recess the rigid plastic foam ⅜ inch in the joints so a groove is formed above the rigid plastic foam filler.
D. Fill the recess above the styrofoam with sealant so the joint is sealed over completely.

3.7 PLACE SEALANT
A. Place with a hand or power operated caulking gun after placing the backing rod, if required.
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.

END OF SECTION
SECTION 07922
RELIEF JOINT CRACK SEALING

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Materials and procedures for cleaning and sealing designated relief joints according to the drawings.

1.2  RELATED SECTIONS

A. Section 03152: Concrete Joint Control

1.3  REFERENCES

A. ASTM D 3406: Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements

B. ASTM D 6690: Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS

A. Certification

1. Manufacturer's certification of compliance for all shipments.

1.6  DELIVERY

A. 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>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength Adhesion, 4 hour cure</td>
<td>ASTM D 3406</td>
<td>Section 4.7</td>
</tr>
<tr>
<td>Ductility</td>
<td></td>
<td>12 inches minimum at 0.4 inch/minute at 40 degrees F</td>
</tr>
<tr>
<td>Force-Ductility</td>
<td></td>
<td>4 lbs max.</td>
</tr>
<tr>
<td>Flow</td>
<td>ASTM D 6690</td>
<td>Section 4.3</td>
</tr>
<tr>
<td>Asphalt Compatibility</td>
<td></td>
<td>at 140 degrees F</td>
</tr>
<tr>
<td>Workability</td>
<td></td>
<td>¼ inch penetration</td>
</tr>
<tr>
<td>Curing</td>
<td></td>
<td>45 minutes</td>
</tr>
<tr>
<td>Flexibility, ⅛ inch x 1 inch x 6 inches</td>
<td></td>
<td>no cracks</td>
</tr>
</tbody>
</table>

2.2 EQUIPMENT

A. Sealant Placement Equipment
   1. Use sealant machines capable of circulating hot oil for heat transfer to heat the product.
   2. Do not use direct heat transfer units or tar pots.
   3. Do not exceed the 525 gallon maximum product tank capacity of the sealant placement equipment.

B. Temperature Control
   1. Provide a sealant unit with 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. Follow 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 before 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 with a 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 sealant to designated joints as shown on the plans.

B. Cleaning and Drying
1. Asphalt joints – 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 12 inches wide, centered on the joint.
2. Concrete joints – Clean joints and surface in portland cement concrete by sand blasting before applying the sealant.

C. Fill the joints following the Relief Joint Crack Sealing detail on the plans.

D. Use an appropriate backer rod, compatible with the sealant and all components of the joint sealant system, in the joint opening where the depth and width of the joint opening are greater than 2 inches and ½ inch, respectively.

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: Indicating Oil or Water in Compressed Air

B. ASTM D 4417: Field Measurement of Surface Profile of Blast Cleaned Steel

C. ASTM E 11: Wire Cloth and Sieves for Testing Purposes

D. American Institute of Steel Construction (AISC)

E. Federal Standards

F. Mine Safety and Health Administration (MSHA) Standards

G. National Institute for Occupational Safety and Health (NIOSH) Standards

H. Northeast Protective Coating Committee (NEPCOAT)

I. The Society for Protective Coatings (SSPC)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Materials

1. Source and gradation of the blast abrasive.

2. Type and source of solvent if required.

3. Manufacturer’s information regarding the specified coating materials, including:

   a. Required wet and dry film thickness

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b. Project safety data
c. Thinning recommendations
d. Temperature requirements
e. Profile recommendations
f. Mixing and application procedures
g. Required equipment
h. Method of application
4. Test samples. Refer to this Section, article 1.6.

B. Qualifications, methods, and documentation.
1. Certifications before the preconstruction meeting. Refer to this Section, article 1.7.
2. Detailed plan of protection methods that includes Environmental Protection for approval.
3. Quality Control Plan that contains at a minimum procedures and verification of the following:
   a. Compression air check
   b. Dry film thickness – Refer to SSPC-PA 2
   c. Air temperature
   d. Humidity and dew point
   e. Surface temperature
   f. Abrasive cleanliness check – Refer to SSPC-AB 2
   g. Degree of cleanliness achieved
   h. Surface profile – Refer to ASTM D 4417 method C
   i. Batch number and amount of thinner used
   j. Batch number of paint used
   k. Mixing procedures
   l. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags
4. Daily reports upon request.
   a. Submit no later than 24 hours following the completion of work.

1.6 TEST SAMPLES

A. Department tests paint samples from each batch or lot before use.
   1. Submit samples to the Engineer.
   2. Paints must match the spectrum samples on file in the Department 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. SSPC-QP 1 certification submittal required before the preconstruction meeting.
      b. Remain certified for the duration of the project.
   2. Contractors, subcontractors, and fabricators performing shop surface preparation or coatings applications.
      a. AISC-420-10/SSPC-QP 3 enclosed shop certification submittal required before the preconstruction meeting.
      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 three-part coating system consisting of a zinc primer, epoxy or urethane intermediate coat, and aliphatic urethane top coat from the NEPCOAT Qualified Products List. Refer to http://www.udot.utah.gov/go/standardsreferences.

B. Use paint color No. 26293 for the first field coat and No. 26306 for the top coat following Federal Standard 595.

PART 3 EXECUTION

3.1 GENERAL

A. Use manufacturer’s information regarding the specified coating materials including required wet and dry film thickness, project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.
3.2 INSPECTION

A. Engineer examines surfaces before surface preparation and before application of each succeeding coating. Correct any condition that is determined by the Engineer to negatively affect a proper coating application.

B. Provide safe access to permit inspection of the steel before and after painting. Use rubber rollers or other approved protective devices for scaffold fastenings. Do not mar or damage freshly coated surfaces.

3.3 PREPARE SURFACES

A. Painted steel – Clean surfaces with clean petroleum solvents and then blast clean to a near-white condition following SSPC-SP 10. Use clean oil-free air.

1. Grind off all fins, tears, slivers, and burred or sharp edges present on any steel member or those that result from the blasting operation.
   a. Reblast where needed.
   b. Remove all mill scale.
   c. Do not scar metal.
   d. Grind the edges of all flame cut steel until the hardened edge accepts the blast profile. Refer to ASTM D 4417 method A.
   e. Produce a 0.5 - 3 mils uniform profile not to exceed manufacturer’s recommendation.

2. Remove all abrasive and paint residue using either a commercial vacuum cleaner or by double blowing.
   a. Equip commercial vacuum cleaner with a brush-type cleaning tool.
   b. Double blowing – Vacuum the top surfaces of all structural steel, including items such as top and bottom flanges, longitudinal stiffeners, splice plates, and hangers after the double-blowing operations are completed.

3. Keep the steel dust free and prime within 8 hours after cleaning. Reblast to a near-white condition if any rust is visible before priming.

4. Protect freshly coated surfaces from subsequent blast-cleaning operations.
   a. Repair surface if damaged.
   b. Mask all areas requiring field welding before shop painting.

5. Have the surfaces inspected and approved by Engineer or Construction and Materials Division representative of Department before applying shop coat.
6. Apply the shop coat at the fabrication site. Apply coatings at the fabrication site in an enclosure with a controlled environment to match optimum conditions for application and curing as stated in the manufacturer’s product data sheet.

7. Apply mist coat to the top flange.

B. Field Painting
1. Repair all damage to shop coat that occurs during shipping, handling, and erection.
2. Power wash steel without the field coat to remove contaminants or other foreign matter from the primed surface.
3. Blast clean bolt heads, fasteners, and any rusted areas to a near-white finish. Thoroughly clean the coating surrounding the blasted area and re-prime the same day using organic zinc from the same paint manufacturer and the same dry film thickness specified for the shop coat. Follow SSPC-SP 10.
4. Remove all concrete drippings, abrasive, and paint residue. Vacuum items such as the top and bottom flanges, splice plates, longitudinal stiffeners, and hangers after completing double-blowing operations.
5. Allow the touch-up coat to dry according to manufacturer’s recommendation as listed on the product data sheet.

C. Weathering Steel
1. Refer to Section 05120.

3.4 PREPARE PAINT MATERIALS

A. Mix and thin paint materials according to manufacturer’s product data sheets for both shop and field painting.

B. Mix the paint to a lump-free consistency with a high shear mixer such as a Jiffy mixer according to the manufacturer’s directions.
1. Do not use paddle mixers or paint shakers.
2. Keep paint in the original containers.
3. Mix until all the metallic powder or pigment is suspended and until all paint solids that may have settled to the bottom of the container are thoroughly dispersed.

C. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve according to the material standard. Refer to ASTM E 11.

D. Strain and continuously agitate the mixed material up to and during application.
3.5 APPLY PAINT

A. Apply field coats at the construction site after steel erection work is completed.
   1. Do not apply field coats until Engineer 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.

B. Use wet and dry film thickness gauges for testing the coating thickness during and after application.

C. Apply each coat at proper consistency and thickness according to the manufacturer’s recommendations including field coating. Use pressures recommended by the manufacturer of the coating system when using spray nozzles.

D. Produce a uniform, even coating that bonds to the underlying surface. Refer to SSPC-PA 1.

E. Weather
   1. Follow the manufacturer’s recommendations if weather conditions require paint thinning.
   2. Temperature of the air and the steel must be above 40 degrees F, but not so hot as to cause the paint to blister.
   3. Relative humidity must be less than 85 percent or the combination of temperature and humidity conditions must inhibit surface condensation.
   4. Test humidity by applying a thin film of water to a small area. Surface may be painted if the film evaporates within 15 minutes.
   5. The steel temperature must be a minimum of 5 degrees F above the dew point.

F. Use necessary equipment for the proper application of the specified coating. Observe safety practices found in SSPC-PA Guide 10, “Guide to Safety and Health Requirements.”

G. Blast clean any shop coat that shows any indication of “mud-cracking” or adds more than 7 mils to a soundly bonded coating or bare steel. Refer to SSPC-SP 10.

H. Thoroughly clean areas that have deficient primer thickness to remove all dirt.

I. Apply an intermediate and top coat to any surface at the fabrication site that will be inaccessible for painting after field erection.
J. Do not load structural steel for shipment until shop paint is dry to the touch.

K. Protect all paint systems. Place softeners between plates of cross frames and diaphragms.

3.6 PROTECTION

A. Suspend work if protection is unsatisfactory.

B. Protect pedestrian and vehicular traffic.

C. Protect all portions of the structures that are not to be painted from splatter, splashes, and overspray including superstructure, substructure, slope, and highway appurtenances. Protect areas during painting and blast cleaning operations where other damage can occur.

D. Use barriers during any blast-cleaning operations to protect pedestrians and vehicles and to prevent spreading or falling of abrasive materials and debris on the traveled portions of the pavement. Remove any abrasive materials and debris on pavement, shoulders, or slope paving before reopening work areas to traffic.

E. Provide employees performing the blast-cleaning operations air-supplied blasting hoods approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health.

F. Minimum requirements for the air supply system:
   1. Airline filter, pressure-reducing valve with gauge and pressure release valve.
   2. Do not allow the air supply to be contaminated with harmful materials or elements. Refer to ASTM D 4285.

3.7 QUALITY ASSURANCE

A. Minimum Coating Thickness – Apply two or more coats if the required film thickness cannot be obtained by one coat without producing runs, bubbles, or sags.

B. Refer to SSPC PA 2.

3.8 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 one of the following systems to the areas designated on the plans:
   1. One coat water repellent and two coats tinted concrete sealer.
   2. Two coats sealer.

B. Prepare concrete surfaces and reapply tinted concrete sealer over graffiti.

1.2 RELATED SECTIONS  Not Used

1.3 REFERENCES

A. ASTM D 4262: pH of Chemically Cleaned or Etched Concrete Surfaces

B. ASTM D 4263: Indicating Moisture in Concrete by the Plastic Sheet Method

1.4 DEFINITIONS  Not Used

1.5 SUBMITTALS

A. Materials
   1. Product data for each material proposed for use.
      a. Include manufacturer’s technical information, and manufacturer’s recommendations for surface preparation and application for each material proposed for use.
   2. A one quart sample for testing, manufacturer’s certificate of compliance, and laboratory test results using infrared techniques for each material proposed for use.
   3. Three 8½ inch by 11 inch samples of each concrete coating color required on the project for approval before ordering concrete coating materials.

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. Water Repellent – Use a clear penetrating water repellent as a base coat as specified in the plans. The water repellent coat must be compatible with the concrete sealer.

B. Tinted Concrete Sealer – Use a silicone acrylic concrete sealer that provides a durable, opaque, deep penetrating, water repellent, decorative finish to concrete and masonry surfaces.
   1. Tint the concrete sealer to provide the colors shown on the plans or as specified.

PART 3  EXECUTION

3.1  GENERAL

A. Use only one concrete coating system on an individual structure.

B. Furnish, prepare, apply, cure, and store all materials according to the product manufacturer’s directions and as specified in this Section.
   1. 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 water repellent and tinted concrete sealer to the concrete surfaces shown on the plans.

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 9 or lower according to ASTM D 4262 and no surface moisture according to 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 3,000 psi at a flow rate of 3 to 5 gal/min.
   2. Use a fan nozzle held perpendicular to the surface at a distance of 12 inches to 24 inches.
   3. Prevent overblasting, exposing additional air pockets, disfiguring the surface, or reducing architectural surface textures.
   4. Clean the final concrete surface to be free from release agents, grease, dirt, and any other contaminants. Remove curing compounds that deter penetration of the coating system.
   5. Rinse thoroughly with potable water if detergents or de-greasers are used in the cleaning process.

D. Perform pH test according to ASTM D 4262 before coating concrete surfaces.
   1. Add acid-etch to the power wash stream to reduce the pH if the pH exceeds 9. Rinse acid-etched surfaces with potable water no sooner than one hour after acid etch application and before re-testing the pH level.
   2. Repeat process until the pH level does not exceed 9.
   3. Do not perform pH test when applying coating over an existing coating.

E. Perform chloride test using Chlor*test by Chlor*Rid Company, SCAT test by KTA Tator, or approved equal.
   1. Add a salt remover to the power wash stream to reduce the chloride level and retest the surface if the chloride level exceeds 50 ppm.
   2. Repeat the process until the chloride level does not exceed 50 ppm.

F. Comply with the manufacturer’s recommendations for surface preparation if they exceed the requirements specified in this Section.

3.3 COATING SYSTEM APPLICATION – GENERAL

A. Do not apply the coating if the surface is wet due to rain or other precipitation.
   1. Allow all wet surfaces at least 24 hours to dry before coating.
B. 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.

C. Stir the coating materials thoroughly before and during application.

D. 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 as recommended by the manufacturer.
   2. Spray from multiple angles to ensure that all surface texture impressions are covered.
   3. Spray upper areas from raised platforms.

E. Protect coated surfaces from damage or detrimental elements during drying and curing.

### 3.4 WATER REPELLENT APPLICATION

A. Apply water repellent when required in the plans or as specified.

B. Water repellent is a base coat under two coats of concrete sealer.

C. Follow manufacturer’s recommendations for temperature requirements, application rate, equipment, and any other requirements for application.

D. Thoroughly cure the water repellent a minimum of 24 hours or as recommended by the manufacturer before applying the tinted concrete sealer.

### 3.5 TINTED CONCRETE SEALER APPLICATION

A. Coat only when the outside air temperature will remain between 35 and 100 degrees F for at least 4 hours.

B. Coat areas shown on the drawings and as specified.
   1. Apply a minimum of two coats of the tinted concrete sealer.

C. Apply the first coat evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in one direction.

D. Thoroughly cure the first coat of the tinted concrete sealer a minimum of 3 hours or as recommended by the manufacturer before the second coat of the tinted concrete sealer is applied.
E. Apply the second coat evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in the opposite direction of the first coat.

F. Remove graffiti on previously coated areas by applying the tinted concrete sealer over affected area for a period not to exceed owner’s acceptance.
   1. Evenly apply the tinted concrete sealer at an application rate of 1 gal sealer/350 to 400 sq ft.
   2. Use the same color as the original application.

G. Dilute the tinted concrete sealer with Xylene at a rate of 8 gal/drum or approximately 15 percent when applying the first coat over smooth dense (steel formed) vertical surfaces.
   1. Do not dilute on more porous concrete or when applying the second coat.

H. Comply with the manufacturer’s recommendations for application if they exceed the requirements specified herein.

3.6 FIELD INSPECTION

A. Engineer inspects and approves 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.

3.7 PROTECTION FROM WORK

A. Protect all surfaces that are not to be coated, including structures, slopes, and highway appurtenances, from splatter, splashes, and overspray or when damage during 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 materials and debris from spreading or falling on the traveled portions of the pavement.

C. Suspend work if protection is unsatisfactory.

D. Remove any abrasive material and debris deposited on the structure, pavement, shoulders, or slope protection before reopening work areas to traffic.
3.8 CLEAN UP

A. Follow the manufacturer’s recommendations for cleaning spills and spatters.

3.9 SAFETY PRECAUTIONS

A. Follow safety precautions according to manufacturer’s product data sheets and Material Safety Data Sheet.

END OF SECTION
SECTION 09991
CLEANING AND REPAINTING OR OVERCOATING STRUCTURAL STEEL

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Clean and repaint or overcoat existing structural steel surfaces including all bearing units.

B. Remove existing paint from existing structural steel surfaces.

C. Prepare existing steel surface for repainting or overcoating and paint the cleaned structural steel surfaces.

1.2  RELATED SECTIONS  Not Used

1.3  REFERENCES

A. ASTM D 3359: Measuring Adhesion by Tape Test

B. ASTM D 4285: Indicating Oil or Water in Compressed Air

C. ASTM D 4417: Field Measurement of Surface Profile of Blast Cleaned Steel

D. ASTM D 4541: Pull-Off Strength of Coatings Using Portable Adhesion Testers

E. ASTM E 11: Wire Cloth and Sieves For Testing Purposes

F. Code of Federal Regulations (CFR)

G. Federal Standards

H. Northeast Protective Coatings Committee (NEPCOAT)

I. The Society for Protective Coatings (SSPC)

1.4  DEFINITIONS

A. Overcoating – Spot paint areas with bare steel followed by two coats of paint over the entire surface of each structural steel member.
1.5 SUBMITTALS

A. Materials

1. Source and gradation of the blast abrasive.
2. Type and source of solvent if required.
3. Manufacturer’s information regarding the specified coating materials, including:
   a. Required wet and dry film thickness
   b. Project safety data
   c. Thinning recommendations
   d. Temperature requirements
   e. Profile recommendations
   f. Mixing and application procedures
   g. Required equipment
   h. Method of application
4. Test samples – Refer to this Section, article 1.6.
   a. Cleaning operation samples, disposal evaluation results, and disposal certificates. Refer to this Section, article 3.2 paragraph C.
   b. Samples to the Department and an independent accredited Materials Testing Lab for composition and disposal evaluation.
   c. Paint composition and disposal evaluation results from the independent materials testing lab.
      1) Disposition will be given to the contractor within 30 days.
   d. Disposal certificates for all waste paint.

B. Qualifications, methods, and documentation.

1. Certifications before the preconstruction meeting. Refer to this Section, article 1.7.
2. Detailed plan of protection methods that includes Environmental Protection for approval.
3. Quality Control Plan that contains at a minimum procedures and verification of the following:
   a. Compression air check
   b. Dry film thickness – Refer to SSPC-PA 2
   c. Air temperature
   d. Humidity and dew point
   e. Surface temperature
   f. Abrasive cleanliness check – Refer to SSPC-AB 2
   g. Degree of cleanliness achieved
   h. Surface profile – Refer to ASTM D 4417 method C
   i. Batch number and amount of thinner used
   j. Batch number of paint used
k. Mixing procedures
l. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags
4. Written site specific compliance program documenting the equipment, training, containment, and monitoring system to comply with OSHA’s standard on lead exposure in construction as published in Federal Register, Section 29 CFR 1926.62, May 4, 1993.
a. Worker Health and Safety Program
b. Environmental Protection and Monitoring Program
c. Hazardous Waste Handling and Reporting of Release Program
d. Quality Control Plan and Procedures
e. Refer to SSPC Guide 6 – Guide for Containing Surface Preparation Debris
5. Daily reports upon request.
a. Submit no later than 24 hours following the completion of work.

1.6 TEST SAMPLES
A. Department will test paint samples from each batch or lot before use.
   1. Submit samples to the Engineer.
   2. Paints must match the spectrum samples on file in the Department Central Materials Laboratory.
B. Reject paint that does not match the standard.

1.7 PAINTER AND BLASTER QUALIFICATIONS
A. Contractors and subcontractors performing surface preparation or coatings applications in the field:
   1. Submit SSPC-QP 2 Category A certification before the preconstruction meeting.
   2. Remain certified for the duration of the project.
   3. Do not perform work if certification has expired.
   4. Requests for time extension for any delay to the project completion due to an inactive certification will not be considered and liquidated damages apply.
   5. Notify the Engineer of any changes in certification status.
PART 2 PRODUCTS

2.1 MATERIALS

A. Blasting abrasive – Type and size specified.

B. Solvent – Recommended by the paint system manufacturer.

2.2 COATING SYSTEM

A. Select a complete three-part coating system consisting of a zinc primer, epoxy or urethane intermediate coat, and aliphatic urethane top coat from the NEPCOAT Qualified Products List. Refer to http://www.udot.utah.gov/go/standardsreferences for a link to this list.

   1. Intermediate coat       Color No. 26293
   2. Top coat             Color No. 26306 or as specified

PART 3 EXECUTION

3.1 GENERAL

A. Use manufacturer’s information regarding the specified coating materials, including required wet and dry film thickness, project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.

3.2 PREPARATION – GENERAL

A. Meet soluble salts requirements of SSPC-Guide 15 and the coatings manufacturer.

B. Protection
   1. Fully contain all material resulting from surface preparation and paint overspray.
   2. Enclosure system must withstand extreme high winds.
   3. Protect all portions of the structure that will not be painted.
   4. Protect pedestrian and vehicular traffic. Use barriers during any blast-cleaning operations to protect pedestrians and vehicles and to prevent spreading or falling of abrasive materials and debris on the traveled portions of the pavement. Remove any abrasive materials and debris on pavement, shoulders, or slope paving before reopening work areas to traffic.
C. Recover a minimum of 95 percent of debris from cleaning operation.
   1. Sample debris from cleaning operation.
   2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.
   3. Dispose of waste paint as directed by the Engineer.

3.3 PREPARATION – REPAINTING STRUCTURAL STEEL

A. Clean surfaces including bearing units of all oil, grease, and dirt with clean petroleum solvents or steam cleaning before blasting operation.

B. Blast surfaces clean to near white with 0.5 to 2 mil profile. Refer to SSPC-SP 10.

C. Discoloration, light shadows, or slight streaks caused by stains of rust is not allowed on more than 5 percent of surface area.

D. Define acceptable surface preparation using SSPC-Vis 1.

E. Use SSPC-SP 11 to clean areas such as backside of base plates and corners that cannot otherwise be cleaned.

F. Prime the surface within 8 hours after blasting.

G. Do not prime the surface if rust has started to form. Clean the surface again before applying the prime coat.

3.4 PREPARATION – OVERCOATING STRUCTURAL STEEL

A. Clean designated surfaces of all oil, grease, debris, and dirt with clean petroleum solvents. Follow with high-pressure wash (SSPC-SP 1).

B. Remove all corrosion and all paint that shows peeling, brittleness, checking, scaling, or general disintegration including bearing units.
   1. Use vacuum shrouded power tool cleaning (SSPC-SP 3).
   2. Remove paint from the area and beyond the edges of the area so that remaining paint system shows no rusting or blistering underneath and adheres tightly to the surface. Remaining paint system should have sufficient adhesion that cannot be lifted as a layer by inserting a blade or putty knife under it. Meet requirements of ASTM D 3359 and D 4541.
   3. Feather the edges of the remaining paint system around the cleaned areas so the repainted surface appears smooth.
3.5 PREPARE PAINT MATERIALS

A. Mix the paint to a lump-free consistency with a high shear mixer 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 and mix until all the metallic powder or pigment is suspended.
   3. Continue mixing until all solids or pigments that may have settled to the bottom of the container are thoroughly dispersed.

B. Strain the paint through a screen with openings no larger than those specified for a No. 50 sieve. Refer to ASTM E 11.

C. Strain and continuously agitate the mixed material up to and during application.

3.6 APPLY PAINT – GENERAL

A. Field Inspection
   1. Do not apply paint until the Engineer 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. The painter, blasting operator, or both will consult with the manufacturer’s technical representative for answers to technical questions related to the application of the specified coating materials.

C. Project Conditions/Weather Limitations
   1. Follow the manufacturer’s recommendations if weather conditions require paint thinning.
   2. Apply paint only when the following weather conditions exist:
      a. The temperature of the air and the steel are above 40 degrees F but not so hot as to cause the paint to blister.
      b. The relative humidity is less than 85 percent or such that the combination of temperature and humidity conditions inhibits surface condensation.
      c. Apply a thin film of water to a small area to test humidity. The surface may be painted if the film evaporates within 15 minutes.
      d. The steel temperature is a minimum of 5 degrees F above dew point.
D. Use necessary equipment for proper application of the specified coating. Observe safety practices found in SSPC-PA Guide 10, Guide to Safety and Health Requirements.

E. Apply paint with spray nozzles at pressures recommended by the manufacturer of the coating system.

F. Use wet and dry film thickness gauges for testing the coating thickness during and after application. Refer to SSPC-PA 2. Use equipment capable of taking dry film thickness readings on all portions including nuts and bolts.

G. Apply two or more coats if the required film thickness could not be obtained by one coat without producing runs, bubbles, or sags.

H. Apply paint to produce a uniform, even coating that bonds to the underlying surface. Refer to SSPC-PA 1.

3.7 APPLY PAINT – REPAINTING STRUCTURAL STEEL

A. Prime Coat
   1. Maintain the dry film thickness of the prime coat between 2.5 and 6.0 mils.
   2. Blast clean any coat that produces “mud-cracking” or adds more than 7.0 mils to a soundly bonded coating on bare steel. Refer to SSPC-SP 10. Re-coat the surface.
   3. Thoroughly clean areas that have deficient primer thickness with power washing equipment to remove all dirt. Wire-brush, vacuum, and re-coat the area.

B. Intermediate Coat
   1. Use the coating type and minimum dry film thickness specified.
   2. Produce a dry-film thickness of the intermediate coat greater than 4 mils.

C. Top coat – Keep the dry film thickness greater than 2 mils.

3.8 APPLY PAINT – OVERCOATING STRUCTURAL STEEL

A. Intermediate Coat
   1. Spot paint any areas with bare steel, followed by another full intermediate coat over the entire steel surface.
   2. Apply a minimum dry film thickness of 3 mils for the spot coat and a minimum of 2 mils for the full intermediate coat.
B. Top Coat
   1. Apply top coat to entire steel surface.
   2. Keep the dry film thickness at 2 mils or greater.

3.9 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 13431

PRECAST CONCRETE FIBER OPTIC AND UTILITY VAULT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing precast concrete fiber optic and utility vaults, ground rods, and maintenance markers. Includes Type IV-CV, and Type V-CV Precast Concrete Fiber Optic and Utility Vaults.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill
B. Section 03575: Flowable Fill
C. Section 13551: General ATMS Requirements
D. Section 13553: ATMS Conduit

1.3 REFERENCES

A. American National Standards Institute (ANSI)
B. Underwriters Laboratory (UL)
C. USDA Rural Utilities Service (RUS)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer’s drawings and specifications according to Section 13551.
   1. Alternate designs may be proposed upon approval of the Engineer. Vaults must be design by a Registered Professional Engineer.
   2. Drawings must bear the seal of a Registered Professional Engineer and will not deviate from the functional dimensions shown on the plans.
PART 2 PRODUCTS

2.1 FILL

A. Free draining granular backfill borrow – Refer to Section 02056.

B. Granular backfill borrow – Refer to Section 02056.

C. Flowable fill – Refer to Section 03575.

2.2 FIBER OPTIC VAULTS AND COVERS

A. Fiber vaults – pre-cast concrete. Refer to AT Series Standard Drawings for dimensions of vault types.

B. Provide fiber vaults that are adjustable upwards to meet a new finished grade by the addition of manufacturer-provided risers, collars, or grade rings.

C. Provide fiber vaults that have the cover frames cast separately from the vault structure and are removable and replaceable.

D. Supply Type IV-PC Fiber Optic and Utility Vaults with a hinged metal lid for unpaved areas or a heavy duty round manhole-style lid in paved areas.
   1. Supply Type V-PC vaults with a manhole-style lid only.
   2. Fiber vaults with hinged metal lids will be rated for AASHTO LFRD HL – 93 loading.
   3. Fiber vaults with round manhole style lids will be rated for AASHTO LFRD HL- 93 loading.

E. Provide hinged metal lids that have double-doors (split) and double hinges.
   1. Provide a lid that operates freely over 180 degrees.
   2. Provide a lid with drop handles for easy opening.
   3. Provide a neoprene gasket between the hinged lid and the vault frame.

F. Provide lids with a grounding lug with ½ - 13 NC female threads on the underside of the lid.

G. Provide hinged and manhole lids with pentahead vandal resistant stainless steel bolts with washer.
   1. All bolt holes must be self draining.
H. Furnish metal lids that have a non-skid diamond pattern or similar surface that has a raised pattern of at least \( \frac{3}{32} \) inch high.

I. Provide lids for all fiber vaults that are marked, “UDOT FIBER OPTIC” using a minimum 3 inch high letters with \( \frac{1}{8} \) inch line thickness.
   1. Form letters by engraving, casting, stamping, or with a neat weld bead.

J. Lid Access Points – recessed steel pull slots or holes to allow removal or opening of the lid with a hook or lever.
   1. Replace lid if damage occurs to the pulling point.

K. Furnish an internal heavy duty non-metallic cable racking system on two opposite fiber vault walls.
   1. Furnish and install two stanchions on each rack wall. Fasten to the fiber vault wall according to the manufacturer's instructions.
   2. Use cable rack arms that are appropriate for the amount of slack cable being installed but not less than 3 rack arms in a Type IV vault and 4 rack arms in a Type V vault.

2.3 MAINTENANCE MARKERS

A. Furnish and install Utility Marker Posts for each vault location according to the Plans. Refer to AT Series Standard Drawings.

2.4 CONDUIT PLUGS

A. Refer to Section 13553.

2.5 GROUND ROD

A. Ground Rods – 10 ft x \( \frac{3}{4} \) inch copper-coated steel ground rod according to ANSI/UL 467.

2.6 WIRING

A. Ground Wire – Refer to Section 13551.

2.7 PULL TAPE

A. Pull Tape – Refer to Section 13553.

2.8 MARKER BALL OR DISK

A. Place a marker ball or disk in each vault.
   1. Color – orange
2. Requires no particular orientation when buried
3. Place in bottom of each box
4. Must be designed to last as long as the buried plant
5. Must produce a uniform, spherical RF field in all directions
6. Signal peak when directly over the ball
7. Meets RUS Specifications

PART 3 EXECUTION

3.1 BACKFILL

A. Place 12 inches of free draining granular backfill borrow under vaults.

B. Hand tamp granular backfill borrow or approved native soil around the fiber vault lid.
   1. Match the top 6 inches to the composition, density, and elevation of the surrounding surface.

3.2 FIBER OPTIC AND UTILITY VAULT

A. Install according to manufacturer’s recommendations.

B. Core drill holes to match conduit entry where required without damaging the vault. Core drill holes at thin wall sections only. Do not “knock out” thin wall sections. Use grout to create a complete seal between conduit and the structure wall. Finish grout smooth and flush with the interior wall.
   1. Make core drilled holes in fiber vault not more than ¼ inch larger than conduit diameter.
   2. Seal conduit ends inside all fiber vaults with at least 2 inch thick duct seal after cables 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 fiber vault and grade accordingly.

D. Field-locate fiber vaults to avoid steep slopes and low lying locations with poor drainage.

E. Do not install fiber vaults within the traveled way or shoulders unless called for on the plans.

F. Conduit in fiber vaults
   1. Install conduits into thin wall section only.
   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. Install bushings on all conduits before cable installation according to Section 13553.
5. Refer to AT Series Standard Drawings.

G. Remove concrete sidewalk or other surfaces that require removal by saw cutting.
   1. Remove entire section of concrete, joint to joint.
   2. Replace with in-kind materials to match the existing grade, texture, and color of concrete or other surface.

H. Install Engineer-approved ½ inch preformed expansion joint filler around entire periphery of ring for fiber vaults installed in paved surface.

I. Record GPS coordinates for all fiber vaults for As-Built drawings. Refer to Section 13551.

J. Encase all conduit in flowable fill where conduit enters the fiber optic vault.

3.3 GROUND ROD

A. Install ground rod to extend a minimum of 4 inches and a maximum of 6 inches above box floor.

B. Attach splice enclosure to the ground rod with a ground wire.

3.4 RESTORATION

A. Restore all areas disturbed or damaged during the installation of the fiber optic and utility vaults at no additional cost to the Department.

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 and that meet the manufacturer’s installation requirements.

1.2 RELATED SECTIONS

A. Section 00725: Scope of Work
B. Section 01554: Traffic Control
C. Section 13553: ATMS Conduit
D. Section 13591: Traffic Monitoring Detector Loop
E. Section 13594: Fiber Optic Communication
F. Section 13595: ATMS Integration

1.3 REFERENCES

A. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B. AASHTO Roadside Design Guide
C. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals
D. ASTM F 1554: 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)
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. NID – Non-Intrusive Detection device (radar technology)
D. RMS – Ramp Meter System
E. RWIS – Roadway Weather Information System
F. TMS – Traffic Monitoring Station
G. VMS – Variable Message Sign
H. WIM – Weigh In Motion

1.5 SUBMITTALS

A. Provide two copies of all documentation required for the installation, testing, and maintenance of ATMS components to the Engineer.

B. Provide one copy of the User’s Manual and other manufacturer provided field documentation such as wiring diagrams and troubleshooting guides in a weatherproof sealable sleeve and place in each corresponding field cabinet.

C. Refer to the general purpose and content of all required submittals 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 Department ATMS test procedure forms from http://www.udot.utah.gov/go/standardsreferences.
<table>
<thead>
<tr>
<th>Name</th>
<th>Timeline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor Furnished Material and Equipment Lists</td>
<td>All required material lists to the Engineer within 15 business days from Notice to Proceed.</td>
<td>Include the name of manufacturer, description, and model number of item, dimensions/size (if applicable), and identification or serial number. Obtain approval from the Engineer before ordering any contractor furnished equipment.</td>
</tr>
<tr>
<td>Factory Acceptance Testing (FAT)</td>
<td>Completed and approved within 7 days of FAT completion</td>
<td>Completed on-site Factory Acceptance Test (FAT) for any contractor furnished devices such as VMS, HAR, RWIS, WIM. Completed FAT before shipment of any of the above devices.</td>
</tr>
<tr>
<td>Compliance Certificate</td>
<td>Within five business days of receipt from the Manufacturer for each site.</td>
<td>Compliance certification from the manufacturer on required equipment if required by the plans or Special Provisions.</td>
</tr>
<tr>
<td>Manufacturer's Equipment Documentation</td>
<td>Must be received and accepted before the Engineer's Site Inspection (ESI).</td>
<td>All factory issued manuals, software including software keys, detailed shop drawings, serial numbers for each ITS device, wiring diagrams, certifications, instruction sheets, warranty information including contact numbers for all ITS devices and part lists for all contractor furnished items to the Engineer.</td>
</tr>
<tr>
<td>Punch List from Engineer's Site Inspection (ESI)</td>
<td>Complete and submit to Engineer at the time of the Engineer's Site Inspection (ESI).</td>
<td>Include on the ESI Punch List items that must be completed or adjusted before any part of a device or system installation is energized.</td>
</tr>
<tr>
<td>5 Day ATMS Testing Pre-Notification</td>
<td>Submit 5 days in advance of proposed test dates</td>
<td>Test form to the Engineer 5 days before each test or inspection that must be witnessed by the Department or authorized representative.</td>
</tr>
<tr>
<td>Power Test Data Form</td>
<td>5 days in advance of proposed LFOT dates</td>
<td>Power Test Data Form including designated voltages for power service and device voltage drop with the request for the LFOT and power service turn on. Completed Power Service Test Data Form indicating actual voltages at power service and device as part of the As-Builts.</td>
</tr>
<tr>
<td>Local Field Operations Test Results</td>
<td>Within 5 days of test completion.</td>
<td>Complete Local Field Operations Test to the Engineer for approval for required devices using the current form.</td>
</tr>
<tr>
<td>System Test Results (if required)</td>
<td>Within 5 days of test completion</td>
<td>Complete System Test according to the Special Provisions to the Engineer for approval if required.</td>
</tr>
<tr>
<td>Fiber Channel Plan</td>
<td>5 days before 30 Day Burn In Test</td>
<td>Integration and device communication verification.</td>
</tr>
<tr>
<td>30 Day ATMS Burn-In Test Report</td>
<td>After successful completion of the 30 day test.</td>
<td>Authorization from the Engineer to begin the test and provides a record of device or system performance during the test period.</td>
</tr>
</tbody>
</table>
### Submittal Requirements

<table>
<thead>
<tr>
<th>Name</th>
<th>Timeline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction As-Built Drawings</td>
<td>Within 5 days after the 30 Day ATMS Burn In Test. As-Built drawings will be reviewed, verified, and accepted before final device or system acceptance.</td>
<td>As-Built drawings of each ATMS device installation showing actual locations of all installed conduit, boxes, and cabinets, and any differences in construction from the Project Plan sheets.</td>
</tr>
<tr>
<td>Fiber Optic Cable Test Results</td>
<td>Fiber optic cable test results with As-Built drawings.</td>
<td>Refer to Section 13595 – Fiber Optic Communication for specific testing and submittal requirements.</td>
</tr>
</tbody>
</table>

D. Construction As-Built Drawings
1. Five hard copies (one copy each to the TOC Project Manager, TOC Electronics Manager, Department Fiber Manager, Region Permits Office, and the Engineer) and one electronic copy on CD of As-Built Drawings to the Engineer.
2. As-Built drawings 11 x 17 inch, produced using the current Department approved version of MicroStation CAD software.
3. As-Built drawings that include GPS coordinates of all cabinets, boxes, conduit runs, and device mounting poles. Use a GPS device that can provide coordinates to plus or minus 1 foot or better accuracy.
4. Include device serial number and asset management number at actual installed locations on the As-Built package.
5. Include Fiber Channel Plans with As-Built Package.
6. Include electrical wiring schematic drawings for all services originating at the Power Service and at their serviced device with the As-Built package.

E. Factory Issued Manuals
1. Submit factory issued user manuals containing technical, diagnostic, 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 or as required by the Project Specification following the date of final acceptance of the project by the Engineer.

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.
   1. Repair or replace defective items.
   2. Notify the Engineer when corrective action has been completed.

PART 2 PRODUCTS

2.1 WIRING

A. Copper as specified. Refer to National Electrical Code (NEC).

B. Size as specified. Refer to American Wire Gauge (AWG).

C. Power Conductors
   1. Power source conductors, copper, type RHH, USE, RHW.

D. Signal Cable
   1. Multi-colored cables as specified.
   2. Refer to IMSA 20-1.

E. Ground Wire
   1. Solid, bare, soft-drawn, copper wire as specified.
   2. Refer to NEC Section 250.

F. Detector Cables – Refer to Section 13591.

PART 3 EXECUTION

3.1 TESTING AND ACCEPTANCE

A. Perform the following tests and inspections for all ATMS devices:
   1. ATMS Cable and Conductor Test
   2. Engineer's Site Inspection (ESI)
   3. Local Field Operations Test (LFOT)
   4. Substantial Completion Inspection (SCI)
   5. 30 Day ATMS Burn-In Test

B. Perform the following test if required in the Project Special Provisions.
   1. System Test
C. Notify the Engineer at least five working days before the proposed date and time of all tests and inspections.
   1. Obtain the newest version (at time of bid) of the ATMS Testing Pre-notification Form from the Department Web site http://www.udot.utah.gov/go/standardsreferences.
   2. Verify that the Engineer or the Engineer’s agent witnesses all tests and inspections and signs all required documents.

D. Refer to Section 13595 for integration, testing, and inspection requirements.

E. Refer to Section 13594 for Fiber Optic Communication testing requirements.

3.2 EXISTING FACILITIES

A. Repair any damage to traffic signal equipment, lighting equipment, utilities, and other ATMS items such as fiber optic cable, 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, and other required items.
   3. Request, coordinate, and conduct the on-site meeting and provide all labor, materials, test equipment, and test documentation.
   4. 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.
   5. Maintain all existing central communications without disruption unless allowed in writing by the Engineer.

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 for marking of their facilities.
   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 to prevent project delays.

G. Identify and resolve any conflicts with existing utilities at locations pre-marked in the field by the designer. Notify the Engineer if such conflicts necessitate changes to length or layout of conduit runs.

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 right-of-way or access control fences to access job site.

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. Modify proposed equipment locations to avoid conflict with underground utilities or other obstructions as required. Obtain approval from the Engineer before modifying locations.

B. Coordinate with the Engineer to field-locate all new facilities such as cabinet foundations, camera poles, detector poles, and junction boxes.

C. Field-locate equipment with the Engineer
   1. Avoid areas with poor drainage and place for no impact from thrown snow.
   2. Place for maximum accessibility and safety for maintenance personnel and vehicles, including a 65 foot boom truck or pick truck.
D. Minimum distance behind concrete barrier or guardrail for all above ground equipment is 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 backfill conduit trenches 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 before and 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. Use galvanized 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, Luminaries, 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 (if in acceptable condition) when NEC requirements and Department standards for conduit material and depth of cover can be met as specified by the Engineer.

B. Do not remove existing pull tape from conduit that is to be temporarily abandoned in place.

3.9 ABANDON ATMS FACILITIES IN PLACE

A. Obliterate all existing foundations left in place to a depth of at least 2 ft below the existing surface. Properly dispose of removed items.

B. Remove from conduit all conductors taken out of service. Remove locate wires and pull tape. Cut and plug conduit. Cut the ends of conductors even with the end of the conduit if they cannot be removed due to conduit damage. Seal the end and note on As-Built drawings 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 specified 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 specified Department facility.

C. Cable and Wiring
   1. Spool specified cable to be salvaged neatly onto appropriately sized spools. All salvaged cable must be spooled.
   2. Cut cables only at splice locations or as directed by the Engineer.
3. Cap wires as described in this Section, article 3.12.
4. Do not exceed the minimum bending radius and the maximum pulling tension recommended by the manufacturer’s specifications at any time when removing and spooling salvaged wire.
5. Return to the specified Department facility.

3.11 ELECTRICAL

A. Perform all work according to the National Electrical Code (NEC), National Electrical Safety Code (NESC), International Building Code (IBC), and Underwriters Laboratory (UL).

3.12 INSTALL WIRING

A. Conductors
1. Verify conduit is free of dirt and debris according to Section 13553 before installing conductors.
2. Install grounding conductor in all conduits containing metallic conductors or metallic cable armor or strength members. Refer to NEC, Section 250.
3. Use NEC approved lubricants when pulling conductors in conduit.
4. Protect wire during installation according to Section 13553.
5. Cap wire and cable tape and seal the ends of unused conductors and label them as spares.
6. Use conductors that are color coded as specified in IMSA and comply with NEC, Article 310.
7. Leave 3 ft of slack conductor in each junction box that the conductor passes through.

B. Ground Wire
1. Ground wire in non-metallic conduit must run continuously and be bonded to the ground rod at 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 industry 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, and maintain in operable condition all installed ATMS devices until Final Acceptance. Includes but is not limited to:
   1. Replace damaged cabling.
   2. Repair or replace damaged conduit and junction boxes.
   3. Repair or replace any ATMS Cabinets and their electronics if damaged.
   4. Repair or replace Department and Contractor furnished items.
   5. Maintain all ITS devices, ATMS cabinets, and VMS for cleanliness and perform all preventative maintenance as required by the device manufacturer.

B. Repair installation or replace damaged equipment according to Section 00725.

C. Emergency Maintenance – Provide emergency maintenance on a 7-day per week, 24 hour basis until Final Acceptance of the ATMS device. 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 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.

G. Report and document failed equipment to the engineer when identified. Deliver failed equipment to the Traffic Operations Center Laboratory for inspection and evaluation. Failed equipment determined to be the responsibility of the Contractor will be replaced by the Contractor at no additional cost to the Department.

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 13595: ATMS Integration
K. Section 13595: ATMS Integration
L. Section 16525: Highway Lighting

1.3 REFERENCES

A. AASHTO LRFD Bridge Construction Specifications, 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 submittals according to Section 13551.

B. Refer to this Section, article 3.10 for submittal requirements.

PART 2 PRODUCTS

2.1 FOUNDATION

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

B. Reinforcing Steel, coated – 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 12-inch signal heads refer to Section 02892. Louvered back plate required.

C. Regulatory Sign – MUTCD R10-6, 24 inch x 36 inch.


E. All signal head housings – Highway yellow with hoods.
2.3 RAMP METER MAST ARM SIGNAL ASSEMBLY

A. All 12-inch signal heads – Refer to Section 02892. Louvered back plate required.

B. RS10-29A “1 Vehicle Per Green” and RS10-29B “2 Vehicles Per Green” Signs: 48 inch x 36 inch. Refer to AT Series Standard Drawings.

C. All signal head housings – Highway yellow with hoods.


2.4 RAMP METER ADVANCED WARNING

A. Warning Sign – W3-8, 36 inch x 36 inch. Refer to AT Series Standard Drawings.

B. Signal Pole – Refer to Section 02892 and SL Series Standard Drawings.

C. 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. Refer to Section 02892.

B. Refer to Section 13551 for Anchor Bolts.

2.6 WIRE

A. Refer to Section 02892 for signal cable specifications.

2.7 DETECTOR CIRCUIT

A. Refer to Section 02892.

2.8 LUMINAIRE

A. Refer to 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 must be stainless steel.

E. Adjusting the anchor bolt nuts, plumb all steel poles to the vertical with all signal heads and signs installed.


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>
<thead>
<tr>
<th>Cables Marked with Colored Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane One</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Ramp Meter Circuit</td>
</tr>
<tr>
<td>Detector Circuit</td>
</tr>
<tr>
<td>Advanced Warning Blankout</td>
</tr>
</tbody>
</table>

C. Use Table 2 when connecting the conductors for ramp meter signal heads.

<table>
<thead>
<tr>
<th>Color-Coded Conductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Lanes</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Ramp Meter Signal Circuit</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
3.6 RAMP METER SIGNAL ASSEMBLY SIGN

A. Refer to 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. Refer to Section 02892.

B. Refer to AT Series Standard Drawings for detection locations.

C. Saw cut loops are not allowed. Use preformed loops in new pavement. Use core drilled magnetometer or Non-Intrusive (radar) detection in existing pavement according to the project plans.

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 if using preformed loops. Submit Detector Loop Inductance and Resistance Test to the Engineer for acceptance.

B. Comply with the Submittal and Acceptance Testing Process described in Sections 13551 and 13595.

END OF SECTION
SECTION 13553

ATMS CONDUIT

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Materials and procedures for installing conduit according to the contract. Install conduit by trenching, boring, or plowing unless otherwise specified.

B. Detectable pull tape, conduit, and all materials, labor, workmanship, equipment, and incidental items required for a complete system of conduit.

1.2  RELATED SECTIONS

A. Section 00725: Scope of Work

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 02705: Pavement Cutting

D. Section 02741: Hot Mix Asphalt (HMA)

E. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork

F. Section 03575: Flowable Fill

G. Section 13551: General ATMS Requirements

H. Section 13554: Polymer Concrete Junction Box

I. Section 13595: ATMS Integration

1.3  REFERENCES

A. ASTM D 2241: Poly-Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

B. ASTM F 2160: Solid Wall High Density Polyethylene (HDPE) Conduit based on Controlled Outside Diameter (OD).

C. American National Standards Institute (ANSI)

D. National Electrical Code (NEC)
E. National Electrical Manufacturers Association (NEMA)
F. Railroad Specifications
G. State of Utah Administrative Rule R930-6 – Accommodation of Utilities and the Control and Protection of State Highway Rights of Way
H. Underwriters Laboratory (UL)
I. USDA Rural Electrification Administration (RDUP) Specifications

1.4 DEFINITIONS
A. Department Fiber Optic Group Representative – An authorized member of the Department Fiber Optic Group at the Traffic Operations Center.

1.5 SUBMITTALS
A. Refer to Section 13551.
B. Refer to this Section, articles 3.2 paragraph I 1, and 3.7 paragraph A.

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 F 2160.
3. HDPE conduit having a ribbed interior.
4. Rigid steel as specified in UL-6. Galvanized as specified in ANSI C80.1
5. Flexible watertight conduit and fittings as specified.

B. Non-Metallic Conduit
1. New, prefabricated
2. ATMS Multi-duct Conduit Types
   a. 1D = four 1.25-inch conduits
   b. 2D = eight 1.25-inch conduits
   c. 4D = sixteen 1.25-inch conduits
3. Color-code each conduit or cell as follows:
   a. One, two, or three conduits gray
   b. 1D Bank 1 blue, orange, green and brown
   c. 2D Bank 1 blue, orange, green, and brown
      Bank 2 slate, white, red, and black
   d. 4D Bank 1 blue, orange, green, and brown
      Bank 2 slate, white, red, and black
      Bank 3 same as bank 1 with a contrasting stripe
      Bank 4 same as bank 2 with a contrasting stripe

C. Meet or exceed all of the conduit manufacturer’s recommendations for all materials used in the installation of conduits including 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 must provide watertight integrity.

E. Sweeps – factory manufactured sweeps (11¼, 22½, 45, and 90 degree angles) complete with bell and spigot.

F. Detectable Pull Tape – flat profile, low stretch polyester, detectable, sequential footage marked, 1,200 lb tensile strength pull tape in each conduit.

G. 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 ft
   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 according to Section 02056.
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.  The placement of conduit in areas of parallel utilities must meet Department Utilities and Local Utilities standards and be approved by the Engineer.  Refer to State of Utah Administrative Rule R930-6.

C.  Obtain appropriate permits before work begins.

D.  Record conduit, junction box, and vault longitudinal and latitudinal GPS coordinates (x, y coordinates).  Record coordinates every 250 ft on straight conduit runs and every 100 ft where conduit deviates from a straight run.  Refer to Section 13551 for As-Built drawing requirements.

E.  Install conduit under park strip where curb and gutter is present.

F.  Maximum spacing between junction boxes and vaults 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 incurred during installation prevents the installation of cable within maximum pulling tension rating of the cable.
   4.  Notify the Engineer if utility avoidance requires junction box and conduit locations differing from requirements for deflection in the Section, article 3.2.

G.  Conduit under Railroad Right-of-Way – Refer to Section 00725 and any appropriate railroad specifications.
   1.  Coordinate all work and permits with appropriate Railroad personnel.
   2.  Complete Railroad Safety Training.

H.  Minimum Cover of Conduit
   1.  Minimum cover in sidewalks or paved surfaces is 3 ft.
   2.  Minimum cover in highway right-of-way, greater than 20 ft from the edge of the pavement is 3 ft.
   3.  Minimum cover in highway right-of-way, within 20 ft of the edge of the pavement is 5 ft.
I. The Department will not grant additional time or money for installing conduit in difficult subsurface conditions.

3.2 INSTALLATION

A. Prevent conduit from deflecting vertically or horizontally along its length by a ratio greater than 10:1, (no more than 4-inch deflection per 40 inch in length) when installing conduit that houses communication cable.

B. Prevent sum total of the vertical and horizontal conduit deflection or bend between any two junction boxes from exceeding 270 degrees when installing conduit.

C. Install conduit within 1 ft of existing parallel conduit run if the planned location of conduit is parallel to the existing traffic signal or ATMS conduit.

D. Pre-approve with the engineering field bending conduit in cases where factory sweeps are not appropriate. Field bending must be performed using a heat box or heat blanket. Torch heating conduit is prohibited. Install all conduit bends to have a radius that is not less than the following:
   1. 24 inches within the cabinet and pole foundations
   2. 36 inches in all other locations

E. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, or 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. Proof all conduits with an approved mandrel before installation of cabling and detectable pull tape.

G. Provide detectable pull tape in all 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.
   4. Use flat profile, low stretch polyester, 1,200 lb tensile strength detectable pull tape that is sequential footage marked.
   5. Verify that the pull tape is detectable throughout its entire length by performing a continuity test or equivalent verification.

H. Place all conduit that is encased in a structure according to current International Building Code and as approved by the Engineer.
I. Secure conduit on concrete structures with standard galvanized steel conduit clamps using an Engineer approved anchoring system.
   1. Submit attachment process for approval by the Engineer before work begins.
   2. Use a best practices installation process as defined by the attachment product manufacturer’s requirements.
   3. Use waterproof conduit expansion fittings at structure expansion joint crossings.

J. Limit cable percentage fill in conduit to the maximum allowed by NEC and RDUP requirements.

K. 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.

L. Use galvanized rigid steel or flexible watertight conduit for above ground application. Use PVC or HDPE conduit for underground application.

M. Apply corrosion protection according to NEC Article 346 to any portion of galvanized rigid steel conduit buried in the ground or encased in concrete.

N. 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.

O. Install a bushing or adapter at ends of all nonmetallic conduit that contains a conductor according to NEC Article 346 and 347.

P. Furnish and install Utility Marker Posts along the longitudinal conduit running line as specified in the Plans. Refer to AT Series Standard Drawings.

3.3 TRENCH

A. Paved Surface (asphalt or 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 according to Section 02705.

3. Refer to AT Series Standard Drawings for depth of flowable fill under paved surfaces.

4. Compact soil under pavement according to 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 according to 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. New pavement thickness must be 3½ inches minimum and 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. Backfill using native material, if suitable, that matches the composition, density, and elevation (±0.2 inch), of the existing surface according to Section 02056 or as directed by the Engineer.
   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 encases all exterior surfaces of the conduit. Separate multi-duct conduits using a commercially available conduit spacer or approved equivalent. Place spacers no more than 4 ft apart and not more than 2 ft from each coupler.
H. Anchor the conduit in trench at 16 ft intervals to maintain the required conduit depth during flowable fill placement.

I. Minimum separation between all conduits and the wall of the trench is 1½ inches.

J. Do not place flowable fill within 8 inches of the finished grade in native earth.

3.4 BORE OR PLOW

A. Immediately contain, remove, and properly dispose of all drilling fluid outside the bore.

3.5 USE OF EXISTING OR OCCUPIED CONDUIT

A. Maintain the physical condition and functional integrity of all cabling and wiring in existing or occupied conduit.

B. Cable or wire installation in an existing or occupied conduit.
   1. Remove any existing fiber optic cable or copper wire.
   2. Test the integrity and clean the conduit by successfully pulling a Department-approved mandrel through the conduit.
   3. Re-pull existing and new fiber optic cable or copper wire together.
   4. Perform all necessary splices and replace any impacted fiber cable and spider fan-out kits according to Section 13594.
   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, colored, textured, or decorative surfaces damaged during conduit and junction box installation.

B. Coordinate with local utilities for utility repair.

C. Notify the Engineer of all necessary repairs.
D. Replace all damaged facilities in kind.

3.7 APPROVALS

A. Follow the submittal, testing, and approval process according to Section 13551 and Section 13595.

B. All conduit products and work containing communication cable must be jointly approved by the Engineer and the Department Fiber Optic Group Representative.

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 02056: Embankment, Borrow, and Backfill
B. Section 02842: Delineators
C. Section 02892: Traffic Signal
D. Section 03055: Portland Cement Concrete
E. Section 03152: Concrete Joint Control
F. Section 03575: Flowable Fill
G. Section 13551: General ATMS Requirements
H. Section 13553: ATMS Conduit

1.3 REFERENCES

A. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
B. ASTM C 580: Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
C. American National Standards Institute (ANSI)
D. Society of Cable Telecommunications Engineers (SCTE) Standards
E. Underwriters Laboratory (UL)
F. USDA Rural Utilities Service (RUS) Specifications
1.4 DEFINITIONS  Not Used

1.5 SUBMITTALS

A. Backfill
   1. Supplier and source
   2. Sieve analysis
   3. Soil classification
   4. Maximum dry density and optimum moisture

B. Concrete mix design for Engineer’s approval

C. Hot and cold weather plan

D. Flowable fill batch proportions and trial batch for approval

PART 2 PRODUCTS

2.1 FILL

A. Free draining granular backfill borrow – Refer to Section 02056.

B. Granular backfill borrow – Refer to Section 02056.

C. Flowable fill – Refer to 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 meet all the requirements of ANSI/SCTE 77 2007, including Tier 22 loading.

C. Use split lids with Type III-PC junction boxes.

D. 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.

E. 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.

F. Bolts – stainless steel recessed hex head bolts with washer. Refer to AT Series Standard Drawings.

2.3 MAINTENANCE MARKERS

A. Furnish and install Utility Marker Posts for each box location as specified in the Plans. Refer to AT Series Standard Drawings.

2.4 CONDUIT PLUGS

A. Refer to Section 13553.

2.5 GROUND ROD

A. Ground Rods – 10 ft x \( \frac{3}{4} \) inch copper-coated steel ground rod as specified by ANSI/UL467.

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. Place a marker ball or disk in each junction box.
   1. Color – orange
   2. Requires no particular orientation when buried
   3. Place in bottom of each box
   4. Must be designed to last as long as the buried plant
   5. Must produce a uniform, spherical RF field in all directions
   6. Signal peak when directly over the ball
   7. Meets RUS Specifications

PART 3  EXECUTION

3.1  BACKFILL

A. Place 12 inches of free draining granular backfill 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 according to manufacturer’s recommendations.

B. Precast junction boxes with precast conduit holes or drill holes to match conduit entry where required without damaging the box. Use grout to create a complete seal between conduit and the structure wall. Finish grout smooth and flush with the interior wall.
   1. Make drilled holes in junction box not more than 1/4 inch larger than conduit diameter.
   2. Seal conduit ends inside all junction boxes with at least 2 inch thick duct seal 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. Conduit in junction box
   1. Do not install conduit within 2 inches of junction box corner.
   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. Install bushings on all conduits before cable installation according to Section 13553.
   7. Refer to AT Series Standard Drawings.

G. Remove concrete sidewalk or other surfaces that require removal by saw cutting.
   1. Remove entire section of concrete, joint to joint.
   2. Replace with in-kind materials to match the existing grade, texture, and color of concrete or other surface.

H. Install Engineer-approved ½ inch preformed expansion joint material around entire periphery of ring for junction boxes installed in paved surface.

I. Record GPS coordinates for all junction boxes according to as-built drawings. Refer to Section 13551.

J. Encase all conduit in flowable fill where conduit enters the junction box.

K. 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. Use grout according to ASTM C 579 and ASTM C 580.

L. Do not stack boxes.

3.3 CONCRETE COLLAR

A. Refer to AT Series Standard Drawings.

B. Concrete AA(AE) – Refer to Section 03055.
C. Install concrete collars around junction boxes in all locations except where junction boxes are in concrete paved surfaces.

3.4 GROUND ROD

A. Install ground rod to extend a minimum of 4 inches and a maximum of 6 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 pedestal-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: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
C. ASTM B 766: Electro-deposited Coatings of Cadmium
D. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications
1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Provide submittals according to Section 13551.

PART 2 PRODUCTS

2.1 ATMS CABINET

A. Pedestal-Mounted Cabinet – State furnished NEMA 3R, 5052 aluminum control cabinet, 0.125 inch minimum thickness with the maximum dimensions of 66 inch H x 24 inch W x 22 inch D.

B. Pole-Mounted Cabinet – Provide NEMA 3S or better, 5052 aluminum control cabinet, 0.125 inch minimum thickness with the maximum dimensions of 36 inch H x 24 inch W x 22 inch D that has the following:
   1. Pole mounting hardware
   2. Anti-graffiti cabinet finish
   3. Air filter with two thermostat operated fans
   4. Removable self-standing 19 inch EIA/TIA compliant equipment rack assembly with 1-PDA #2 with 1 power supply assembly
   5. Corrosion resistant handle with Corbin #2 locks and padlock eye
   6. Two full size doors – one front, one rear
   7. Two position bar stops on bottom of each door
   8. Solid bottom
   9. One fluorescent light
   10. NEMA 3S or better, compliant enclosure

C. Provide fittings, flexible conduit, ground rods, ground wire, other materials, equipment, 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 ½ inch diameter pre-drilled holes.
   2. Cross-section dimensions – 1½ inch x 1½ 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.
   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. Contact the Engineer at least 14 days before picking up the ATMS Cabinet or Pole-Mounted ATMS Cabinet to coordinate pickup location and time.

   B. Use Concrete AA(AE) maintenance pads when surrounding area is not paved. Refer to AT Series Standard Drawings. Locate cabinet in an area where maintenance equipment has full access to the site.

   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 foundations 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 cabinet foundation parallel to the roadway. Refer to AT Series Standard Drawings.

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 PEDESTAL-MOUNTED ATMS CABINET

A. Install pedestal-mounted cabinets so the door that accesses the front face of the control equipment is adjacent to the Type II-PC junction box. 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 damaged galvanized surfaces with hot stick galvanized both within the hole and around the hole.

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 according to the AT Series Standard Drawings or an approved underground service pedestal according to the SL Series Standard Drawings and 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 02466: Drilled Shaft

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03310: Structural Concrete

E. Section 13551: General ATMS Requirements

F. Section 13553: ATMS Conduit

G. Section 13554: Polymer Concrete Junction Box

H. Section 13555: ATMS Cabinet

I. Section 13595: ATMS Integration

1.3 REFERENCES

A. AASHTO M 270: Structural Steel for Bridges

B. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

C. American Iron and Steel Institute (AISI)

D. American Wire Gauge (AWG)

E. National Electrical Code (NEC)
1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Provide submittals according to Section 13551.
B. Refer to this Section, article 3.9 for submittal requirements.

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 – Refer to AASHTO M 270 Grade 36.
D. Non-Shrink Grout – Refer 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, and manufacturer’s operation manual and equipment list.
2. Dome Camera assembly – includes camera with integrated pan/tilt unit, control receiver, environmental enclosure, and manufacturer’s operation manual and equipment list.
4. Refer to AT Series Standard Drawings to identify the required component parts, installation details, and wiring diagrams.

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. Refer to AISI Type 316.

D. Provide all materials, equipment, and incidentals required to pressurize Dome CCTV cameras in the field.

2.7 DATA SURGE SUPPRESSOR

A. State furnished Data Surge Suppressor with the following general characteristics (typical) and according to 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 according to communication details:
   1. Typical application LAN, closed circuit video
   2. Surge 3,000 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

2.10 CONDUIT

A. Refer to Section 13553.

PART 3 EXECUTION

3.1 INSTALLATION

A. Contact the Engineer a minimum of 14 calendar days in advance to schedule the pickup for State furnished equipment.

B. Load, transport, and install all State furnished materials according to the manufacturer’s instructions.

C. Mount CCTVs at locations according to 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 and junction boxes according to Section 13553 to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing camera cables and conductors.
F. Pressurize Dome CCTV camera in the field according to AT Series Standard Drawings.

G. Connect the camera, controller and all wires according to AT Series Standard Drawings.

H. Connect camera lowering system and terminate wires according to AT Series Standard Drawings.

I. 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 according to Section 03211.

F. Place concrete according to Section 02466 and 03055. Provide ordinary surface finish according to 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 according to 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 so 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 according to the manufacturer’s instructions before delivery to the job site.

B. Assemble the Camera Lowering system on CCTV pole and install according to manufacturer’s instructions at the job site.

C. Deliver the CCTV and Camera Lowering systems to the job site, terminate all cabling, and install according to the contract.

3.6 CCTV COMPOSITE CABLE

A. Install CCTV composite cables in conduit and poles. Run cables continuously and without splices between camera and cabinet. Do not exceed 500 ft for length of composite cable. Use cable connectors when and where exposed cables enter the pole.

B. Keep cable ends sealed at all times during installation until connectors are installed using an approved cable end cap.

C. Install cable without violating the minimum bending radius and the maximum pulling tension recommended by the manufacturer’s specifications at any time.

D. Provide 6 ft of CCTV composite cable slack in all cabinets. Refer to Section 13555.
E. Make all camera cable connections between the CCTV camera, Remote Data Port Enclosure (RDPE), surge suppression device, and communications equipment, as required to provide a fully operational CCTV system.

3.7 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. Refer to NEC 250.1.

3.9 TESTING AND ACCEPTANCE

A. Follow the submittal, testing, and acceptance process according to Section 13551 and Section 13595.

END OF SECTION
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 submittals according to Section 13551.

B. Refer to this Section, article 3.6 for submittal requirements.
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. Contact the Engineer at least 14 calendar days before picking up the State furnished Overhead VMS display, VMS controller, and VMS cable (fiber optic).

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. Provide and install surge suppressors at the VMS Sign Controller and ATMS Cabinet when connected by conductive communications cable. Use NX4-60-1G Polyphaser or equivalent. The 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.

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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 according to 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 or Cat 5e controller cable between VMS and VMS controller in ATMS cabinet according to the following requirements:
   1. Freeway signs use Multimode fiber
   2. Multimode fiber includes a fan out kit and ST connectors
   3. Surface street signs use either Multimode or Cat 5e cable
   4. Do not exceed 1,000 ft for Cat 5e cable length

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. Follow the submittal, testing, and acceptance process according to Section 13551 and 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 incident 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 submittals according to Section 13551.
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 according to 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 according to 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 $\frac{1}{6}$ 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 according to NEC 250.1.

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. SmartSensor™ Installation Guides (SSIG)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide submittals according to Section 13551.
B. Refer to this Section, article 3.5 for submittal requirements.
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.

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. Schedule pick up of State furnished materials and equipment with the Engineer at least 30 calendar days in advance of desired pick up date.

B. Load, transport, and install all State furnished materials according to 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.
   1. 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, 60 inches +/- 6 inches above grade at pole base.
   2. Install additional NID surge protector in the ATMS cabinet with the 24 VDC power supply.

G. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease, and other foreign substances.
H. Use offset bracketing or other method to ensure that NIDs are mounted out of the lowering path if NIDs are installed on camera poles with camera lowering devices in use.

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 according to 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 according to the contract.

F. Arrange wiring neatly at cabinet, junction boxes, and fixtures.

3.5 TESTING AND ACCEPTANCE

A. Complete the submittal, testing, and acceptance process described in Section 13551 and Section 13595 for all NID devices.

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. Refer to 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.


C. Use a safety switch as indicated in the contract.

D. Provide circuit breakers sized according to the contract.

E. Provide conductors as sized and numbered according to the contract.

F. Provide riser and weatherhead according to 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 – According to 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. Refer to 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, according to 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 according to the contract and 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 \( \frac{1}{6} \) 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. Refer to IMSA 50-2.
B. Samples of materials for approval when requested.
C. Provide the following submittals according to Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Manufacturer’s Equipment Documentation
PART 2 PRODUCTS

2.1 MATERIALS

A. Refer to 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. Position the cut approximately halfway along the joint to maximize the created pavement slabs.

D. Minimum distance between saw-cut and transverse joints or between adjacent lead-in saw cuts is 1½ ft.

E. Loop Spacing – 21½ ft between leading edges. Maximum tolerance is 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. Refer to 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 loop wire termination and within the cabinet at the detector loop cable (DLC) termination.

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 form 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. Install lead-in cable and loop wire neat and tight within the ATMS cabinet.

H. Maximum detector lead-in cable length allowed is 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 conduit entrance 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 and Resistance Test as described in Section 02892 and submit to the Engineer for acceptance. Use current version at time of bid of the Detector Loop Inductance and Resistance Test form. Refer to http://www.udot.uta.gov/go/standardsreferences.

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 for all stations to 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. Materials and procedures for RWIS site preparation, including installing conduit, junction boxes with grounding rods, tower foundation and tower lower section, and concrete pads.

B. Prepare site for State furnished and State installed RWIS cabinet, RPU, communications equipment, and environmental sensors.

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 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

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 work begins.

PART 2 PRODUCTS

2.1 POWER

A. Use electrical components as listed and defined by the National Electrical Code (NEC).

B. Supply conduit according to Section 13553, junction boxes according to Section 13554, and ground rods according to Section 13554 and NEC 250.

2.2 REMOTE PROCESSING UNIT (RPU) TOWER FOUNDATION AND SERVICE PAD

A. Refer to Section 02056 for compaction.

B. Use class AA(AE). Refer to Section 03055

C. Use 6-6-10-10 welded wire mesh. Refer to 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 ¾ inch diameter 10 ft 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
PART 3 EXECUTION

3.1 GENERAL

A. Refer to the National Electrical Code (NEC).

B. Obtain Engineer approval for tower site location and pavement sensor placement (if required) before construction.

C. Contact the Engineer at least 14 days before the 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

E. Install conduit according to Section 13553, junction boxes according to Section 13554, and ground rods according to Section 13554 and NEC 250.

F. Install all State furnished materials according to 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.

C. Finish all surface concrete with Ordinary Surface Finish. Refer to Section 03310.

D. RPU and tower installed by the Department.

E. Solar panels will be mounted to the tower 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 – Refer to AT Series Standard Drawings.

3.4 ENVIRONMENTAL SENSORS

A. Furnished and installed by the Department.

3.5 RPU

A. Furnished and installed by the Department.

3.6 COMMUNICATION EQUIPMENT

A. Furnished and installed by the Department.

3.7 RWIS TOWER

A. Install tower base and lower section only. Refer to AT Series Standard Drawings.

END OF SECTION
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 submittals according to Section 13551.
B. Refer to this Section, article 3.4 for submittal requirements.

PART 2 PRODUCTS

2.1 PIEZO ELECTRIC SENSORS

A. State 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 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 30 days before starting work to schedule and attend a pre-installation meeting.

C. Contact the Engineer 14 days before picking up State furnished materials.

D. Install all State 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 before placing piezo.
B. Lead In Wires
1. Saw cut ½ inch wide x 3¼ to 6 inch deep slot for piezo lead in wires.
2. Cover lead in wire with at least 3 inches of approved embedded sealant.
3. Leave a minimum of 12 inches between saw cut and concrete joints.
4. Locate all lead in wires downstream 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 before 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. Complete the submittal, testing, and acceptance process described in Section 13551 and Section 13595 for all WIM devices.

END OF SECTION
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 13431: Precast Concrete Fiber Optic and Utility Vault
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. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications
B. National Electrical Code (NEC)
C. National Electric Safety Code (NESC)
D. Telcordia Guidance
E. Underwriters Laboratory (UL)
F. USDA Rural Utilities Service (RUS)

1.4 DEFINITIONS

A. FDU – Fiber Distribution Unit – A storage and management box for use in cabinets and communication hubs for the terminated ends and splice points of the fiber optic cable.
B. OTDR – Optical Time Domain Reflectometer
C. OSP – Outside Plant
D. SMF – Single-mode fiber
E. UDOT Fiber Optic Group Representative – An authorized member of the UDOT Fiber Optic Group at the Traffic Operations Center.
F. Backbone – Cable that connects two buildings or a building to a Hub/Node
G. Damage – Loss, injury, deterioration, diminution, or distortion caused by negligence, design, or accident.
H. Distribution – Cable that originates at a distribution splice, interface cabinet, or device and terminates at or links served devices.
I. Drop – Cable that originates at a distribution splice, interface cabinet, or device and terminates at or links served devices.
J. Full Splice – A splice that has had all fibers spliced.
K. Ring Cut Splice – A splice where only selected fibers are severed and others remain intact.

1.5 SUBMITTALS

A. Provide all submittals according to Section 13551 plus additional fiber optic submittals and acceptance testing submittals listed in this Section.
   1. Refer to Articles 2.3 C, 3.2 paragraph I2, and 3.7 paragraphs B2, B4k, B4o, and B6a.

B. Qualified Fiber Optic Technician Resume and Certificate
   Furnish evidence of training and experience for all fiber optic staff including but not limited to installation technicians, splice technicians, and test technicians before any work begins.
   1. Include in the file for each technician the following:
      a. Resume listing relevant education and experience.
      b. Work experience showing a total of at least two years.
      c. Certificate of completion for the fiber optic training course.

C. Required Pre-Construction Submittal
   1. Submit 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.
   4. Installation schedule.
5. Factory test results showing the attenuation of each cable fiber in dB/km measured at 1310 nm and 1550 nm.

6. Pre-Construction Fiber Optic Cable Reel Test.

D. Required Post Construction Final Submittal
   1. OTDR Test Results
      a. Hard copy printed and bound test results
      b. Current OTDR calibration certificate
      c. Electronic submittal on CD
   2. Power Meter/Light Source Test Results
      a. Obtain the current test form from the UDOT Fiber Group Representative.
   3. Submit all required fiber tests with As-Built Plans according to Section 13551.

1.6 SPLICE PLANS

A. Request Project Splice Plans from the UDOT Fiber Group Representative through the Engineer. Splice Plans will include splice details and device assignments to fiber channels. Request the Splice Plans at least 30-days before the desired start date of splicing and termination.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials that are UL listed.

B. Provide all incidental materials including but not limited to fiber optic jumpers, cable ties, labels, tie wraps, connectors and consumables.

C. Outside Plant materials meet Fluid Penetration Test standards (TIA/EIA-455-82B).

D. Provide and install all cable in continuous lengths. Splicing or cutting the fiber cable is strictly forbidden except where called for explicitly in the Splice Plans.

E. Splice and terminate all fibers in the fiber optic cable as indicated on the Splice Plans and as specified herein.

F. Provide all optical glass from the same approved manufacturer.
2.2 FIBER OPTIC CABLE

A. Approved for use by the Rural Utilities Service (RUS).

B. Outside Plant (OSP) type, loose tube, single-mode fiber optic cable. All-dielectric cable is required on distribution runs. Armored cable is required on backbone runs. Refer to cable call outs in the plans.

C. Use gel filled fiber optic cable complying with Telcordia GR20-CORE and TIA/EIA-4720000-A.

D. Use cable with individual buffer tubes and individual fiber strands color coded in compliance with EIA/TIA-598 Color Coding of Fiber Optic Cables.

Table 1
Fiber Optic Glass
Optical Fiber Specifications

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>SINGLE MODE</th>
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</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Step Index</td>
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<tr>
<td>Core Diameter</td>
<td>8.2 μm (Nominal)</td>
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<tr>
<td>Cladding Diameter</td>
<td>125μm ± 0.7 μm</td>
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<tr>
<td>Core to Cladding Offset</td>
<td>≤ 0.8 μm</td>
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<tr>
<td>Coating Diameter (OSP)</td>
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<tr>
<td>Coating Diameter (IP)</td>
<td>900 μm ± 15 μm</td>
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<tr>
<td>Cladding Non-circularity</td>
<td>≤ 0.7%</td>
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<tr>
<td>Proof Tensile Test</td>
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<tr>
<td><strong>Attenuation</strong></td>
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<td>@ 850nm(MM)</td>
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<tr>
<td>@ 1300nm(MM)</td>
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<td><strong>Chromatic Dispersion</strong></td>
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<td>Dispersion Slope</td>
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</table>
E. Outer Jacket Labeling
1. Date of manufacture and the manufacturer’s name.
2. A numerical sequence at intervals no greater than 10 ft.
3. “Utah Department of Transportation” or “UDOT” or “DOT” at an interval of no greater than 10 ft.
4. Marking height \( \frac{3}{8} \) inch nominal.

F. Label and tag all fiber optic cables in every accessible location, 6 inches from the end plate on enclosures using Panduit PST-FO (2 inch x 3.5 inch) or equivalent with the following information:
1. Strand count
2. Location
3. Type of circuit such as drop cable, distribution, and backbone
4. Example:
   Direction of Fiber (North, South, East, or West)
   48 ct SMFO
   Locate ID = 3500 So Distribution
   or
   Locate ID = Drop CCTV @ Main St and Center St

2.3 FIBER OPTIC DROP CABLE

A. Drop Cable
1. Six single mode fibers
2. All dielectric, non-armored cable
3. Single buffer tube
4. Gel filled
5. Central core construction
6. Rated at a minimum of 400 lb pulling tension
7. Meets RUS requirements
8. Supply with ST connectors only
9. Locatable mule tape with each drop cable

B. Use a Pre-Terminated Drop Cable Unit
1. Factory assembled.
2. Pre-terminated with a 6 fiber port molded patch panel unit that acts as a cabinet fiber distribution unit (FDU).
3. Submit drop cable product specifications to Engineer for approval before their use.
4. Locatable mule tape with each pre-terminated drop cable unit.

C. Submit factory test results for each drop cable assembly
1. Test results include reflectance and insertion loss.
2. Test report references the serial number of the assembly.
3. Submit the test report to the Engineer before installation.
4. Include test report with the As-Built submission.
D. The pre-terminated assembly will be shipped coiled or on a spool. The free end of the cable will be on the top end of the coil or spool in either case.

2.4 FIBER OPTIC CONNECTORS

A. Supply connector type on jumpers according to the contract
   1. ST – Connectors (Standard)
      a. Factory installed or field installed single mode ST or single mode ST compatible connectors
      b. Ceramic ferrules
      c. Maximum insertion loss 0.30 dB
      d. Connector back reflection greater than 40 dB

2.5 FIBER OPTIC JUMPER/PATCH CORDS

A. Supply jumper and patch cords that are:
   1. Factory made
   2. Buffered
   3. Strengthened with aramid yarn
   4. Utilize ST connectors
   5. No more than 3 ft long in field cabinets and no more than ten ft long in communication hubs
   6. Contain no splices or mid-length couplers

B. Inside plant (IP) Jumpers
   1. Meet NEC jacketing requirements
   2. Outer jacket color
      a. Orange for multimode jumpers
      b. Yellow for single mode jumpers

C. Jumper Connectors
   1. Connectors will mate directly to the optical interfaces on the equipment and to the optical coupler ports on the jumpers.
   2. No additional couplers are allowed.
   3. Use only one type of connector on any assembly or subassembly.

D. Clean all connectors utilizing an alcohol-free wipe.

2.6 HUB FIBER OPTIC DISTRIBUTION UNIT (FDU)

A. Supply FDU with:
   1. Splice storage area with splice trays
   2. One per buffer tube, as required
   3. Patch panel up to 144 terminations according to the plan set
4. Fiber optic ST couplers installed within the patch panel
5. Cover to protect the terminations and splices stored within the FDU

B. Furnish and install new cabinet FDUs to replace any fan-out kits or FDUs that must be severed to make fiber terminations

2.7 TYPE A AND B FIBER OPTIC CABLE SPLICING ENCLOSURE

A. Provide splice enclosures with the following minimum characteristics:
   1. Complies with Telcordia GR-771
   2. Corrosion resistant shell
   3. Allows re-entry without replacing the cable seals
   4. Strength member tie-off
   5. External ground lug
   6. Enclosure must be bonded inside and outside
   7. Mechanism to resist cable pull-out
   8. All required accessories to complete the splice

B. Type A
   1. Accommodates up to 48 splices
   2. Contains two or more 12-count splice trays

C. Type B
   1. Accommodates up to 288 splices
   2. Contains two or more 36-count splice trays

2.8 SPLICING ENCLOSURE FIBER DETAILS

A. Provide a minimum of 3 ft of buffer tube slack from end plate.

B. Provide label for each buffer tube located 1 inch from the splice tray. Description on label will identify 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 Department furnished splice details without written authorization (email is acceptable) from UDOT Fiber Optic Group located at the UDOT Traffic Operation Center, 2060 South 2760 West, Salt Lake City, through the Engineer.

B. Splice all drop cables to the main fiber run with a mid-span entry to the cable unless specified differently in the contract.

C. Contact the Engineer a minimum of five business days in advance of installing fiber optic cable into any existing conduit, ATMS site, or building facility or any testing required to be witnessed by Department Fiber Technician.

D. Perform all work in facilities on conduits, junction boxes, cabinets, and buildings containing the Department’s existing equipment only in the presence of the Engineer or his authorized representative.
   1. Refer to Section 13553 for conduits.
   2. Refer to Section 13554 for junction boxes.
   3. Refer to Section 13555 for cabinets.
   4. Refer to Section 13431 for vaults.

E. Fully restore contractor-caused damage or breaks to in-use project fiber cable and its conduit within 24 hours of damage. Repair damage to project fiber cable or its conduit that is not in use within 48 hours of damage detection to prevent impacting the project schedule.

F. Lubricate cable with a lubricant designed for fiber optic cable installation. Use the following minimum lubricant quantity for each cable pull:
   \[ Q = 0.0008 \times D \times L \]
   Where:
   - \( Q \) = the quantity of lubricant (gallons)
   - \( D \) = the diameter of the conduit (inches)
   - \( L \) = the length of the pull (feet)

G. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension as rated by the cable manufacturer.
H. Maintain the following minimum bend radii:
   1. 20 times Cable Diameter during installation.
   2. 10 times Cable Diameter installed.

I. Cable Slack Requirements
   1. Pull and store excess cable slack at designated intervals, including at each pull box, splice box, hub, and each TMC or TOC. The following are minimum required lengths of slack cable – slack at locations with splice enclosures is measured from enclosure end plate to conduit. Note that the slack is to be equally distributed on either side of the splice enclosure.
      a. Type II and III Poly Concrete Junction Box (No Splice) 35 ft
      b. Fiber Splice Point Junction Box or Vault 100 ft
      c. Future Splice Point (total slack) 100 ft
      d. Bridge Barrier Wall (Each End of Bridge) 15 ft
      e. Device Cabinet 15 ft
      f. Hub Building (Outside) 75 ft
      g. TMC and TOC (OSP Entrance) 50 ft Max
      h. TMC and TOC (IP at Equipment Room) 50 ft Max
      i. Drop Cable 65 ft or equal in length to existing fiber cable plus 10 ft for splicing
   2. Provide proper storage of slack cable, both long term and short term. Do not leave slack cable lying free on the ground or floor of a Device Cabinet/Hub/TOC/TCC. Only during the actual pulling process will this be allowed. Neatly bind cables to be spliced together from conduit to splice enclosure with tape. Submit shop drawings of the materials and installation of the anchored mounting channels (Unistrut) to be installed in these areas for approval by the Engineer. Locate the splice enclosure at the center point of the slack loop when performing splicing.
   3. Ground and bond the armor when installing armored fiber optic cable. Meet NEC and NESC requirements for grounding and bonding armored cable.

J. No additional compensation will be considered for additional slack provided in excess of the minimum specified.

K. Replace any fiber optic cable segment that does not meet the specification requirements 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.
   1. Acceptable environments include office type environments in buildings, splice trailers, and splicing tents with floors.
   2. Do not splice, test, connect, or open fiber ends in locations with freezing temperatures, rain, snow, or wind-blown dust.
   3. Verify connectivity of all working fiber.
   4. Verify connectivity and test according to Section 3.7 B before closing.

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 or heat shrink tubing to provide additional protection and strain relief of each fusion splice point.
   5. Comply with maximum splice loss allowance of 0.05 dB as measured with a fusion machine as described in this Section, Article 3.7 paragraph B.

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. Pre-Installation Test (reel test)
1. Test the fiber optic cable at the site storage area before installation.
2. Test two optical fibers from each buffer tube from one end with an OTDR compatible with wavelength and fiber type.
3. Test for continuity, length, anomalies, and approximate attenuation.
4. Record each measurement with color, location, and type of fiber measured.
5. Test for contractor protection only. Submit to the Engineer upon request.
6. Use no less than 1,000 ft of launch cable.

B. Post Installation Test
1. Contact the Engineer a minimum of five business days before performing tests (Post Termination and Splicing OTDR and Power Meter).
2. Submit all test results according to the As-Built submittal requirements in Section 13551.
3. Perform all fiber optic testing with an OTDR capable of producing output files that are compatible with Department OTDR software or furnish at no cost to the Department the software necessary for viewing the OTDR data.
4. OTDR Testing Requirements
   a. Test every fiber strand passing through any open splice tray after completing the required work. Test all fibers both within the trunk cable and the drop cable.
   b. Conduct all traces with a launch cable or fiber test box between the OTDR and the fiber under test.
   c. Do not exceed insertion loss 1.0 dB.
   d. Conduct all traces at both 1310 nm and 1550 nm.
   e. Provide traces with the following information:
      1) Horizontal Axis – Distance in feet.
      2) Vertical Axis – Attenuation scale in dB.
      3) Traces showing attenuation versus distance.
      4) Cursors positioned at cable ends.
   f. Tabulate for each trace – method, fiber type, wavelength, pulse width, refractive index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, and operator initials.
   g. Provide an event table showing all events with more than 0.05 dB loss containing event type, position from OTDR end, loss, and reflectance.
   h. The maximum total allowable attenuation is 1.0 dB for cables less than 3,300 ft (1 km) in length.
i. Identify fibers by strand number.

j. Submit results in printed form on 8 1/2 x 11 inch paper in a suitable binder organized by cable and strand number.

k. 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.

l. Cover sheets are required for final test results with reviewer’s signature, date, and a statement indicating the installation complies with the requirements of this section.

m. The Contractor’s employee who has reviewed the traces is required to sign or initial them. A check mark is required on all traces that satisfy the requirements identified herein. Flag any discrepancies that may exist with a short description of the proposed corrective action such as re-splice for intermediate test results.

n. Submit to the Engineer on digital media with a printed index.

o. Cable tested by certified staff.

p. Department inspector witnesses and approves before final approval by the Engineer.

5. Post Termination Test 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. Insertion loss < 1.0 dB.

   e. No event > 0.30 dB.

   f. Trace produced for each strand in all cable segments including drop cable.

6. Power Meter/Light Test

   a. Connect the light source to the connectorized fiber at the location identified on the Fiber Optic Light Source Power Meter Test Form provided by the Engineer or Fiber Optic Group Representative. 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.

   b. Use the light frequencies of 1310 nm and 1550 nm or as indicated in test forms.

   c. Test every field location required to obtain access to each cable segment.

   d. Perform all testing using two qualified fiber optic technicians and two vehicles.

   e. A Department inspector and the Fiber Department Representative witnesses and approves the results before final approval by the Engineer.
f. Acceptance Criteria
   1) Cable attenuation as called for in test plans.
   2) Test is available for each strand indicated in test plans or test will be available for each strand in each cable segment.

END OF SECTION
SECTION 13595

ATMS INTEGRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Integrate all project ATMS devices including successful completion and documentation of all required inspections and operational tests.

B. Installing, connecting, and configuring all incidental equipment and components as required for a complete and operational system.

C. Provide all necessary test equipment and other products necessary to test the integrated ATMS device, sub-systems, and systems with no additional cost to the Department.

1.2 RELATED SECTIONS

A. Section 13551: General ATMS Requirements

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. Field Installation – The process of installing, connecting, and configuring an ATMS device to the point that the device is ready to be energized, tested, and integrated.

B. Integration – The process of enabling the completed ATMS device to function as intended. This includes but may not be limited to connecting all items such as required communication, control, and power cables, entering all required device parameters, aiming devices such as antennas, calibrating or adjusting devices, enabling communication to the device from the TOC, and completing all specified tests to verify that integration is complete.

C. Final Acceptance – The date of written notification from the Department that all items identified on the Engineer’s site inspection punch list are complete, satisfactory completion of the 30 day burn-in test, receipt and approval of As-Built drawings, and that the Department accepts ownership and maintenance of the system or devices. The warranty period begins on the date of written notification of Final Acceptance.
1.5 SUBMITTALS

A. Provide submittals according to Section 13551.

B. Refer to submittals listed in this Section.
   1. Refer to Articles 3.2 paragraph A3, 3.2 paragraphs B (Table 1), C3, D1, D2, E3, F2, G3, H1a, and H1b.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 INTEGRATION

A. Provide qualified staff or sub consultants to perform ATMS device integration. Use only those firms pre-certified by the Department to perform ATMS integration.

B. Do not apply AC power to any device, cabinet, or system until after the Engineer’s Site Inspection and without the oversight of qualified integration personnel.

3.2 ACCEPTANCE TESTING

A. Testing and Acceptance Process
   1. Follow the required steps in the ATMS device testing and acceptance process shown in the table below.
   2. Conduct testing and inspection steps in sequence. Multiple steps may be conducted on the same day with adequate notification and scheduling.
   3. Completion of all required submittal, integration, and testing steps as well as receipt of written notification from the Engineer is required for Final Acceptance by the Department.
<table>
<thead>
<tr>
<th>REQUIRED TEST</th>
<th>PREREQUISITES</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATMS Cable and Conductor Test</td>
<td>Basic construction of conduits, boxes, wiring, and cabinets. Perform this test after wire has been pulled but before devices are energized</td>
<td>The ATMS Cable and Conductor Test is used to confirm that cable is not faulty and has not been damaged during installation</td>
</tr>
<tr>
<td>Engineer’s Site Inspection (ESI)</td>
<td>Approval of all required submittals as noted in Section 13551 and completion of basic construction elements</td>
<td>The ESI is used to confirm that the device or system has been constructed according to the project requirements and is ready to be energized and begin the integration process. The ESI will note any obvious issues with wiring, configuration, incorrect inventory, differences from Project Plans, or general cleanliness of the site.</td>
</tr>
<tr>
<td>Local Field Operations Test (LFOT)</td>
<td>Successful completion of local configuration and integration as well as completion of operational punch list items from the ESI</td>
<td>The LFOT is used to confirm that the device or system has been configured and integrated according to the project requirements and is ready to be tested centrally.</td>
</tr>
<tr>
<td>Systems Test (if required)</td>
<td>Successful completion of LFOT and integration of device to central TOC control</td>
<td>Project specific by Special Provision. Certain projects or types of devices may require a complete system test where multiple elements, applications, or devices are tested simultaneously</td>
</tr>
<tr>
<td>Substantial Completion Inspection (SCI)</td>
<td>Successful completion of the LFOT, successful integration of device to the Traffic Operations Center, active central communications to device</td>
<td>The SCI is used to confirm that the ATMS device, subsystem, or system meets the operational parameters described within the project plans, specifications, and Special Provisions. The Contractor must demonstrate the remote device sites communicate to the TOC and operate as a single integrated system as required in the project requirements in addition to having all construction and integration tasks completed. The system will be considered substantially complete and may begin the 30 day ATMS burn-in period with the successful completion of this inspection and testing.</td>
</tr>
<tr>
<td>30 Day ATMS Burn-In Period</td>
<td>Successful Substantial Completion Inspection and submission of the 30 day ATMS burn-in test form.</td>
<td>The 30 day ATMS burn-in period confirms that the ATMS device or system was properly constructed and integrated.</td>
</tr>
</tbody>
</table>
ATMS TESTING AND ACCEPTANCE PROCESS MATRIX

<table>
<thead>
<tr>
<th>REQUIRED TEST</th>
<th>PREREQUISITES</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Acceptance</td>
<td>Satisfactory completion of the 30 day burn-in test, completion of all items on the Engineer’s Site Inspection punch list, and submittal of approved As-Built drawings.</td>
<td>Final Acceptance transfers ownership of the system or devices to the Department. At that point the warranty begins and the ownership and maintenance of the site or system transfers to the Department. Written notification from the Department to the contractor is required for Final Acceptance to occur.</td>
</tr>
</tbody>
</table>

B. ATMS Cable and Conductor Test
1. Perform the Cable and Conductor Test before making any connections.
3. Schedule the test with the Engineer. Submit to the Engineer the ATMS Testing Pre-Notification Form at least 5 days before the agreed test date.
4. Verify that all cables and conductors are installed according to the project requirements and the manufacturer’s recommended best practices before testing.
5. Perform all resistance testing after final termination and cable installation but before any electronics or field device connections.
6. Replace cable and retest if any cable fails to meet the parameters of the test or if any testing reveals any defects in the cable.
7. Furnish all equipment, appliances, and labor necessary to test the installed cable and conductors.

C. Engineer’s Site Inspection (ESI)
1. Prepare for and complete the ESI after all material submittals are approved and after the completion of basic construction.
2. Schedule the inspection with the Engineer. Submit to the Engineer the ATMS Testing Pre-Notification Form at least 5 days before the agreed inspection date.
3. Generate, maintain, and track a punch list of items that must be complete before:
   a. The device may be energized
   b. The device may be accepted
4. Successfully complete the ESI and critical punch list items as directed by the Engineer before energizing the cabinet or any internal device.
D. Local Field Operations Test (LFOT)
1. Conduct the LFOT after completing the Engineer’s Site inspection and receiving approval from the Engineer to begin the test.
3. Schedule the test with the Engineer. Submit to the Engineer the ATMS Testing Pre-Notification form at least 5 days before the agreed test date.
4. Verify that all devices and material are installed according to the project requirements and manufacturers recommended best practices before testing.
5. Repair, replace, adjust, or otherwise address issues with the device that prevents all test steps from passing. Repeat test steps during/after repair until step is passed.

E. Substantial Completion Inspection (SCI)
1. Prepare for and complete the SCI after completing the LFOT and receiving approval from the Engineer to begin the SCI.
2. Schedule the inspection with the Engineer. Submit to the Engineer the ATMS Testing Pre-Notification form at least 5 days before the agreed inspection date.
3. Notify Region Blue Stakes Coordinator of the SCI walk through.
4. Verify that central communications to the device is active before initiating the SCI.
5. Generate, maintain, and track SCI punch list of items that must be complete before Final Acceptance can occur

F. 30 Day ATMS Burn-In Test
1. Conduct the 30 Day ATMS burn-in test after completing the SCI.
3. Schedule the test with the Engineer. Submit to the Engineer 30 day ATMS burn-in test form at least 5 days before the agreed test start date.
4. Begin the 30 day ATMS burn-in test upon written approval from the Engineer.
5. Verify that central communications and electrical power are continually available during the 30 day test period.
6. The Engineer or designated representative will coordinate and oversee the full life-cycle of the burn-in period. During the burn-in test, Operators at the TOC will monitor and exercise the devices remotely. The burn-in period will continue for 30 days, unless an equipment failure occurs.
7. Perform a diagnostic test in the event that an equipment failure occurs. Respond and conduct diagnostic test within 24 hours of notification by the Engineer. The burn-in test will be suspended during diagnostic testing.

8. Complete all necessary work to correct the problem within 24 hours of notification unless the Engineer allows additional time.

9. Provide a written (or email) Equipment Failure Report to the Engineer within 72 hours after notification of the problem. The written failure report will fully describe the problem, its cause, and all actions taken to rectify the failure. All equipment, materials, or software listed in the report will contain the manufacturer’s name, model, field location, and serial number. All equipment or modules used in the replacement or repair will meet the operational requirements and project specifications and be subject to the full testing process.

10. Do not perform field repairs on electrical or electronic equipment. Malfunctioning electrical or electronic equipment will be replaced in kind or as approved by the Engineer.

11. Within two working days after receiving the Equipment Failure Report the Engineer will notify Contractor in writing or by email whether the 30 day burn-in test will be continued, extended until a set time is reached, or restarted by setting time back to Day Zero.

G. Final Acceptance

1. The device, system, or sub-system will be eligible for Final Acceptance upon completion of the successful 30 Day ATMS burn-in test. To complete the Final Acceptance Process:
   a. Confirm all As-Built drawings have been submitted, verified, and approved.
   b. Confirm all required submittals have been submitted and approved.
   c. Complete all ESI and SCI punch list items.
   d. Receive written approval from the Engineer that the device or system has been accepted by the Department.

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. Section 13554: 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
D. ASTM A 36: Carbon Structural Steel
E. ASTM A 572: High-Strength Low-Alloy Columbium-Vanadium Structural Steel

F. ASTM A 595: Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use

G. ASTM B 3: Soft or Annealed Copper Wire

H. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

I. ASTM B 29: Refined Lead

J. ASTM B 766: Electrodeposited Coatings of Cadmium

K. ASTM D 3035: Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

L. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

M. American Iron & Steel Institute (AISI)

N. American National Standards Institute (ANSI)

O. American Wire Gauge (AWG)

P. Illuminating Engineering Society (IES)

Q. Institute of Electrical and Electronics Engineers

R. Institute of Transportation Engineers (ITE)

S. Intertek ETL Listed

T. National Electric Code (NEC)

U. National Electrical Manufacturers Association (NEMA)

V. National Fire Protection Association (NFPA)

W. Standard Specifications for Construction and Bridges on Federal Highway Projects

X. Underwriters Laboratories (UL)
1.4 DEFINITIONS

1.5 SUBMITTALS

A. Supply manufacturer’s 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).

B. A licensed Journey Electrician must be responsible for and supervise all onsite work related to this Section.

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  WIRE AND GROUNDING

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-2/RHW-2. Conform to NEC Article 200.
   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.

2.2. CONDUIT

A. Schedule 40 PVC and 80 PVC conduit and fittings rated at 200 degrees F as specified. Refer to NEMA TC-2/TC-3 UL.

B. SDR-11 HDPE – NEMA TC-7, ASTM 3035.

C. Galvanized rigid steel conduit and fittings as specified. Refer to ANSI C 80.1.

2.3 JUNCTION BOXES

A. Refer to Section 13554.

2.4 POWER CABLE ROUTE MARKER

A. Refer to ASTM B 29, alloy 5052-H38. 0.08 inch thick sheet aluminum as specified.

B. White and red enamel paint – Refer to Section 09972.

C. Mounting hardware – Refer to Section 05120.

D. Flanged channel mount post – Refer to Section 02842.
2.5 SPLICE, MOLDED CONNECTOR, AND FUSE HOLDER

A. Splicing—Use 3 port or 4 port mechanical squid compression splice compatible with individual cable insulation and with water seal for underground use. Do not use split-bolt type splice for insulated wire circuits. Comply with current NEC code.

B. Use spring-loaded, molded connector and fuse holder with 90 percent minimum conductivity according to ANSI/UL 486A. Include an integrated break-away coupling for luminaire pole with slip base h 200,000 A interrupting rating. Refer to UL Class CC.

C. Light pole fuses with rating according to Table 1.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Wattage</th>
<th>Current (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>250/400</td>
<td>20</td>
</tr>
<tr>
<td>208/240</td>
<td>250/400</td>
<td>15</td>
</tr>
<tr>
<td>277/480</td>
<td>250/400</td>
<td>10</td>
</tr>
</tbody>
</table>

D. Lighting Circuit Fuses – Refer to UL Class RK5.

E. Service Disconnect Fuses – Refer to UL Class R.

2.6 POLE – GENERAL

A. Use tapered steel poles. Refer to SL Series Standard Drawings.

B. Galvanized according to AASHTO M 111.

C. Performance Criteria
   2. Designed for luminaire weight of 77 lb with projected area of 3.0 ft².
   3. Maximum allowable deflection of 4\(\frac{3}{4}\) inch. Deflection criteria are based on a 100 lb horizontal load applied at 6 inches below shaft top.

D. Pole Designated for Decorative Lighting
   1. Provide a festoon outlet located 16 ft from the base plate with duplex receptacle and weather-proof cover.
   2. UL listed.
E. Light Pole Numbers
1. General
   a. Use 3 inch, series C legend, green reflectorized sheeting as specified with 1 inch vertical spacing between letters. The legend reads from top to bottom.
   b. Use 4 inch wide, white reflectorized sheeting as specified for legend backing.
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
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.
4. Drilled shafts – Refer to Section 02466.
2.7 **POLE – MOUNTING HEIGHT UNDER 45 FEET**


B. Breakaway base – Refer to SL Series Standard Drawings.

C. Steel base plate – Type NS, ASTM A 572 Grade 50 or ASTM A 36.

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 100 ft or higher and Fatigue Category II for poles under 100 ft.

B. Steel base-plate – Refer to ASTM A 572 grade 50 or ASTM A 36.

C. Anchor bolts – Refer to AASHTO M 232, ASTM F 1554, grade 55.

D. High Mast Service Hoist Assembly
   1. Mast head assembly – Provide steel support sheaves for support of hoisting cables. Use sheaves with oil-impregnated, sintered-bronze bushings mounted on stainless steel shafts. Include mast head cover of galvanized steel or spun aluminum that protects the assembly from weather.
   2. Hoisting cables – three $3/16$ inch, 7 x 19 non-rotational stainless steel cables.
   3. Luminaire support ring – minimum 10-gauge galvanized or stainless steel ring and 2 inch diameter luminaire arms. Mount a weather tight wiring enclosure containing a pre-wired 600 V terminal block with power receptacle for testing luminaries when ring has been lowered.
   4. Power cable sheave – brushed with oil-impregnated, sintered-bronze bushings with a stainless steel shaft.
   5. Ring centering device – roller-contact, spring-loaded, water-resistant, non-marking roller on stainless steel shaft.
6. Winch – worm gear driven and self-locking with ¼ inch, 7 x 19 non-rotational, stainless steel cable.
7. Internal drive motor – UL Listed as heavy duty, reversing, with torque limiter, capable of raising the luminaire support ring at a minimum rate of 15 feet per minute.
8. Latching system—Use a bottom latching system to hold luminaire ring in its raised position. Install safety chains for securing the clevis assembly.

2.9 HIGHWAY LUMINAIRE

A. Physical Requirements
1. Low-profile, die-cast aluminum housing with white or grey minimum 3 mil powder coat finish. Wide angular channels that allow for natural removal of dirt and debris.
2. 1.5 inch to 2.5 inch O.D. horizontal tenon mount.
3. Built in bubble level.
4. High temperature wiring.
5. Hinged door with tool-less entry.
6. Large terminal block directly in line with incoming power wires, accommodate up to 6 AWG wire.
7. Luminaire weight and projected area within design loading limits.
8. UL 8750 and UL 1598 compliant.
10. ETL Listed for wet locations.
11. Refer to SL Series Standard Drawings.

B. LED Driver
1. Rated for a minimum 70,000 hours.
2. NEMA IP66 rated.
3. Voltage a specified. Multi-volt 120 – 277 VAC or 480 VAC.

C. LED Optics Chamber
1. EMA IP66 rated.

D. Performance Requirements
1. IES L70 lumen maintenance minimum 70,000 hours.
2. Apparent color temperature 4000K – 4500 K .
3. Type II light distribution pattern.
4. Luminaire Type A
   a. Minimum 9,000 delivered lumens per IES LM-79.
   b. Required power – maximum 140 Watts.
5. Luminaire Type B
   a. Minimum 14,500 delivered lumens per IES LM-79.
   b. Required power maximum 230 Watts.
2.10 HIGH MAST LUMINAIRE

A. Physical Requirements
   1. Symmetrical or asymmetrical with the asymmetrical capable of 360 degrees rotation.
   2. Cast Type 319 aluminum ballast housing with slipfitter mounts adjustable to at least plus or minus 3 degrees.
   4. UL 1572 compliant.
   5. Universal or Advance standard ballast with standard capacitor and ignitor. Do not use electronic ballasts or ignitors.

B. High Pressure sodium ballast
   1. Operates at 480 VAC.
   2. Refer to ANSI C82.4, C82.6, C92.1, and ANSI/UL 1029.
   3. Power Factor must maintain 90 percent for nominal secondary load and a least 70 percent for any 10 percent voltage variation.
   4. Lamp Wattage – maintain no more than 5 percent variation.
   5. Regulation – maintain no more than 35 percent for 10 percent line-voltage variation.
   6. Must start and operate at the rated lamp wattage at ambient temperatures down to -20 degrees F for the rated life of the lamp.
   7. Must sustain lamp operation for a minimum of 4 seconds at a voltage dip of 35 percent.

C. Lamp
   1. Philips, Sylvania, General Electric, or approved equivalent 1000 W E-25 lamp with mogul base.
   2. Non-cycling characteristics.
   3. Rated life of no less than 24,000 hours at 10 hours per start-up.

2.11 UNDERSTRUCTURE LUMINAIRE

A. Physical Requirements
   1. LED or induction lamp fixture, specifically designed for understructure application.
   2. Die-cast aluminum housing with vandal-proof fastener..
   3. Optical assembly – heat and impact resistant, tempered glass, or prismatic acrylic lens and stainless steel lens guard.
   4. Wall mount – minimum 60 degree beam angle.
   5. UL 8750 and UL 1598 compliant.
   7. ETL Listed for wet locations.
B. LED Driver
1. Rated for a minimum 70,000 hours.
2. NEMA IP66 rated.
3. Voltage as specified. Multi-volt 120 – 277 VAC or 480 VAC.

C. LED Performance Requirements
1. IES L70 lumen maintenance minimum 70,000 hours.
2. Apparent color temperature 000 K – 4500 K.
3. Minimum 7500 delivered lumens per IES LM-79.
4. Required power – maximum 110 Watts.

D. Induction Lamp Driver
1. Power Factor– minimum of 90 percent for a 10 percent voltage variation.
2. Lamp Wattage– 150 W – 165 W with no more than 5 percent variation.
3. Regulation– maintain no more than 30 percent for 10 percent line voltage variation.
4. Must start and operate at the rated lamp wattage at ambient temperatures down to 20 degrees F for the rated life of the lamp.
5. Must maintain lamp operation for a minimum of 4 seconds at a voltage dip of 40 percent.

E. Induction Lamp Performance Requirements
1. Apparent color temperature of 3,500 K to 4,100 K.
2. Rated life of no less than 100,000 hours at 10 hours per start up.

2.12 OVERHEAD SIGN LUMINAIRE

A. General Requirements
1. LED or induction lamp fixture with die-cast aluminum housing, die-cast aluminum door and integral glare shield.
2. 1¼ inch square conduit clamp support.
3. Photometrics designed specifically for sign illumination.
4. Weight – no more than 40 lbs with a projected area of not more than 2.5 ft².
5. Meet all applicable specifications outlined in 2.11 of this Section.
6. LED performance– Minimum 5000 delivered lumens at a maximum 70 Watts.
7. Induction lamp performance– 70 W to 85 W.

2.13 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

2.14 CONTROL EQUIPMENT

A. Photocell Control Units
   1. Refer to ANSI 136.10, NEMA Base.
   2. Fail safe in the "on" position. Turns on at 32 Lx ± 10 percent.

B. Lighting Contactor
   1. Hermetically sealed, steel tube mercury contacts.
   2. Manually operated, mechanically held contact.
   3. Remote or photoelectric-operated, magnetic, electrically held contactor.
   4. Three position slide selector with "on-off-auto" switch.

C. Control Relay
   1. Refer to ANSI/IEEE C37.13, C37.27 and C62.41.
   2. Contact rating of 3,000 W minimum.
   4. Multiple relay – Zinc/di-chromate-plated magnet, Class B insulation rating coil, cadmium oxide contact, dual expulsion gap lightning arrester and valve type line arrester with no less than 650 V rating.

D. Enclosure
   1. Refer to NEMA 3R Type 4. Encase in a cabinet with padlock as specified.

E. Circuit Breaker UL Rated
   1. 240 V at 10,000 A interrupting rating
   2. 480 V at 5,000 A interrupting rating

2.15 SUBSTATION

A. Refer to 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.
2.16 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, rated for No. 2 AWG wire.
   e. Lighting control by 12year warranty photocell module.
   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.
2.17 CONCRETE AND ASPHALT

A. Concrete – Section 03055, Class AA(AE)

B. Hot Mix Asphalt – Section 02741

C. Flowable Fill – Section 03575

2.18 HARDWARE

A. Screws – stainless steel

B. Nuts, bolts, and washers
   1. Galvanized – Refer to AASHTO M 111.
   3. Type NS, as specified.

C. Mounting bands and buckles – stainless steel, ¾ inch wide, 0.03 inch 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. Receive materials at the Department’s Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse to schedule a pickup.
   2. Receive drop shipment materials at location specified.

C. Contact local power utility at least 30 days before the connection date and verify the exact location, voltage, procedure, and materials required by the power utility.

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 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 AND JUNCTION BOXES

A. Refer to Section 02892.

3.5 INSTALL WIRING

A. Refer to Section 02892.
B. Install wiring according to the appropriate articles of NFPA 70. Neatly arrange wiring within items such as cabinets and junction boxes.
C. Install molded connectors on the cable so that the load side retains the fuse when it is disconnected at the cable’s breakaway coupling.
D. Use compression or bus bar and water seal as specified.
E. Use dual connection fuse holders in the luminaire pole for continuous circuits. Do not splice wire in junction boxes unless the circuit is split into two separate runs.
F. Use minimum No. 8 AWG wire in luminaire pole.

3.6 INSTALL LUMINAires AND BALLasts

A. Clean all light control surfaces, refractors, and reflectors immediately before installation to provide the maximum lumen output possible. Clean according to the luminaire manufacturer’s recommendations.
B. Adjust luminaires with a level.
C. Adjust sign bridge luminaires for optimum and uniform light distribution.
D. High mast luminaire – Obtain manufacturer’s certification that the service hoist operation is correctly installed.

3.7 INSTALL POWER SOURCE CONNECTION

A. Lighting pedestal – Refer to SL Series Standard Drawings. Install according to manufacturer’s recommendations.

B. Service Disconnect Switch
   1. Install the grounded neutral conductor from secondary power source to the switch box.
   2. Install mounting bracket within 1 ft of both top and bottom of the switch box and within 3 ft of other cabinet or fitting.
   3. Provide and install material required by the appropriate power company.
   4. Install padlock on the switch box door and handle.

3.8 INSTALL 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.

3.9 PHOTO-ELECTRIC CONTROL

A. Adjust to “North Sky” position.

3.10 POLE

A. Refer to SL Series Standard Drawings.

B. Center the shaft top over the center of the foundation after the arm extension, luminaire, and all accessories are in place or according to the manufacturer’s requirements.

C. Install pole identification numbers at a 45 degree angle to approaching traffic. Remove old identification numbers without damage to galvanizing.
D. Torque
   1. Anchor bolts to 118 lb/ft.
   2. Slip bolts to 80 lb/ft, release, and re-torque to 70 lb/ft.

E. Installing Items on a Pole
   1. Do not drill steel pole.
   2. Use stainless steel mounting bands.

3.11 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).

3.12 SALVAGE

A. Remove equipment to be reused or salvaged carefully so that it remains in the condition existing before its removal.

B. Pole assembly remains the property of the Department. Transport to the location specified.

C. Remove foundation to a depth of 12 inches below the existing surface and backfill with local material.

D. Remove and discard abandoned junction boxes. Backfill with local material and compact to match adjacent grade.

END OF SECTION
SECTION 16526

ELECTRICAL WORK BRIDGES

PART 1  GENERAL

1.1  SECTION INCLUDES

A. 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. American Wire Gauge (AWG)

G. Electronic Industries Association (EIA)

H. National Electrical Manufacturers Association (NEMA)

I. 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. Refer to ASTM A 307.

B. Other Bolts and Anchors
   1. Refer to ASTM A 307.
   2. Electro-plated cadmium. Refer to ASTM B 766.

2.3 CONDUIT AND FITTINGS

A. Use schedule 40 PVC conduit and fittings rated at 190 degrees F as specified when the conduit is totally enclosed within concrete.
   1. Refer to NEMA TC-2.
   2. Refer to 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. Refer to UL 6.
   3. Refer to 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. Refer to AASHTO M 55.

B. Use boxes a minimum of 12 x 8 x 6 inches or the size and type shown on the plans.

C. Hold the cover rigidly in place by screws or bolts manufactured of a non-corrosive material.

2.5 WORKMANSHIP

A. Conform to the requirements of the National Electric Code and any local ordinances that may apply.
B. Place the anchor bolts accurately. Do not bend the anchor bolts or ream the holes in the base plate.

2.6 FUTURE USE PULL WIRE

A. Install all conduit segments with No. 14 AWG THHN wire for future use as pull wire for mule tape.

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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