

## **RED LAKE DAM MODIFICATIONS**

**Navajo Nation, New Mexico**

### **SECTION A – FOREWORD**

Red Lake Dam is located approximately 1/2-mile northwest of Navajo, New Mexico. Work includes construction of the following elements:

1. Sand filter and gravel drain.
2. Embankment placement and slope protection.
3. Toe drain, inspection wells, and piezometers.
4. Outlet works, irrigation diversions, control structures, and spillway improvements.
5. Boat ramp and parking area.
6. Early Warning System (EWS) building.

#### **TELEPHONE INQUIRIES REGARDING THIS SOLICITATION SHOULD BE MADE TO:**

Contractual Issues: Attn: Lynelle Benallie, Contracting Officer (CO), Bureau of Indian Affairs, Navajo Region, Branch of Contracts, P.O. Box 1060, Gallup, NM 87305. (Express Mail to: Federal Building, 3<sup>rd</sup> Floor, 301 W. Hill Street 87301)

Telephone: (505) 863-8404

**PRE-BID SITE VISIT: A PREBID SITE VISIT WILL BE HELD. PROSPECTIVE BIDDERS CONTACT LYNELLE BENALLIE AT THE TELEPHONE NUMBER LISTED ABOVE.**

**FOR DATE AND PLACE OF BID OPENING, SEE "SOLICITATION, OFFER, AND AWARD," STANDARD FORM 1442.**

**FOR INFORMATION REGARDING BUREAU OF RECLAMATION'S PUBLICATION "RECLAMATION SAFETY AND HEALTH STANDARDS" (Revised 2009) WHICH IS APPLICABLE TO WORK UNDER THIS CONTRACT, SEE CLAUSE AT "WBR 1452.223-81 SAFETY AND HEALTH."**

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**SECTION B**  
**SUPPLIES OR SERVICES AND PRICES**

**Red Lake Dam Modifications**  
**Navajo Nation, New Mexico**

**B.1 SCHEDULE**

- (a) Offers will be considered for award on the following schedule, but no offer will be considered for award on only a part of the schedule.
  - (1) Offerors not responding to all bid schedule line items will be considered nonresponsive and will not be evaluated for award.
  - (2) Offers will be evaluated based on the Contractors qualifications and the total of the Bid Schedule. Award will be made to the responsive offer which brings the best value.
  - (3) The Contracting Officer (CO) or Contracting Officers Representative (COR) may remove items from the schedule based on available funds.
- (b) All offers are subject to the terms and conditions of this solicitation.
- (c) The quantities in the schedule are estimated quantities for comparison of offers only and except as provided in the contract clause at FAR 52.211-18, Variation in Estimated Quantity, no claim shall be made against the Government for overruns or underruns.
- (d) See the contract clause at WBR 1452.232-81, Payment for Mobilization and Preparatory Work.
- (e) Offerors' submitted bid schedule shall include all items necessary to complete all construction and Contractor requirements presented in the Drawings and Specifications. Work items not specifically identified in the Bid Schedule shall be incorporated into the Offerors' lump sum line item pricing for related work.
- (f) Contractor is responsible for paying royalties on all borrow materials per permit requirements.

**BID SCHEDULE**

<b>Item</b>	<b>Supplies or Services</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Amount</b>
1	Mobilization and Demobilization	Preparing site access, moving in, setting up equipment and facilities for the Work, cleanup and disposal of waste materials, restoration of the site upon completing the Work, and moving out.	1	LS		\$
2	Removal and Disposal of Existing Structures	Excavation, removal, and hauling of materials and structures offsite for disposal at direction of the COR or BIA Representative. Includes existing metal conduits, power poles, fencing and gates, and miscellaneous structures.	1	LS		\$
3	Removal and Placement of Concrete Structures for Fish Habitat	Excavation, removal, hauling, and stockpiling abandoned concrete structures and concrete piping for reuse as fish habitat at the direction of the COR or BIA Representative. Includes removal of exposed rebar as specified.	1	LS		\$
4	Water for Dust Abatement	Application of water to reduce airborne dust during construction.	1	LS		\$
5	Dewatering	Labor, materials, and equipment necessary to unwater surface water and dewater groundwater for excavations and as needed to maintain safe work area free from standing water and prepared foundations as specified.	1	LS		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
6	Diversion and Care of Water During Construction	Construction of cofferdam and associated diversion and protection works to control and manage stored water from storm inflows.	1	LS		\$
7	Erosion Control	Construction of erosion control facilities within construction limits.	1	LS		\$
8	Abandoning Existing Piezometers	Removal of existing piezometers and grouting standpipes in subsurface as shown on the Drawings.	1	LS		\$
9	Clearing and Grubbing	Removal of vegetation, rubbish, and other items as necessary to provide a suitable working surface.	30	ACRE		\$
10	Tree Removal – Embankment and Reservoir	Removal of trees identified by the COR near embankment. <b>**Tree removal must take place before March 15<sup>th</sup>.</b>	1	LS		\$
11	Tree Removal – Borrow Area	Removal of trees necessary for borrow development. <b>**Tree removal must take place before March 15<sup>th</sup>.</b>	1	LS		\$
12	Stripping	Excavation and stockpiling of topsoil and overburden materials to expose adequate subgrade for construction at the embankment, borrow areas, access roads, canal conduits, EWS building, and boat ramp and adjacent parking area. Includes existing riprap on upstream slope. Onsite disposal of excess or unsuitable material is considered incidental to the cost of the Work.	15,585	CY		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
13	Excavation for Roadways	Excavation and grading of road section to provide drainage and ditching.	1	LS		\$
14	Primary Access Road Construction	Place and compact Zone 1 fill for primary access road.	3,200	CY		\$
15	Access Road and Boat Ramp Parking Area Gravel Surfacing	Place and compact gravel surface for primary and downstream access roads and boat ramp parking area.	1,500	CY		\$
16	Required Embankment and Spillway Excavations	Removal and stockpiling of embankment and foundation materials to reconstruct embankment, replace outlet works to ERC Sta. 1+70, rehabilitate the spillway, reshape the spillway channel, and place filters. Excludes excavation for outlet works conduits and structures incidental to those line items. Onsite disposal of excess or unsuitable material is considered incidental to the cost of the Work.	29,100	CY		\$
17	Zone 1	Foundation preparation, conditioning, processing, hauling, placing, spreading, and compacting Zone 1 materials obtained from existing embankment or borrow area. Includes required fill for embankment (including outlet works backfill to ERC Sta. 1+70), spillway, and boat ramp. Excludes primary access road and pipe backfill.	19,250	CY		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
18	Zone 1A	Foundation preparation, conditioning, processing, hauling, placing, spreading, and compacting Zone 1A materials obtained from existing embankment or borrow area.	6,400	CY		\$
19	Zone 2 Inclined Filter	Furnish, place, condition, spread, and compact Zone 2 materials for inclined filter.	6,400	CY		\$
20	Zone 2 Filter Trench	Furnish, place, condition, spread, and compact Zone 2 materials for filter trench.	1,800	CY		\$
21	Zone 3	Furnish, place, and spread Zone 3 materials.	2,100	CY		\$
22	PVC Raceways	Furnish and install PVC pipe for carrying equipment cables.	1	LS		\$
23	Geotextile Type A	Furnish and install Type A geotextile at the downstream toe of the embankment, embankment crest, boat ramp parking area, and other areas as shown on the Drawings.	25,750	SY		\$
24	Geotextile Type B	Furnish and install Type B geotextile as riprap bedding on the upstream slope.	15,400	SY		\$
25	Geonet	Furnish and install geocomposite materials for drainage on the downstream slope.	2,700	SY		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
26	15-inch Riprap	Furnish, place, and spread riprap with a median size of 15 inches on the upstream slope, at the spillway, at the energy dissipation structure, and at the boat ramp and adjacent parking area.	11,000	CY		\$
27	Dam Crest Gravel Surfacing	Hauling, placing, spreading, and compacting gravel surface materials at embankment crest and parking area.	1,300	CY		\$
28	Outlet Works Concrete Structures	Furnish concrete, forms, and materials for the construction of reinforced cast-in-place intake structure, Emergency Release Conduit impact basin, Arizona Canal Conduit and New Mexico Canal Conduit outlet structures, meter vault, and spillway apron extension. Excludes EWS structure, outlet works encasement, and carrier pipe encasement.	1	LS		\$
29	Outlet Works Concrete Encasement	Furnish concrete, forms, and materials for the construction of reinforced cast-in-place outlet works conduit encasement.	1	LS		\$
30	Outlet Works Vent Pipe and Carrier Pipe Encasement	Furnish concrete, forms, and materials for the construction of unreinforced cast-in-place vent pipe and carrier pipe encasement.	1	LS		\$



Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
31	Leveling Slab and Mass Concrete	Furnish and install concrete and materials for leveling slab under outlet works conduit encasement, unreinforced conduit encasement near the meter vault, mass concrete at spillway, and thrust block.	1	LS		\$
32	Inspection Wells	Furnish and install precast concrete inspection wells. Includes roof hatch, covers, base slabs, access ladders, grab bars/safety posts, gratings, weir plates, ultrasonic water level sensor, staff gauge, and other items and instruments included in the inspection well designs.	1	LS		\$
33	Piezometers	Drill and construct piezometers.	1	LS		\$
34	Crest Survey Monuments	Furnish and install survey monuments.	6	EA		\$
35	Staff Gauge	Furnish and install staff gauge.	1	LS		\$
36	12-inch Diameter Perforated HDPE Drain Pipe	Furnish and install 12-inch diameter perforated HDPE pipe for toe drain.	2,400	LF		\$
37	12-inch Diameter Solid HDPE Drain Pipe	Furnish and install 12-inch diameter solid HDPE pipe for toe drain and cleanouts.	250	LF		\$
38	Drain Cleanouts	Furnish and install cleanouts for toe drain system.	3	EA		\$
39	Trashracks	Furnish and install trashracks.	1	LS		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
40	Complete Hydraulically-Operated Sluice Gate Package (3 gates)	Furnish and install hydraulically-operated sluice gates for intake structures, including individual hydraulic power units, hydraulic lines, and all associated operating equipment.	1	LS		\$
41	Miscellaneous Metal Fabrications	Furnish and install miscellaneous access ladders, safety posts, pipe guardrails, covers, stop logs, air vent outlets, bollards, and other structures.	1	LS		\$
42.A	EWS Building – Concrete	Furnish and construct EWS cast-in-place concrete building walls, footings, slab-on-grade, 6-inch site pad, roof slab with form metal deck, and roof hatch curb.	35	CY		\$
42.B	EWS Building – Grating Systems	Furnish and construct aluminum grating for working floor and sump pit floor.	1	LS		\$
42.C	EWS Building – Steel Framing	Furnish and construct steel support framing and associated connections.	1	LS		\$
42.D	EWS Building – Roof Hatch, Access Ladder, Door, and Louvers	Furnish and construct roof hatch, access ladder, door, and louvers.	1	LS		\$
42.E	EWS Building – Roof Security Fencing	Furnish and construct roof access perimeter security fencing.	1	LS		\$
42.F	EWS Building – Sump Pit and Local Drainage Grading	Furnish and construct sump pit and local drainage grading.	1	LS		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
43	EWS Complete Electrical System	Furnish and install solar power systems, electrical conduits, insulated conductors, grounding system, wiring devices, distribution panelboard, and lighting systems.	1	LS		\$
44	Barbed Wire Fence	Furnish and install barbed wire fence along the New Mexico Canal and access roads.	3,950	LF		\$
45	Sonic Flowmeter Systems	Furnish and install sonic flowmeters.	1	LS		\$
46	Irrigation System	Furnish and install 6-inch diameter HDPE feeder pipe and lateral pipe, riser pipe, utility vault, and portable diesel-powered pump for Mr. Jumbo's irrigation system. Includes all required fittings, valves, excavations, trenching, and backfill.	1	LS		\$
47	Primary Access Road Culverts and Structures	Furnish and install HDPE pipes, precast concrete flared end sections, and drop inlets.	1	LS		\$
48	Steel Pipe and Miscellaneous Fittings and Connections	Furnish and install steel pipe as shown, including flanges, couplings, connections, and end sections for HDPE pipe.	1	LS		\$
49	HDPE Pipe for Outlet Works (12-inch diameter and under)	Furnish and install HDPE conduit for hydraulic lines, equipment cables, and air vents.	1	LS		\$

Item	Supplies or Services	Description	Quantity	Unit	Unit Price	Amount
50	HDPE Pipe for Outlet Works (greater than 12-inch diameter)	Furnish and install HDPE for outlet works and canal conduits and canal connections. Includes all required fittings, bulkheads, pipe bedding, pipe zone fill, Zone 1 fill, and required excavations downstream of ERC Sta. 1+70. Onsite disposal of excess or unsuitable material is considered incidental to the cost of the Work.	1	LS		\$
51	Articulated Concrete Block (ACB) Mats for Boat Ramp	Furnish and install ACB mats for construction of boat ramp, including preparation of foundation soils and furnishing and installing geotextile filter fabric, geogrid, and gravel base layer beneath ACB mats.	1	LS		\$
52	Prefabricated Precast Concrete Vault Toilet Building	Furnish and install precast concrete vault toilet building at boat ramp parking area.	1	LS		\$
53	Security Gate	Furnish and install gates and cattle guards as shown on the Drawings.	2	EA		\$
54	Placing Topsoil	Placement of topsoil cover over disturbed borrow area and downstream embankment slope.	15,585	CY		\$
55	Topsoil Erosion Control Matting	Furnish and place erosion control on topsoil for revegetation.	14,400	SY		\$

<b>Item</b>	<b>Supplies or Services</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Amount</b>
56	Seeding and Soil Supplements	Furnish and place seed to revegetate areas for reclamation, including borrow areas, the downstream embankment slope, and other disturbed areas.	18	ACRE		\$

TOTAL FOR BID SCHEDULE \$ \_\_\_\_\_

**END OF SCHEDULE**

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**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1      GENERAL**

**1.01    LOCATION**

- A.    Work is located at Red Lake Dam approximately 1/2-mile northwest of Navajo, New Mexico, McKinley County.

**1.02    PRINCIPAL COMPONENTS OF WORK**

- A.    Site Construction:
1.    Excavation, removal, and disposal of existing structures and items.
  2.    Clearing and grubbing construction areas of vegetation and rubbish.
  3.    Cutting and removing trees.
  4.    Stripping and stockpiling of topsoil from construction areas.
  5.    Removing water from work areas and controlling water to prevent flow of water into work areas.
  6.    Excavating, placing, and compacting access roadway embankments, drainage provisions, and gravel surfacing.
  7.    Excavating of material from dam embankment and foundation.
  8.    Excavation for structures.
  9.    Excavation for borrow.
  10.    Excavation and grading of existing spillway channel.
  11.    Placing and compacting embankment materials.
  12.    Furnishing, placing, and compacting sand filter and gravel drain materials for dam embankment.
  13.    Furnishing and installing geotextile.
  14.    Furnishing and placing rock riprap.
  15.    Abandoning existing piezometers.
  16.    Drilling and constructing piezometers.
  17.    Furnishing and installing survey monuments.
  18.    Furnishing and installing Jumbo's irrigation pipeline and irrigation connection.
  19.    Furnishing and installing perforated and non-perforated HDPE drain pipe for toe drains and drain cleanouts.

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20. Furnishing and installing precast concrete inspection wells for toe drains.
  21. Furnishing and installing HPDE conduits for hydraulic lines, equipment cables, and air vents.
  22. Furnishing and installing emergency release and irrigation diversion conduits.
  23. Divert and capture water.
  24. Furnishing and installing access road culverts and structures.
  25. Furnishing, placing, and compacting gravel surfacing material on the dam embankment and parking area.
  26. Placing fish habitat structure.
  27. Furnishing and installing boat ramp and articulated concrete blocks.
  28. Furnishing and installing security fencing at early warning system building.
  29. Furnishing and installing security gates and cattle guards.
  30. Furnishing and installing barbed wire livestock fence.
  31. Grading, reclamation, seeding, and establishing vegetation of areas disturbed by construction.
- B. Concrete:
1. Constructing reinforced cast-in-place intake structure, Emergency Release Conduit (ERC) impact basin, Arizona Canal (AZC) Conduit and New Mexico Canal (NMC) Conduit outlet structures, meter vault, spillway apron extension, and early warning system (EWS) building.
  2. Furnishing and installing reinforced cast-in-place outlet works concrete encasement.
  3. Furnishing and installing unreinforced cast-in-place vent and carrier pipe encasement.
  4. Furnishing and installing leveling slab, thrust block, and mass concrete at spillway.
  5. Paint existing concrete at spillway with graffiti resistant coating.
  6. Furnishing and installing prefabricated precast concrete vault toilet building.
- C. Waterway Construction:
1. Furnishing and installing trashracks.
  2. Furnishing and installing section bulkhead for intake structure.
- D. Metals:
1. Furnishing and installing roof hatch covers, gratings, ladders, pipe guardrails, covers, and other miscellaneous metals.

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- E. Equipment:
    - 1. Furnishing and installing hydraulically-operated sluice gates, controllers, and mounting equipment for outlet works intake structures, and associated hydraulic operating equipment tubing.
    - 2. Furnishing and installing sonic flowmeter systems.
  - F. Plumbing:
    - 1. Furnishing and installing drainage sump pumping unit.
  - G. Heating, Ventilating and Air Conditioning.
    - 1. Furnishing and installing bullet-resistant louvers.
  - H. Mechanical:
    - 1. Furnish and installing PVC raceways and pull boxes for instrumentation cables.
  - I. Electrical:
    - 1. Furnishing and installing solar power system for EWS building.
    - 2. Furnishing and installing electrical conduit, insulated conductors, grounding system, and wiring devices.
    - 3. Furnishing and installing distribution panel board.
    - 4. Furnishing and installing lighting system.
    - 5. All work to make a complete project.

### **1.03 SPECIFICATIONS REQUIREMENTS**

- A. Requirements in Division 1, General Requirements, apply to Divisions 2 through 53.
- B. Imperative statements in these specifications are Contractor requirements, unless otherwise stated.
- C. Where specifications are written in streamlined form, the words “shall be” are included by inference where a colon (:) is used within the sentence or phrase.

### **1.04 DEFINITIONS**

- A. When the specifications use a word or term defined in the Federal Acquisition Regulations (FAR), the definition of the word or term shall be in accordance with FAR sections in effect at the time the solicitation was issued.
- B. Quality Assurance: Inspection and tests performed by COR or BIA Representative to ensure compliance with the terms of the contract.

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- C. Quality Control: Activities performed by Contractor to ensure work conforms to contract requirements.
  - D. Contractor Quality Testing: Specified tests to be performed by the Contractor.
    - 1. The BIA may use the test results for Quality Assurance.
    - 2. The Contractor may use the test results as part of Contractor quality control.
      - a. The BIA anticipates that these tests will be part of the Contractor's quality control program; however, the tests do not relieve the Contractor of providing adequate quality control measures in accordance with the clause at FAR 52.246-12, Inspection of Construction.

### **1.05 ACRONYMS**

- A. The following acronyms apply to specifications Divisions 1 through 53:
  - 1. CO: BIA's Contracting Officer.
  - 2. COR: BIA's Contracting Officer's Representative.
  - 3. BIA Representative: BIA's acting representative in the field

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

**END OF SECTION**

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**SECTION 01 12 40**  
**CONSTRUCTION OF THE WORK**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Developing Baseline Schedule: Include in lump sum price offered in the schedule for mobilization and preparatory work.
  2. Updating and Using Construction Program: Include as an element of Contractor's overhead.

**1.02 REFERENCE STANDARDS**

- A. Associated General Contractors of America (AGC)
1. AGC Manual Construction Planning and Scheduling Manual, 2004
- B. Bureau of Reclamation (USBR)
1. USBR Equipment Cleaning Manual Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species (Technical Memorandum No. 86-68220-07-05) 2012 Edition. Available online at: <http://www.usbr.gov/mussels/prevention>

**1.03 DEFINITIONS**

- A. Schedule: The Critical Path Method (CPM) of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the project.
- B. Project Calendar(s): Cross reference of numerical work days with calendar days. The project calendar serves as the basis for the day/date conversion and assigns work days and non-workdays.
- C. Resources: Equipment, labor or crews, materials, subcontractors, fabricators, manufacturers, and consultants.
- D. Required Submittal Number (RSN): Identifies items to be submitted together as a complete submittal.

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## 1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
1. Furnish database files in format compatible with Microsoft Project.
  2. Furnish schedule and analysis data on flash drive or other approved means of transferring electronic files.
  3. Upon request, provide information and data used to develop and maintain the Construction Program to the CO.
- B. RSN 01 12 40-1, Representative Information:
1. Designation of authorized representative to develop and maintain Construction Program. Representative experienced in developing and maintaining construction schedules and knowledgeable of activities and progress on-site to develop and maintain accurate and reliable schedules.
- C. RSN 01 12 40-2, Baseline Schedule:
1. Include:
    - a. Construction Program/Schedule database.
    - b. Definition of project calendars.
    - c. Gantt chart (Bar chart) for project.
    - d. Activity report including all logic constraints consisting of predecessors, successors, and constraint dates.
    - e. Table listing equipment, manpower, and material limitations used to produce baseline schedule. This listing may be independent of the schedule database.
- D. RSN 01 12 40-3, Updated Schedule:
1. Include:
    - a. Construction Program database with updated activity and milestone data.
    - b. Definition of project calendars if revised from baseline calendars.
    - c. Gantt chart for project.
    - d. Narrative report specifically stating status of project.
      - 1) If negative float exists, cite specific actions and conditions which caused the “behind schedule” condition and provide proposed course of action to complete the project within the specified delivery time.
      - 2) List of Contractor-initiated changes to the current schedule stating the reason for the action taken and any unresolved issues relating to the Construction Program. BIA and BIA Representative reserve



the right to reject Contractor-initiated changes to the current schedule which negatively impact any action by BIA or the BIA Representative which was initiated on the basis of the current schedule.

- e. RSN submittals register. Register updated monthly includes submittals as listed in submittal table; revised submittals; dates and status. This register document is separate from the scheduling database.

E. RSN 01 12 40-4, Time Impact Analysis:

- 1. Include:
  - a. Construction Program database with proposed revised activity and milestone data.
  - b. Proposed revised schedule due to the change or delay with added, changed, or deleted activities highlighted.
  - c. Narrative report explaining results and conclusions.

F. RSN 01 12 40-5, Land Use and Landscape Rehabilitation Plan:

- 1. For each Contractor use of site on Tribal land.
  - a. Show use location and extent of impact. Uses include but are not limited to the following:
    - 1) Buildings and service areas including offices, shops, warehouses, storage areas, fuel and oil storage areas, and fabrication yards.
    - 2) Parking areas, temporary roads, and haul routes.
    - 3) Utilities including air, power, and water lines; fire hydrants; and compressor station.
    - 4) First-aid and medical facilities.
    - 5) Areas for processing, storing, and disposing of waste materials from construction operations.
    - 6) Temporary fences.
  - b. Describe methods to preserve, protect, and repair if damaged, vegetation (such as trees, shrubs, and grass) and other landscape features on or adjacent to the jobsite, which are not to be removed and which do not interfere with the work required under this contract. Include methods to mark work area limits, protect disturbed areas, and prevent erosion.
  - c. Describe methods to protect, and repair if damaged, existing improvements and utilities at or near the jobsite.
  - d. Describe methods for removing temporary structures and facilities, cleanup, and rehabilitating site after completion of construction activities.

Rehabilitation for borrow area must be in coordination with the approved Sand and Gravel Reclamation Plan.

2. Submit revised drawings of changes in use of BIA land made during design and erection stages or after use of BIA land is in operation.

### **1.05 PROJECT CONDITIONS**

- A. Project is located on Tribal land.
  1. Use construction easement shown on drawings for required construction facilities.
  2. Location, construction, operation, maintenance, and removal of construction facilities on Tribal land will be subject to approval of the COR or BIA Representative.
- B. Housing for construction personnel will not be permitted at jobsite, except temporary housing for guards or watchmen approved by the COR or BIA Representative.
- C. When private land is used for construction facilities, or other construction purposes, make necessary arrangements with landowner for use of land.

### **1.06 CONSTRUCTION ACTIVITIES**

- A. Employ best management practices to preserve the natural landscape and land use values. Except where earthmoving is required for temporary and permanent structures, approved staging/stockpiling areas, and borrow activity, all trees, shrubbery, and other vegetation shall be protected from damage.
- B. Upon completion of the project, all work areas shall be left in a condition to provide proper drainage, protection from erosion, and to establish vegetation. Any removed topsoil shall be replaced in the best location to facilitate revegetation. Impacts to land within the project area shall be reduced through implementation of site erosion control. The final site condition will be approved by the COR or BIA Representative.

### **1.07 CONSTRUCTION SEQUENCE**

- A. Clearing and grubbing trees and cutting and removing trees shall not be performed between March 15<sup>th</sup> and August 15<sup>th</sup> without conducting a migratory bird nesting survey prior to the work. Trees with migratory birds' nests shall not be removed between March 15<sup>th</sup> and August 15<sup>th</sup>.
- B. Prepare construction schedules using CPM, under concepts and methods outlined in AGC Manual.
  1. Prepare schedule based on required sequence and interdependence of activities.
  2. Prepare detailed activity network for accomplishing required work organized by work breakdown structure.

3. Activities except “Award” shall have predecessor activities and activities except “Contract Complete” shall have successor activities.
4. Meet contract requirements; milestone(s) in accordance with the clause at FAR 52.211-10, Commencement, Prosecution, and Completion of Work; funding constraints in accordance with the clause at WBR 1452.232-80, Limitation of Funds; and other relevant specification sections. Include interim milestone dates, interface dates for BIA or BIA Representative, contract completion date, and other time or seasonal constraints specified in the contract documents.
5. Include work of subcontractors, BIA interfaces, and contract milestones.
6. Adjust Construction Program/schedule for seasonal weather conditions.
7. If activity codes are utilized, use unique activity code names assigned as project codes rather than global codes. Utilize the Work Breakdown Structure in lieu of activity codes for general organization of the schedule.
8. Define activities to a level of detail resulting in their durations being no greater than 20 workdays unless otherwise accepted by CO.
  - a. Durations for administrative activities (e.g., submittals and reviews, fabrication, manufacturing), or other specific activities identified in the contract will not be subject to the workday limitation.
9. Include activities for BIA or BIA Representative review and approvals. Assign submittal review activities to a 7-calendar days with durations as specified in Section 01 33 00 - Submittals. Include activities for submittal preparation, submittal reviews, and fabrication or manufacturing activities when work involves significant quantities, long lead times, on the critical path, or as requested by the COR or BIA Representative.
10. Include contract title, contract number, and Contractor’s name on the transmittal cover sheet and each sheet of the Gantt chart.
11. For each activity on the Gantt chart, display identification number, activity description, planned duration, start date, finish date, total float, and calendar identification.
12. Include table of abbreviations used in the schedule, listed and defined alphabetically.
13. Use finish to start logic relationships between activities. Do not utilize start to start, finish to finish, or start to finish logic relationships. Do not use negative lead or lag times.
14. Use durations in units of whole workdays.
15. Provide best estimate of time required to complete the activity considering the quantity of work and planned resources for the activity.
16. Equate durations of BIA or BIA Representative reviews and other identified actions to the maximum number of calendar days specified in their respective paragraphs.

17. Establish workday calendar(s) and use these in the schedule to translate the activity's workday duration into calendar dates. Use calendar names unique for this project, do not use software default calendar names. Save calendars as project calendars, not global calendars.

C. Baseline Schedule:

1. Represents Contractor's as-planned approach to accomplishing the work. Do not include actual start dates, percent completes, or actual finish dates.
2. Meets all requirements of the Construction Program.

D. Updated Schedule:

1. Meet bi-weekly with the COR and/or BIA Representative at BIA's project office, or at a location approved by the COR or BIA Representative, to review progress made to the end date of the progress payment period. Provide a three week look-ahead schedule at each meeting. Establish dates that activities were started and completed and remaining duration for each activity started but not completed during the period.
  - a. Discuss and mutually agree upon changes to the schedule.
  - b. Update schedule and Construction Program database with mutually agreed upon changes.
2. Following receipt of an executed contract modification, incorporate the activity data and logic relationships stipulated in the modification into the current schedule for inclusion in the next scheduled progress update.
3. Assign a unique project file name for each schedule update.
4. Monthly updated schedules shall be submitted and approved by BIA or the BIA Representative before monthly progress payments may be submitted by the contractor.

## **1.08 TIME IMPACT ANALYSIS**

- A. Provide a time impact analysis for contract changes, e.g., a change order, proposed modification, or value engineering change proposal to support a claim or request for an equitable adjustment to the contract which involves a delay or accelerated schedule.
- B. The CO may use time impact analysis to determine if a time extension or reduction to the contract milestone dates is justified.
- C. A time impact analysis is applicable whether the Contractor's current schedule milestone dates are the same as, earlier, or later than, those required under the contract.
- D. Changes, additions, or deletions to activities; activity durations; or activity time frames will not automatically mean that an extension or reduction of contract time is warranted or due the Contractor.

- 
- E. Time extensions for performance will be considered only to the extent that the Contractor's current scheduled milestone dates exceed the contract milestone dates.
  - F. For activities directly affected by the change or delay, include the current and proposed items:
    - 1. Activity description.
    - 2. Types and quantities of major pieces of equipment, principal manpower, and pacing materials (materials that affect activity start, duration, or finish).
    - 3. Activity duration.
    - 4. A narrative containing the rationale used in developing the proposed logic relationships and activity data.
  - G. Float is not for the exclusive use by or benefit of either the BIA or the Contractor.
  - H. Prepare a single time impact analysis for modifications issued after Notice to Proceed (NTP) and prior to approval of the baseline schedule. Submit the time impact analysis with the first progress update.
  - I. Perform time impact analyses using data in the most recent approved schedule prior to change or delay event.
    - 1. Prepare proposed revised schedule and narrative description describing and highlighting where changes or delays will be included.
    - 2. Prepare summary comparing the results of two schedule analyses: One using current schedule data from the last approved schedule prior to event requiring analysis, and one using proposed schedule data incorporating the changes or delays.
      - a. Show contract milestones and activities whose periods of performance have shifted as a result of any change which affects production and/or manufacture schedules, material orders, construction seasons, and labor and/or equipment utilization.
      - b. Base mathematical analyses on status of work and available float at the time the CO directs or proposes a change to the work, the Contractor submits a value engineering change proposal, or when a delay occurs.

## **1.09 REVIEW AND EVALUATION**

- A. Baseline Schedule:
  - 1. Within 21 calendar days after receipt of baseline schedule:
    - a. CO will accept or reject the proposed baseline schedule.
    - b. Upon request from the CO, meet with the COR and/or BIA Representative for a joint review of the proposed baseline schedule.

- c. If schedule is rejected, revise and resubmit within 7-calendar days following the date of the rejection letter.
  2. Do not proceed with onsite work, except mobilization and surveying, until baseline schedule has been approved by the BIA or the BIA Representative.
- B. Updated Schedules:
  1. The BIA will require 14-calendar days after receipt of each monthly update to review and approve or reject the updated schedule.
  2. If the updated schedule is rejected, revise and resubmit updated schedule within 7-calendar days following the date of the rejection letter.
  3. The COR will schedule a pre-submittal meeting with the contractor's representative each month to review a draft updated schedule prior to the contractor submitting RSN 01 12 40-3, Updated Schedule.
- C. Failure to include any element of the work will not release Contractor from completing required work under the contract.
- D. Performance will be evaluated by the BIA using the approved CPM schedules.

#### **1.10 FAILURE TO COMPLY**

- A. Failure to comply with the requirements of this Section shall be grounds for a determination by the CO that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the specified time.
- B. The CO may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

## **PART 2 PRODUCTS**

See individual specification sections.

## **PART 3 EXECUTION**

### **3.01 CLEANING**

- A. Construction Equipment:
  1. Before bringing on site, clean construction equipment to remove dirt, vegetation, and other organic material to prevent introduction of noxious weeds, and invasive plant and animal species.
  2. Contractor cleaning procedures shall result in equipment being cleaned as well or better than the procedures described in USBR Cleaning Manual.

3. The COR or BIA Representative will inspect construction equipment following procedures described in USBR Cleaning Manual before allowing the equipment onsite.

### **3.02 RESTORATION**

- A. Restore temporary construction roads to equal or better condition at the original contours and make impassable to vehicular traffic when no longer required.
- B. After completion of work, scarify and regrade land used for construction purposes and not required for completed installation so that surfaces blend with natural terrain and are in a condition that will provide proper drainage and prevent erosion.
- C. Cover with topsoil and seed disturbed areas of land used for construction purposes and not required for completed installation in accordance with Section 32 91 19 - Revegetation.

**END OF SECTION**

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**SECTION 01 33 00**  
**SUBMITTALS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedules for other items of work.

**1.02 DEFINITIONS**

- A. Days: Calendar days.
- B. Portable Media: Includes the following devices used in transmitting electronic documents.
1. Compact Disc (CD).
  2. Digital Video Disc (DVD).
  3. Universal Serial Bus (USB) flash drive.
- C. Required Submittal Number (RSN): Identifies items to be submitted together as a complete submittal.
- D. Submittal Types, as listed in Table 01 33 00A – List of Submittals:
1. A – Approval:
    - a. BIA or the BIA Representative will approve or disapprove these submittals.
    - b. Approval submittals are considered to be “shop drawings” within the terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction.
  2. I – Informational:
    - a. The BIA or BIA Representative will acknowledge receipt of these submittals.
    - b. The BIA or BIA Representative may reject an Informational submittal when the submittal does not comply with the contract. The Contractor shall correct mistakes or deficiencies in rejected Informational submittals and resubmit.
    - c. Informational submittals are considered to be “shop drawings” within the terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction, except that approval by the BIA or BIA Representative is not required.

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### 1.03 SUBMITTAL REQUIREMENTS

- A. In case of conflict between requirements of this section and requirements included elsewhere in these specifications, requirements included elsewhere take precedence.
- B. General:
1. Prepare in English.
  2. Label with contract number and title, and RSN.
  3. Measurement units: US Customary Units.
- C. Drawings:
1. Minimum identification in title block:
    - a. Contract number and title.
    - b. Contractor's or supplier's title and drawing number.
    - c. Date.
  2. Provide space next to title block for review stamps.
  3. Size: ANSI D size (22 inches by 34 inches).
  4. Draw to scale with computer drafting equipment.
  5. Final drawings:
    - a. AUTOCAD® drawing format (.dwg), on portable media.
    - b. Compile using 'eTransmit' utility in AutoCAD for a complete package including all support files.
    - c. Original ANSI D size (22 inches by 34 inches) plots.
    - d. Show as-built changes, including revision dates, made during installation.
- D. Product Data:
1. Mark manufacturer's data for commercial products or equipment, such as catalog cut sheets.
    - a. Identify manufacturer's name, type, model, size, and characteristics.
    - b. Illustrate that product or equipment meets requirements of specifications.
    - c. Mark items to be furnished in a manner that will be clear and legible after photocopying. Do not use highlighter.
    - d. Strike through items that do not apply.
- E. Certifications:
1. Certifications by a registered professional: Signed and sealed by registered professional.

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2. Manufacturer's certifications: Signed by authorized representative of manufacturer.
- F. Manuals, Shop Drawings, and Specialized Tools:
1. Copies:
    - a. Printed copies: Bound and indexed.
    - b. Electronic copies: Portable Document Format (.pdf) on portable media.
  2. Contents:
    - a. Parts identification lists, lists of special tools, and accessories.
    - b. Schematics and wiring diagrams.
    - c. Detailed instructions for installing, operating, lubricating, and maintaining equipment.
    - d. As-built drawings, photographs, and test records or reports if required by the specifications.
    - e. Manufacturer's Standard Operating Procedures

#### **1.04 SUBMITTALS PROCEDURES**

- A. Submit only checked submittals. Submittals without evidence of Contractor's approval will be returned for resubmission.
- B. Submit complete sets of required materials for each RSN as specified in "Submittals Required" column in Table 01 33 00A - List of Submittals. A complete set includes all listed items for RSNs with multiple parts.
- C. Electronic and Hard Copy Submittal Procedures:
  1. E – Electronic:
    - a. File format: Portable Document Format (.pdf).
    - b. Include in each file name:
      - 1) Required submittal number (RSN) as first part of name.
      - 2) Version or revision designation, i.e. Version 1 or Rev A.
    - c. Include transmittal letter as first page(s) of each file.
  2. H – Hard copy: If requested, submit 2 sets and in a format transmitted in accordance with this section.
- D. Include the following information in transmittal letters:
  1. Contract number and title.
  2. RSN for each attached submittal.
  3. Responsible code.

4. Number of sets for each RSN.
  5. Identify submittal as initial or resubmittal.
- E. More than one RSN may be submitted under a transmittal letter, provided the responsible code is the same.

### **1.05 REVIEW OF SUBMITTALS**

A. Time Required:

1. Submittal review will require 28 days for review of each submittal or resubmittal, unless otherwise specified.
2. Time required for review of each submittal or resubmittal begins when complete sets of materials required for a particular RSN are received and extends through return mailing postmark date.

B. Time in Excess of Specified:

1. The CO may extend the contract completion date to allow additional time for completing work affected by excess review time.
  - a. The time extension will be to the extent that excess review time caused delay to the contract completion date.
  - b. The time extension will not exceed the time used in excess of the specified number of days for review of submittals or resubmittals.
  - c. Concurrent days of excess review time resulting from review of two or more separate submittals or resubmittals will be counted only once in extending the contract completion date.
2. No time extension will be allowed if the Contractor fails to make complete approval submittals in sequence and within time periods specified.
3. Adjustment for delay will be made only to the extent that:
  - a. Approval was required under the contract, and
  - b. Requests for approval were properly and timely submitted and were approved.
4. Adjustment will be subject to terms of paragraphs (b) and (c) of the clause at FAR 52.242-14, Suspension of Work, however, no such delay shall be deemed to be a "suspension order" as the term is used in that clause.

C. Return of Submittals:

1. One set of submittals required for approval will be returned either approved, approved subject to comment, or not approved.

2. Submittals not approved:
  - a. Revise and resubmit for approval.
  - b. Show changes and revisions with revision date.
  - c. Describe reasons for significant changes in transmittal letter.
  - d. Resubmit returned submittals within 28 days after receiving the comments, unless otherwise specified.
  - e. Requirements for initial submittals apply to resubmittals.
3. Do not change designs without approval of the CO after approval drawings, documentation, and technical data have been approved.
4. The COR will acknowledge Informational submittals.
  - a. Informational submittals will not be returned when they comply with the specifications.
  - b. Informational submittals that do not comply with the specifications may be returned for resubmittal or additional information may be requested.

## **1.06 TRANSMITTAL**

- A. Addresses for codes listed in Table 01 33 00A - List of Submittals:
  1. CO: Lynelle Benallie, Bureau of Indian Affairs, Navajo Region, Branch of Contracts, P.O. Box 1060, Gallup, NM 87305. (Express Mail to: Federal Building, 3<sup>rd</sup> Floor, 301 W. Hill Street 87301).
  2. COR: Pearl Chamberlin, Bureau of Indian Affairs, Navajo Region, Branch of Contracts, P.O. Box 1060, Gallup, NM 87305. (Express Mail to: Federal Building, 2<sup>nd</sup> Floor, 301 W. Hill Street 87301).
  3. BIA Representative: Chad Masching, GEI Consultants, 4601 DTC Blvd Suite 900, Denver, Colorado 80237. Files may be submitted to the BIA Representative electronically via email.
- B. Send original transmittal letter with appropriate number of sets, as indicated in this specification, to the CO, COR, and BIA Representative.
- C. Send copy of transmittal letter with appropriate number of sets to offices that are not the responsible code, but show "No. of sets to be sent to" in Table 01 33 00A – List of Submittals.
- D. Submittals required by the specifications, but not listed in Table 01 33 00A - List of Submittals:
  1. Submit in accordance with this section. Include one electronic copy of all submittals to the BIA and BIA Representative.
  2. Submit to COR unless otherwise specified.

**PART 2      PRODUCTS**

Not Used

**PART 3      EXECUTION**

Not Used

**Table 01 33 00A – List of Submittals**

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
I-1	Safety and Health (WBR 1452.223-81)	Safety program	Submitted and accepted before commencing onsite work. See section 3 of RSHS	A	COR	1	2	1
I-2	Safety and Health (WBR 1452.223-81)	Monthly accident summary report	First day of each month. See paragraph 3.8 of RSHS.	A	COR	1	2	1
01 12 40-1	Construction of the Work	Representative Information	Within 21 days after receipt of Notice to Proceed	A	COR	1	2	1
01 12 40-2	Construction of the Work	Baseline Schedule	Within 21 days after receipt of Notice to Proceed	A	COR	1	2	1
01 12 40-3	Construction of the Work	Updated Schedule	With monthly requests for progress payments	A	COR	1	2	1
01 12 40-4	Construction of the Work	Time Impact Analysis	Within 28 days after the CO directs a contract change, with any proposal for a future modification, with any value engineering proposal, or with any request or claim for an equitable adjustment to the contract	A	COR	1	2	1
01 12 40-5	Construction of the Work	Land Use and Landscape Rehabilitation Plan	At least 28 days before use of land	A	COR	1	2	1
01 33 26-1	Electrical Drawings and Data	Final Drawings	After completion of related work	A	COR	1	2	1
01 33 26-2	Electrical Drawings and Data	Operations and Maintenance Instruction Books	After final drawings have been approved	A	COR	1	2	1
01 35 10-1	Site Safety and Security	Complete LHM and MSDS	At least 28 days before jobsite delivery of hazardous material	I	COR	1	2	1
01 35 10-2	Site Safety and Security	Updated LHM and MSDS	At least 28 days before jobsite delivery of hazardous material not previously listed	I	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
01 35 10-3	Site Safety and Security	Safety Program	Submitted and accepted before commencing onsite work. See Section 3 of RSHS	A	COR	1	2	1
01 35 10-4	Site Safety and Security	Monthly Accident Summary Report	See paragraph 3.8 of RSHS	I	COR	1	2	1
01 35 10-5	Site Safety and Security	Medical Facilities Plan	Submitted and approved before start of operations	A	COR	1	2	1
01 46 00-1	Quality Procedures	Quality Procedures Plan	Within 14 days of Notice to Proceed	A	COR	1	2	1
01 51 00-1	Temporary Facilities	Traffic Control Plan	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 51 00-2	Temporary Facilities	Vehicular Access Video Documentation	Before use of roads for construction traffic	I	COR	1	2	1
01 51 00-3	Temporary Facilities	Access Plan	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 56 10-1	Protection of Existing Facilities	Plan for Protecting Existing Installations	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 57 20-1	Environmental Protection	Vegetation Protection Plan	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 57 20-2	Environmental Protection	Pollution Prevention Plan	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 57 20-3	Environmental Protection	Spill Prevention, Control, and Countermeasure (SPCC) Plan	At least 28 days before delivery or storage of oil	A	COR	1	2	1
01 57 20-4	Environmental Protection	Spread of Noxious Weed Prevention	At least 28 days before start of onsite construction work	A	COR	1	2	1
01 71 20-1	Surveying	Surveying Plan	At least 28 days before beginning survey work	A	COR	1	2	1



RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
01 71 20-2	Surveying	Resume	At least 28 days before beginning survey work At least 28 days before personnel change	I	COR	1	2	1
01 71 20-3	Surveying	Accuracy Check Results	At least 28 days before beginning survey work	I	COR	1	2	1
01 71 20-4	Surveying	Completed and Reduced Survey Notes	Within 2 days of completing and reducing notes	I	COR	1	2	1
01 71 20-5	Surveying	Survey Books or Electronic Data	Within 2 days of completing book or data files	I	COR	1	2	1
01 71 20-6	Surveying	Quantity Survey Notes and Computations	Accompanying progress payment requests	I	COR	1	2	1
01 71 20-7	Surveying	Workday's Survey Notes	At conclusion of workday when requested by COR	I	COR	1	2	1
01 74 00-1	Cleaning and Waste Management	Waste Production and Disposal Records	Within 28 days of waste disposal	I	COR	1	2	1
01 74 00-2	Cleaning and Waste Management	Hazardous Wastes Manifest	Within 28 days of hazardous waste disposal	I	COR	1	2	1
01 74 00-3	Cleaning and Waste Management	Environmental Consultant Resume	At least 28 days before beginning environmental assessment	I	COR	1	2	1
01 74 00-4	Cleaning and Waste Management	Post-Construction Site Assessment	Within 14 days after completion of work	I	COR	1	2	1
01 78 30-1	Project Record Documents	Final As-Built Drawings	Within 14 days after completion of work	A	COR	1	2	1
02 41 07-1	Removal and Dispose of Structures	Removal and Disposal of Existing Structures Plan	At least 28 days before start of related construction work	A	COR	1	2	1
02 41 07-2	Removal and Disposal of Structures	Previously Abandoned Structures Removal and Disposal Plan	At least 28 days before start of related construction work	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
03 11 10-1	Concrete Formwork	Formwork Design and Drawings for Concrete Structures	At least 28 days before start of related construction work	A	COR	1	2	1
03 15 12-1	PVC Waterstop	Purchase Orders	At least 28 days before start of related construction work	I	COR	1	2	1
03 15 12-2	PVC Waterstop	Samples	At least 28 days before delivery of waterstops to jobsite	A	COR	1	2	1
03 15 12-3	PVC Waterstop	Certifications	At least 28 days before delivery of waterstops to jobsite	A	COR	1	2	1
03 15 12-4	PVC Waterstop	Instructions	At least 28 days before delivery of waterstops to jobsite	A	COR	1	2	1
03 20 00-1	Concrete Reinforcement	Reinforcement Diagrams and Lists	At least 28 days before beginning fabrication of reinforcements	A	COR	1	2	1
03 30 00-1	Cast-In-Place Concrete	Material Approval Data	At least 28 days before beginning fabrication of reinforcements	A	COR	1	2	1
03 30 00-2	Cast-In-Place Concrete	Concrete Placement Drawings	At least 28 days before jobsite work begins	A	COR	1	2	1
03 30 00-3	Cast-In-Place Concrete	Concrete Placement Schedule	At least 28 days before jobsite work begins	A	COR	1	2	1
03 30 00-4	Cast-In-Place Concrete	Certifications	At least 28 days before jobsite work begins	A	COR	1	2	1
03 63 00-1	Epoxy Grout for Metal Work	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
05 50 00-1	Metal Fabrications	Approval Drawings and Data	At least 28 days before start of related construction work	A	COR	1	2	1
05 50 00-2	Metal Fabrications	Final Drawings	Within 14 days of completion of on-site test	A	COR	1	2	1
07 62 00-1	Sheet Metal Flashing and Trim	Product Data	At least 28 days before start of related construction work	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
07 62 00-2	Sheet Metal Flashing and Trim	Shop Drawings	At least 28 days before start of related construction work	A	COR	1	2	1
07 92 00-1	Caulking and Sealants	Action Submittals	At least 28 days before start of related construction work	A	COR	1	2	1
07 92 00-2	Caulking and Sealants	Informational Submittals	At least 28 days before start of related construction work	A	COR	1	2	1
07 92 00-3	Caulking and Sealants	Closeout Submittals	At least 28 days before start of related construction work	A	COR	1	2	1
08 30 00-1	Bullet Resistant Door and Frames	Product Data	At least 28 days before start of related construction work	A	COR	1	2	1
08 30 00-2	Bullet Resistant Door and Frames	Door Hardware Templates	At least 28 days before start of related construction work	A	COR	1	2	1
08 30 00-3	Bullet Resistant Door and Frames	Shop Drawings	At least 28 days before start of related construction work	A	COR	1	2	1
09 96 20-1	Coatings	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
09 96 20-2	Coatings	Final Approval Data	At least 28 days before delivery of material to jobsite	A	COR	1	2	1
09 96 20-3	Coatings	Documentation	At least 28 days before delivery of material to jobsite	A	COR	1	2	1
09 96 23-1	Graffiti Resistant Coatings for Concrete	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
09 96 23-2	Graffiti Resistant Coatings for Concrete	Final Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
09 96 23-3	Graffiti Resistant Coatings for Concrete	Documentation	At least 28 days before delivery of material to jobsite	A	COR	1	2	1
10 14 00-1	Signage	Shop Drawings	At least 28 days before start of related construction work	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
10 14 00-2	Signage	Product Data	At least 28 days before start of related construction work	A	COR	1	2	1
10 14 00-3	Signage	Samples	At least 28 days before start of related construction work	A	COR	1	2	1
10 14 00-4	Signage	Manufacturer's Instructions	At least 28 days before start of related construction work	I	COR	1	2	1
10 14 00-5	Signage	Warranty Documentation	Within 14 days after completion of work	A	COR	1	2	1
10 44 00-1	Fire Protection Specialties	Product Data	At least 28 days before start of related construction work	A	COR	1	2	1
13 34 13-1	Vault Toilets	Certifications and Data	At least 28 days before jobsite work begins	A	COR	1	2	1
23 37 01-1	Bullet Resistant Louvers	Approval Data	At least 28 days before fabrication or procurement	A	COR	1	2	1
23 37 01-2	Bullet Resistant Louvers	Final Data	At least 28 days before start of related construction work	A	COR	1	2	1
26 05 19-1	Electrical Conduit	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
26 05 20-1	Conductors and Cables	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
26 05 20-2	Conductors and Cables	Field Test Reports	Within 28 days after test	A	COR	1	2	1
26 05 26-1	Grounding and Bonding	Test Reports	Within 28 days after test	A	COR	1	2	1
26 27 40-1	Wiring Devices	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
26 27 40-2	Wiring Devices	Test Reports	Within 120 days after notice to proceed	A	COR	1	2	1
26 28 10-1	Enclosed Circuit Breakers	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
26 33 00-1	Battery Equipment	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
26 51 10-1	Interior Luminaires	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
31 03 10-1	Diversion and Care of Flow During Construction	Water Control Plan	At least 28 days before start of related construction work	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
31 03 10-2	Diversion and Care of Flow During Construction	Cofferdam and Diversion Plan	At least 28 days before start of related construction work	A	COR	1	2	1
31 03 33-1	Dewatering	Removal of Water Plan	At least 28 days before beginning water removal and control operations	A	COR	1	2	1
31 09 12-1	Instrumentation	Survey Reports	Within 7 days after survey	A	COR	1	2	1
31 09 12-2	Instrumentation	Abandoning Existing Piezometers Plan	At least 28 days before beginning water removal and control operations	A	COR	1	2	1
31 09 12-3	Instrumentation	Instrumentation Plan	At least 28 days before beginning water removal and control operations	A	COR	1	2	1
31 11 00-1	Clearing and Grubbing	Herbicide (if used)	At least 28 days before application	A	COR	1	2	1
31 23 23-1	Excavation	Excavation Plan	At least 28 days before beginning excavation	A	COR	1	2	1
31 23 24-1	Exploratory Trench Excavation	Exploratory Trench Excavation Plan	At least 28 days before beginning exploratory trench excavation	A	COR	1	2	1
31 23 24-2	Exploratory Trench Excavation	Located Structures Information	At least 7 days after exploratory trench excavation	A	COR	1	2	1
31 24 00-1	Fill and Backfill	Embankment Construction Plan	At least 28 days before beginning embankment construction	A	COR	1	2	1
31 24 00-2	Fill and Backfill	Road Plan	At least 28 days before beginning roadway construction	A	COR	1	2	1
31 24 00-3	Fill and Backfill	Certification and Laboratory Test Results	At least 28 days before beginning placement of Zone 2	A	COR	1	2	1
31 32 32-1	Geotextiles	Certifications and Data	At delivery of geotextile and/or geonet to jobsite	A	COR	1	2	1
31 32 37-1	Geocell	Certification	At delivery of geocell to jobsite	A	COR	1	2	1
31 35 23-1	Articulated Concrete Block (ACB)	Shop Drawings	At least 28 days before start of related construction work	A	COR	1	2	1
31 35 23-2	Articulated Concrete Block (ACB)	Certification and Laboratory Test Results	At least 28 days before beginning placement of ACB mats	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
31 37 00-1	Riprap	Materials Data and Laboratory Test Results	At least 28 days before beginning placement of riprap	A	COR	1	2	1
31 37 00-2	Riprap	Riprap Placement Plan	At least 28 days before beginning placement of riprap	A	COR	1	2	1
32 15 10-1	Gravel Surfacing	Certification	At least 28 days before start of related construction work	I	COR	1	2	1
32 31 10-1	Security Gates and Fencing	Barbed Wire Fence Certifications	At least 28 days before start of related construction work	I	COR	1	2	1
32 31 10-2	Security Gates and Fencing	Pipe Gate Fence Certifications	At least 28 days before start of related construction work	I	COR	1	2	1
32 31 40-1	Erosion Control	Silt Fence Certification	At least 28 days before start of related construction work	I	COR	1	2	1
32 91 19-1	Revegetation	Seeding Plan	At least 28 days before beginning seeding	A	COR	1	2	1
32 91 19-2	Revegetation	Certifications	At delivery of seed to jobsite	A	COR	1	2	1
32 91 19-3	Revegetation	Sample	At least 28 days before start of related construction work	A	COR	1	2	1
32 91 19-4	Revegetation	Manufacturer's Information	At least 28 days before start of related construction work	A	COR	1	2	1
32 91 19-5	Revegetation	Installation Plan	At least 28 days before start of related construction work	A	COR	1	2	1
33 09 12-1	Sonic Flowmeter System	Approval Data	At least 28 days before procurement	A	COR	1	2	1
33 09 12-2	Sonic Flowmeter System	Final Data	At least 28 days before shipment to the site	I	COR	1	2	1
33 09 12-3	Sonic Flowmeter System	Simulated Test Reports	Within 28 days after completion of field quality testing	I	COR	1	2	1
33 11 11-1	Irrigation System	Approval Data	At least 28 days before beginning installation of irrigation system	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
33 11 11-2	Irrigation System	Shop Drawings	At least 28 days before beginning installation of irrigation system	A	COR	1	2	1
33 11 11-3	Irrigation System	Fusion Procedures	At least 28 days before beginning installation of irrigation system	A	COR	1	2	1
33 46 36-1	Toe Drain Pipes and Cleanouts	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
33 46 36-2	Toe Drain Pipes and Cleanouts	Certifications	At least 28 days before start of related construction work	A	COR	1	2	1
33 46 36-3	Toe Drain Pipes and Cleanouts	Samples	At least 28 days before start of related construction work	A	COR	1	2	1
33 46 36-4	Toe Drain Pipes and Cleanouts	Survey Reports	Within 7 days after survey	A	COR	1	2	1
33 82 23-1	Optical Fiber Communications Distribution Cabling	Approval Data	At least 28 days before start of related construction work	A	COR	1	2	1
33 82 23-2	Optical Fiber Communications Distribution Cabling	Pre-Installation Test Reports	At least 7 days before installation	A	COR	1	2	1
33 82 23-3	Optical Fiber Communications Distribution Cabling	Post-Installation Test Reports	After installation	A	COR	1	2	1
35 21 95-1	Steel Pipe	Shop Drawings	At least 28 days before beginning installation of pipes	A	COR	1	2	1
35 21 95-2	Steel Pipe	Product Data	At least 28 days before beginning installation of pipes	A	COR	1	2	1
35 21 95-3	Steel Pipe	Final Drawings and Data	After installation	A	COR	1	2	1
35 21 96-1	HDPE Pipe	Shop Drawings	At least 28 days before beginning installation of pipes	A	COR	1	2	1
35 21 96-2	HDPE Pipe	Fusion Procedures	At least 28 days before beginning installation of pipes	A	COR	1	2	1

RSN	Section Title	Submittals Required	Due Date or Delivery Time	Type*	Responsible Code	Number of Copies Submitted		
						CO	COR/Tribe	BIA Representative
35 23 15-1	Hydraulically-Operated Sluice Gate	Approval Drawings and Data	Before fabrication or procurement	A	COR	1	2	1
35 23 15-2	Hydraulically-Operated Sluice Gate	Final Data	After installation	I	COR	1	2	1
48 14 00-1	Solar and Electrical Equipment	Approval Data	Within 120 days after notice to proceed	A	COR	1	2	1
48 14 00-2	Solar and Electrical Equipment	Approval Drawings	Within 120 days after notice to proceed	A	COR	1	2	1
48 14 00-3	Solar and Electrical Equipment	Test Report	Within 28 days after test	A	COR	1	2	1

**END OF SECTION**



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**SECTION 01 33 26**  
**ELECTRICAL DRAWINGS AND DATA**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in price offered in the schedule for Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. Institute of Electrical and Electronic Engineers (IEEE)
1. IEEE 315 (1975) Graphic Symbols For Electrical And Electronics Diagrams (Including Reference Designation Class Designation Letters)
  2. IEEE C37.2 (2008) Standard Electrical Power System Device Function Numbers and Contact Designations
- B. National Institute of Building Sciences (NIBS)
1. NIBS NCS (2011) United States National CAD Standard – Version 5

**1.03 DEFINITIONS**

- A. Drawings: As used in this Section, means ‘shop drawings’ as defined in Clause FAR 52.236-21 – Specifications and Drawings for Construction, excluding incidental device or component drawings intended as, or a part of, the manufacturer’s technical catalog data.

**1.04 SUBMITTAL PROCEDURES**

- A. In addition to the requirements in Section 01 33 00 – Submittals, prepare electrical drawings and data submittals in accordance with the following.
- B. Drawings, General:
1. Provide drawings with a government title block as described in Section 01 33 00 – Submittals. Government will provide specific title block information when approval drawings are submitted.
  2. Drafting conventions: In accordance with NBIS NCS, unless otherwise indicated elsewhere in these specifications.
- C. Drawings in Government Format:
1. Conductor (wire) designations: Show and label each conductor (wire) with a designation as shown on drawing 1743-D-302.

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- D. Drawings and Data in Manufacturer's Format: Furnish with manufacturer's standard format, except where noted below.
1. Device designations and symbols: Conform to IEEE 315, IEEE C37.2.
  2. Equipment layout drawings:
    - a. Indicate dimensions of equipment.
    - b. Indicate location of devices and items of equipment including nameplates, conduit entries, and other features in their relative physical location.
    - c. Identify each device and item of equipment with a bill of material reference number.
  3. Bill of Material (BOM) List or drawing:
    - a. Provide information on manufacturer, style, type, rating, quantity, and other identifying information for each device or item of equipment.
    - b. Provide unique reference number for each device or item of equipment listed on bill of material.
  4. Manufacturer's technical catalog data:
    - a. Provide technical data for each device or item of equipment.
    - b. Include manufacturer's name and address (physical or internet); catalog number, type, style, or model number, electrical ratings, and dimensions.
    - c. Where several items are listed on same sheet, indicate items being submitted for approval.
    - d. Demonstrate proposed device or item of equipment meets specifications requirements.
    - e. Mark catalog data sheet with appropriate BOM item number.
    - f. Assemble catalog data sheet into one enclosing cover with BOM index.
- E. Final Drawings:
1. Provide for all specification drawings and for equipment as shown in the Submittal Table, see Section 01 33 00 – Submittals.
  2. Revised to reflect comments and as-built conditions.
    - a. Mark the drawings in the following colors:
      - 1) Red – Additions to original drawings.
      - 2) Green – Deletions to original drawings.
      - 3) Blue – Notations necessary for explanation of as-built markings.
  3. Provide electronic files on Compact Disc (CD).
    - a. Provide drawings in Portable Digital Format (.pdf) as well as in Drawing (.dwg) format.

- 1) DWG files shall be provided using AutoCAD® “E-Transmit” utility.

F. Test Reports:

1. Typed, 8 1/2- by 11-inch sheets.
2. Certified.
3. Submit multi-page reports in bound folder or three-ring binder.

G. Operation and Maintenance Instructions Books:

1. Electronic copies:
  - a. Portable Document Format (.pdf) format on CD.
  - b. Conform to print copies.
  - c. Bookmark file(s) to aid in navigating.
2. Print copies:
  - a. Assemble each set of material into one or more books with enclosing covers.
  - b. Use double-sided copying for all multi-page data, brochures, manuals, documents, etc. Do not double-side drawings or pages that include graphs.
3. Provide following items:
  - a. Index sheet at front of each book which provides page or index tab number information for each device or item of equipment in book.
  - b. Manufacturer's operation and maintenance procedures, installation details, as necessary, and catalog data sheets for each device or item of equipment.
  - c. List of recommended spare parts and components.
  - d. Complete parts lists for all replacement parts.
  - e. Manufacturer's full-size circuit breaker and fuse time-current curves.
  - f. A dedicated tab for insertion of equipment test reports, or provide copies of all test reports, as required in individual equipment specifications sections.
  - g. Copies of bills of materials.
  - h. Copies of all approved final drawings.
    - 1) Drawing to be printed at ANSI B size (11- by 17-inch) in accordance with NBIS NCS.

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## **1.05 CONSTRUCTION DOCUMENTATION**

- A. With equipment shipment, or under separate cover, provide and maintain at least 2 copies of manufacturer's equipment drawings (i.e., check prints) and manufacturer's installation instructions at the construction site.
  - 1. Drawings shall be in 'as-built' condition at time of equipment shipment and shall reflect Government approval comments.
- B. Mark drawings with changes and revisions made during installation and checkout of equipment.
  - 1. As-built marking procedures: As described in Article 1.04E.
- C. When installations are complete.
  - 1. Use one set of the drawings in preparing final drawings.
  - 2. Provide at least one set of drawings to the COR.
- D. Make drawings and data available to Government inspectors as requested.

## **1.06 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 33 26-1, Final Drawings:
  - 1. Provide marked up final drawings with as-built installation routing showing all conduit, conduit bodies, grounding, and device locations for all electrical equipment.
- C. RSN 01 33 26-2, Operations and Maintenance Instruction Books:
  - 1. Provide after Final Drawings have been approved.
  - 2. Submit one electronic copy of instruction book until approval is received. Upon approval, provide printed copies as stated in Section 01 33 00 - Submittals.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

Not Used

**END OF SECTION**

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**SECTION 01 35 10**  
**SITE SAFETY AND SECURITY**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedules for other items of work.

**1.02 DEFINITIONS**

- A. LHM: List of Hazardous Materials.
- B. MSDS: Material Safety Data Sheet.

**1.03 REFERENCE STANDARDS**

- A. Bureau of Reclamation (USBR)
1. RSHS-2009 Reclamation Safety and Health Standards
    - a. Available on the Internet at:  
<http://www.usbr.gov/ssle/safety/RSHS/rshs.html>.

**1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 35 10-1, Complete LHM and MSDS.
- C. RSN 01 35 10-2, Updated LHM and MSDS:
1. Comply with paragraph (e) of clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1.
- D. RSN 01 35 10-3, Safety Program:
1. Written safety program in accordance with Section 3 of RSHS.
- E. RSN 01 35 10-4, Monthly Accident Summary Report:
1. Form 7-2218 or other acceptable form in accordance with paragraph 3.8 of RSHS.
- F. RSN 01 35 10-5, Medical Facilities Plan:
1. Describe facilities for providing medical attention for injured or disabled employees.
  2. Plans for providing medical attention for injured or disabled employees, and provisions for arranging dependable ambulance service.

3. Qualifications of the proposed attendant (registered nurse, emergency medical technician, or a paramedic).
4. Documentation that the facility is equipped and maintained as directed by a consulting physician.

### **1.05 APPLICATION**

- A. For the purposes of this contract, the definition of “materials delivered under this contract” in the clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1, includes materials delivered to the BIA and all materials expected to be used during contract performance at the jobsite.

### **1.06 SERVICE**

- A. Regardless of crew size, provide a medical first aid station and attendant in accordance with RSHS Section 5.2.1. a and b.
- B. Do not perform onsite work until first aid plans have been submitted, approved by the BIA or BIA Representative, and implemented on site.

### **1.07 PROJECT CONDITIONS**

- A. Comply with RSHS.
- B. Comply with NNOSHA.
- C. Provide and maintain a work environment and procedures that will:
  1. Safeguard the public, BIA, and BIA Representative personnel exposed to Contractor operations and activities.
  2. Avoid interruptions of site operations and delays in project completion dates.
  3. Control costs in contract performance.
- D. Do not require persons employed in performance of this contract, including subcontracts, to work under conditions which are unsanitary, hazardous, or dangerous to the employee’s health or safety.
- E. Provide appropriate safety barricades, signs, and signal lights.
- F. Maintain accurate record of and report to the CO the following occurrences during performance of this contract:
  1. Death.
  2. Occupational disease.
  3. Traumatic injury to employees or the public.
  4. Property damage in excess of \$2,500.

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## **1.08 RESPONSIBILITIES**

- A. Make facilities and services available for providing emergency aid to employees, subcontractor employees, BIA employees, and public.
- B. Provide first aid services free of charge to BIA and BIA Representative employees injured on job.
- C. BIA and BIA Representative employees not injured on job and public may be charged fees for rendered services based on reasonable and established fee rates.
- D. Protect work and existing facilities from unauthorized entry, theft, and vandalism.
- E. Secure vehicles at all times.
- F. Initiate a security program at job mobilization.
- G. Maintain security throughout construction period until acceptance of work by the BIA and BIA Representative.
- H. Protect vehicles at all times.

## **1.09 ENTRY CONTROL**

- A. Restrict entrance of personnel and vehicles into project site.
- B. Restrict entry to authorized persons with proper identification.
- C. Maintain a continuous log of workmen and visitors and make available to BIA and the BIA Representative on request.
- D. Coordinate access of BIA and BIA Representative personnel to jobsite with the COR.
- E. Do not deliver hazardous materials to jobsite which are not included on the original or previously updated LHM and MSDS before receipt of updated LHM and MSDS by COR

## **1.10 PERSONNEL IDENTIFICATION**

- A. Issue durable identification card to each person authorized to enter jobsite.
  - 1. Show person's name and employer's name on card.
  - 2. Maintain a list of authorized persons and provide a copy to the COR.
  - 3. Collect card from authorized person at completion of their work at jobsite.

## **PART 2 PRODUCTS**

Not Used

**PART 3      EXECUTION**

Not Used

**END OF SECTION**



**SECTION 01 42 10**  
**REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work.

**1.02 REFERENCE STANDARDS**

- A. Referenced editions of standard specifications, codes, and manuals form a part of this specification to the extent referenced.
- B. These specifications take precedence when conflicting requirements occur between specifications and referenced standard.

**1.03 JOBSITE REFERENCE STANDARDS**

- A. Maintain at fabrication site, a copy of referenced standard specifications, codes, and manuals required for work in progress at fabrication site. Make available for use by the BIA and BIA Representative.
- B. Maintain onsite, a copy of referenced standard specifications, codes, and manuals required for onsite work in progress. Make available for use by the BIA and BIA Representative.

**1.04 AVAILABILITY**

- A. Code of Federal Regulation (CFR):
1. Available online, authorized by the National Archives and Records Administration (NARA) and the Government Printing Office (GPO), at [www.gpoaccess.gov/cfr/index.html](http://www.gpoaccess.gov/cfr/index.html).
- B. Federal Specifications, Standards, and Commercial Item Descriptions; and Military Specifications:
1. Copies of Federal Specifications, Standards, and Commercial Item Descriptions may be obtained from GSA Federal Supply Service, see the provision at FAR 52.211-1, Availability of Specifications Listed in the GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29.
  2. Copies of Military Specifications may be obtained from Department of Defense, see the provision at FAR 52.211-2, Availability of Specifications, Standards, and

Data Item Descriptions Listed in the Acquisition Streamlining and Standardization Information System (ASSIST).

C. Bureau of Reclamation Documents:

1. Reclamation Safety and Health Standards (RSHS), 2009 edition, may be downloaded at <http://www.usbr.gov/ssle/safety/RSHS/rshs.html>.
  - a. Hard copies of RSHS, stock number 024-003-00204-6, may be purchased from The Superintendent of Documents at the U.S. Government Printing Office (GPO), phone number 202-512-1800.
    - 1) GPO online bookstore:  
<http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=024-003-00204-6>.
2. Bureau of Reclamation Standard Specifications may be over the internet at <http://www.usbr.gov/library/>.
3. Bureau of Reclamation manuals and other publications including significant scientific, technical, and engineering works are available from the National Technical Information Service (NTIS). Information regarding availability and pricing may be obtained by contacting NTIS at the following address:

United States Department of Commerce  
National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161  
Telephone: 703-487-4650 or 1-800-553-6847

D. Industrial and Governmental Documents:

1. When a reference has a joint designation (e.g., ANSI/IEEE) these specifications generally cite the proponent organization (e.g., IEEE).
2. Addresses for obtaining industrial and governmental (other than Federal and Bureau of Reclamation specifications and standards) specifications, standards, and codes are listed in Table 01 42 10A - Addresses for Specifications, Standards, and Codes.

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AA	The Aluminum Association Inc. 1525 Wilson Boulevard Suite 600 Arlington, VA 22209	703-358-2960 Fax: 703-358-2961

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ABMA	American Bearing Manufacturers Association 2025 M Street, NW. Suite 800 Washington, DC 20036	202-367-1155
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, NW., Suite 249 Washington, DC 20001 www.aashto.org	202-624-5800 800-231-3475
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331 USA	248-848-3700
AGC	Associated General Contractors of America 2300 Wilson Boulevard., Suite 400 Arlington, VA 22201	800-242-1767
AGMA	American Gear Manufacturers Association 500 Montgomery Street, Suite 350 Alexandria, VA 22314-1560 www.agma.org	703-684-0211 Fax 703-684-0242
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601-2001 www.aisc.org	312-670-2400
ANSI	American National Standards Institute 1819 L. Street, NW. Washington, DC 20036 www.ansi.org	202-293-8020
APA	The Engineered Wood Association 7011 S. 19th Street Tacoma, WA 98466-5333	253-565-6600
API	American Petroleum Institute www.api.org	800-854-7179
ASME	American Society of Mechanical Engineers 3 Park Avenue New York, NY 10016-5990 www.asme.org	800-843-2763

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ASTM	ASTM International P.O. Box C700 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 www.astm.org	610-832-9585
AWPA	American Wood Protection Association P.O. Box 361784 Birmingham, AL 35236-1784 www.awpa.com	817-326-6300
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126 www.amweld.org	800-443-9353 305-443-9353
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org	303-794-7711
CID	Commercial Item Description <a href="http://apps.fas.gsa.gov/pub/fedspecs/">http://apps.fas.gsa.gov/pub/fedspecs/</a>	
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Parkway, Suite 300 Columbia, MD 21046 www.chainlinkinfo.org	301-596-2583
IBC	International Building Code developed by International Code Council 500 New Jersey Avenue, NW., 6th Floor, Washington, DC 20001 www.iccsafe.org	888-422-7233
ICC	International Code Council 500 New Jersey Avenue, NW., 6th Floor, Washington, DC 20001 www.iccsafe.org	888-422-7233
IEEE	Institute of Electrical and Electronics Engineers 3 Park Avenue, 17th Floor New York, NY 10016-5997 www.ieee.org	212-419-7900

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ISO	International Organization for Standardization 1, ch. de la Voie-Creuse Case postale 56 CH-1211 Geneva 20 Switzerland www.standardsinfo.net	Tel.: +41 22 749 01 11
MUTCD	Manual on Uniform Traffic Control Devices <a href="http://mutcd.fhwa.dot.gov/kno_2009.htm">http://mutcd.fhwa.dot.gov/kno_2009.htm</a>	
NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Avenue, Suite 1000 Chicago, IL 60603 www.naamm.org	312-332-0405
NACE	NACE International 1440 South Creek Drive Houston, TX 77084-4906 webmaster@nace.org	281-228-6200
NEMA	National Electrical Manufacturers Association 1300 N 17th Street, Suite 1847 Rosslyn, VA 22209 www.nema.org	703-841-3200
NETA	International Electrical Testing Association P.O. Box 687 106 Stone Street Morrison, CO 80465 www.netaworld.org	303-697-8441
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	800-344-3555 617-770-3000
NRMCA	National Ready Mix Concrete Association 900 Spring Street Silver Spring, MD, 20910 www.nrmca.org	301-587-1400

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
SAE	Society of Automotive Engineers SAE World Headquarters 400 Commonwealth Drive Warrendale, PA 15096-0001 USA www.sae.org	1-724-776-0790
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Drive Chantilly, Virginia 20151-1219 www.smacna.org	703-803-2980
SSPC	The Society of Protective Coating 40 24 <sup>th</sup> Street Pittsburg, PA 15222 www.sspc.org	877-281-7772
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 www.ul.com	847-272-8800
WWPA	Western Wood Products Association 522 SW Fifth Avenue, Suite 500 Portland, OR 97204-2122 www.wwpa.org	503-224-3930

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

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**SECTION 01 46 00**  
**QUALITY PROCEDURES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work.

**1.02 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 46 00-1, Quality Procedures Plan.

**1.03 DEFINITIONS**

- A. Quality Assurance: Inspection and tests performed by BIA or the BIA Representative to ensure compliance with the terms of the contract.
- B. Quality Control: Activities performed by Contractor to ensure work conforms to contract requirements.
1. The clause at FAR 52.246-12 - Inspection of Construction, requires the Contractor to establish an inspection system to ensure quality.
- C. Contractor Quality Testing: Specified tests to be performed by the Contractor.
1. The BIA and BIA Representative may use the test results for Quality Assurance.
  2. The Contractor may use the test results as part of Contractor quality control.
    - a. The BIA anticipates that these tests will be part of the Contractor's quality control program; however, the tests do not relieve the Contractor of providing adequate quality control measures in accordance with the clause at FAR 52.246-12 - Inspection of Construction.
    - b. Quality Control also includes other Contractor activities to ensure work conforms to contract requirements.

**PART 2 PRODUCTS**

Not Used

**PART 3      EXECUTION**

Not Used

**END OF SECTION**



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**SECTION 01 51 00**  
**TEMPORARY FACILITIES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Temporary Facilities:
1. Include in prices offered in the schedule for other items of work, except for watering for dust abatement.
  2. See Section 31 02 10 – Water for Dust Abatement for measurement and payment of water for dust abatement.

**1.02 REFERENCE STANDARDS**

- A. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE C2-2012 National Electric Safety Code
- B. Federal Highway Administration, Department of Transportation
1. MUTCD, Part 6 Part 6, Temporary Traffic Control, Manual on Uniform Traffic Control Devices, 2009 Edition,  
([http://mutcd.fhwa.dot.gov/kno\\_2009.htm](http://mutcd.fhwa.dot.gov/kno_2009.htm))

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 51 00-1, Traffic Control Plan.
- C. RSN 01 51 00-2, Vehicular Access Video Documentation:
1. Specified documentation of access roads on portable flash drive. Label each disc with contract number and title, Contractor's name, and date video was made.
- D. RSN 01 51 00-3, Access Plan.

**1.04 REGULATORY REQUIREMENTS**

- A. Meet requirements established by jurisdictional authority for use of existing roadways and haul routes; including seasonal or other limitations or restrictions, payment of excess size and weight fees, and posting of bonds conditioned upon repair of damage.
- B. Comply with applicable regulations for haul routes over public highways, roads, or bridges.

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## **1.05 SITE CONDITIONS**

- A. Rights-of-way for access to work from existing roads will be established by the BIA.
  - 1. In accordance with the clause at FAR 52.236-10, Operations and Storage Areas, use only established roadways, parking areas, and haul routes; or temporary roadways, parking areas, or haul routes constructed by the Contractor when and as authorized by the CO.
  - 2. Subject to the clause at FAR 52.249-10, Default (Fixed-Price Construction), unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of work.

## **1.06 TEMPORARY ELECTRICITY**

- A. Provide required electric power for construction.
- B. Provide electricity to maintain power to control and operate the outlet works when needed to operate equipment.
- C. Provide generators, transmission lines, distribution circuits, transformers, and other electrical equipment and facilities required for obtaining power and distributing power to points of use.
- D. Comply with IEEE C2 clearances and spacing for temporary communications and supply lines.
- E. Remove temporary equipment and facilities upon completion of work under this contract.

## **1.07 TEMPORARY WATER**

- A. Provide water for construction purposes.
- B. If water is available, water from the Red Lake and Tohdildonih Wash will be available for construction purposes.
  - 1. Obtain water use permit required for use of water source on Navajo Nation from Navajo Nation Department of Water Resources.
  - 2. Pay fees required for permit and use of water.
  - 3. Navajo Nation Department of Natural Resources requires the Contractor to estimate the amount of water to be used for the project for upfront payment.
- C. Navajo Tribal Utility Authority (NTUA) can be contacted as an alternative water source.
- D. Use water which meets specified requirements for water used in concrete, grout, soil conditioning, and other work.
- E. Provide means of conveying water to points of use.

- F. Remove temporary equipment and facilities upon completion of work under this contract.

## **PART 2 PRODUCTS**

### **2.01 BIA FIELD OFFICE**

- A. BIA will supply portable office trailer for BIA's use.
- B. Contractor shall furnish associated facilities including but not limited to, toilet facilities parking area for exclusive use by Navajo Nation and BIA personnel, electrical, and telephone phone service.
- C. Field office shall be completely set up with all items operational within 20 days of Contractor mobilization activities and at least 15 days prior to commencement of onsite work.

### **2.02 BIA OFFICE TRAILER**

- A. BIA-furnished, triple-wide mobile trailer. Level trailer on site in location identified by COR.
1. Contractor will relocate trailer from Asaayi to Red Lake.
  2. Trailer shall be cleaned, assembled, and placed on a suitable foundation.
  3. Trailer shall meet pertinent code requirements for use and occupancy and shall be renovated as directed by the COR or BIA Representative.
  4. After project completion the Contractor will relocate the trailer to Fort Defiance.
- B. Provide sturdy entrance stairs and landings at doors.
- C. Provide a conference table and separate offices for COR and BIA Representative.
- D. Electrical:
1. 110-VAC power from either a generator or existing transmission lines and furnished with ample cords and proper connections.

- E. Telephone:
  - 1. One telephone line.

### **2.03 PARKING AREA**

- A. Provide safe access between parking area and office facility and safe parking for BIA vehicles near trailer.

### **2.04 MATERIALS**

- A. Materials to maintain and repair existing roadways, parking areas, and haul routes: In accordance with requirements of jurisdictional authority.
- B. Materials to construct, maintain, and repair temporary roadways, parking areas, and haul routes: As approved by the COR or BIA Representative.
- C. Materials to maintain roadways and parking areas constructed under this contract and used by the Contractor for construction work: In accordance with specified requirements for construction of those roadways and parking areas.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Provide area for BIA furnished field office at locations directed by the COR or BIA Representative.
  - 1. Set up, level, tie down, and block.
  - 2. Install RSHS compliant access steps and landings with handrails for each door.

### **3.02 EXAMINATION**

- A. Investigate condition of available public or private roads for clearances, restrictions, bridge-load limits, bond requirements, and other limitations that affect or may affect access and transportation operations to and from the jobsite.
- B. Document condition of specified access roads with color digital video prior to use of roads for construction traffic.

### **3.03 CONNECT UTILITIES**

- A. Connect temporary electricity, telephone, internet and other required services.
  - 1. Adequately size and correctly place to perform their function without damage or interruption of service.

2. Internet connections shall have the capacity of Digital Subscriber Line (DSL) or better.

B. Electrical Power:

1. Supply electrical power during all working hours and during periods when BIA or BIA Representative staff are onsite and as necessary to prevent freezing inside the office trailer during non-working days.

**3.04 PORTABLE TOILET FACILITIES**

- A. Locate one near office facility for use by the BIA and BIA Representative.

B. Self-Contained Toilet Units:

1. Single-occupant units.
2. Chemical, aerated recirculation or combustion type.
3. Vented.
4. Fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

- C. Place on a level surface and fasten to the ground to prevent tipping over.

- D. Maintain toilet facilities on a regular basis to provide clean facilities for use.

**3.05 ESTABLISHED ROADWAYS AND PARKING AREAS**

- A. Established roadways and parking areas are available for the Contractor's use subject to existing restrictions and approval of the COR or BIA Representative.

- B. Existing onsite streets and driveways may be used for construction traffic. Tracked vehicles are not allowed.

- C. Designated areas of existing parking facilities maybe used by construction personnel.

**3.06 TEMPORARY ROADWAYS AND PARKING AREAS**

A. Roadways:

1. Construct temporary all-weather surfaced roadways for access from public thoroughfares to serve construction area, of a width and load-bearing capacity to provide unimpeded traffic for construction purposes.
2. Construct temporary bridges or culverts at stream crossings or cross-drainage channels to allow for unimpeded surface drainage.

B. Parking Areas:

1. Construct temporary parking areas to accommodate use of construction personnel.

2. Provide additional offsite parking when site space is not adequate.
3. Locate as approved by the COR or BIA Representative.

### **3.07 ROADWAYS AND PARKING AREAS CONSTRUCTED UNDER THE CONTRACT**

- A. Roadways and parking areas constructed under Section 31 24 00 – Fill and Backfill of this contract will be available for the Contractor’s use in accordance with requirements of this section.
- B. Prior to acceptance and prior to placing final surfacing permanent roads and parking areas may be used for construction traffic.
  1. Avoid traffic loading beyond design capacity.
  2. Tracked vehicles not allowed.
  3. Contractor is responsible for damage caused by construction operations.
- C. After completion, roadways and parking areas constructed under the contract will be accepted by the CO and will be available for use by the Contractor in the Contractor’s construction operations for the remaining work under the contract.
- D. Acceptance of or parking areas as provided above will not require a release of the percentages withheld from progress payments under the clause at FAR 52.232-5, Payment Under Fixed-Price Construction Contracts.

### **3.08 HAUL ROUTES**

- A. Perform work on rights-of-way established by the BIA as necessary to construct and maintain any roads, bridges, or drainage structures required for establishment and use of haul routes for construction operations.
- B. Use existing available public highways, roads, or bridges as haul routes subject to applicable local regulations.
- C. Minimize interference with or congestion of local traffic.
- D. Provide barricades, flaggers, and other necessary precautions for safety of the public where haul routes cross public highways or roads.
- E. Temporary roadways may be constructed, as approved by the COR or BIA Representative on the downstream dam embankment slope if these roadways are removed prior to completion of work and dam slopes are returned to prescribed lines and original appearance.

### **3.09 MAINTENANCE**

- A. BIA Field Office Space

1. Provide trash removal and toilet facility services.
  2. Keep water cooler supplied with commercially-supplied fresh water.
- B. Access Roads and Parking:
1. Maintain roadways, parking areas, and haul routes in a sound, smooth condition.
  2. Maintain roadbed, side slopes, structures, and surfacing of roads and parking areas until completion and acceptance of all work under this contract. As approved by the COR or BIA Representative, defer until latest practicable date within specified completion period, placement of surfacing on roads or parking areas subject to heavy and deteriorating use by the Contractor's construction operations or equipment.
  3. Maintain surfacing of gravel-surfaced roads and parking areas in a smooth condition until completion and acceptance of all work under this contract.
  4. Snow removal for convenience of the Contractor or to facilitate work operations of the Contractor is considered to be normal required maintenance.
- C. Safety Fence
1. Maintain fence until work in area is complete and accepted by the COR or BIA Representative.
  2. Obtain permission from COR or BIA Representative to remove fence.
  3. Fence materials will remain the property of the Contractor.
  4. Remove and dispose of fence in accordance with Section 01 74 00 - Cleaning and Waste Management.

### **3.10 REPAIR**

- A. Promptly repair ruts, broken pavement, potholes, low areas with standing water, and other deficiencies to maintain road surfacing and drainage in original or specified condition.

### **3.11 REMOVAL AND CLEANUP**

- A. Promptly remove field office, utility services, and debris upon written direction from the COR or BIA Representative.
- B. Remove materials used to construct temporary roadways, parking areas, and haul routes prior to contract completion. Recycle salvageable materials as approved by the COR or BIA Representative.
- C. Remove temporary underground work, fill and regrade site as specified.
- D. Restore Areas: Comply with Section 01 12 40 – Construction of the Work.

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### **3.12 TRAFFIC CONTROL**

- A. Meet requirements of MUTCD, Part 6.
- B. Provide cones, delineators, concrete safety barriers, barricades, flasher lights, danger signals, signs, and other temporary traffic control devices as required to protect work and public safety.
- C. Provide flaggers and guards as required to prevent accidents and damage or injury to passing traffic.
- D. Do not begin work along public or private roads until proper traffic control devices for warning, channeling, and protecting motorists are in place in accordance with approved traffic control plan.
- E. Maintain traffic flow and conduct construction operations to minimize obstruction and inconvenience to public traffic.
- F. Provide unobstructed, smooth, and dustless passageway for one lane of traffic through construction operations.
- G. Construct temporary connections for one lane of traffic between existing roadway and new construction.
- H. Maintain convenient access to driveways, houses, and buildings along line of work.
- I. Protect roads closed to traffic with effective barricades and warning signs. Illuminate barricades and obstructions from sunset to sunrise.
- J. Remove traffic control devices when no longer needed.
- K. Provide traffic control devices as required by MUTCD, Part 6.
- L. Maintain detour in smooth, dust-free condition.
- M. Remove the detour when no longer needed.

**END OF SECTION**



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**SECTION 01 56 10**  
**PROTECTION OF EXISTING FACILITIES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work, except as specified.
    - a. Does not include fencing, pipe gate, and cattle guards shown on the drawings.
  2. Costs for repair of installations damaged by the Contractor's operations are the Contractor's responsibility.

**1.02 REFERENCE STANDARDS**

- A. Bureau of Reclamation (USBR)
1. RSHS-2009 Reclamation Safety and Health Standards
- B. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE C2-2007 National Electrical Safety Code (NESC)

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 56 10-1, Plan for Protecting Existing Installations.

**1.04 PROJECT CONDITIONS**

- A. Drawings included in these specifications show items of existing materials, equipment and utilities but may not show all equipment, materials and utilities existing at the jobsite.
- B. Obtain the location of embedded conduit, pipe, cable, ground mat, and other buried items before performing any drilling, cutting of concrete or excavation.

**PART 2 PRODUCTS**

- A. Replacement Fence Materials:
1. Similar size, class, type, gauge, and weight, constructed using new materials.

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## **PART 3 EXECUTION**

### **3.01 INTERFERENCE WITH OPERATION OR MAINTENANCE**

- A. Do not interfere with operation or maintenance service on utilities, existing on date offers are received.
  - 1. Provide for access to utilities in a manner satisfactory to owners and operators and the BIA or BIA Representative.
- B. Provide required temporary structures; make necessary repairs, replacements, or similar operations; and furnish indemnity or other bonds.

### **3.02 LOCATING EXISTING UTILITIES**

- A. Obtain location of buried conduit, pipe, cable, ground mat, and other buried items before excavating.

### **3.03 CLEARANCES**

- A. The Contractor shall provide all utility clearances in accordance with RSHS.

### **3.04 FENCE REMOVAL**

- A. Remove existing fences and gates where necessary for performance of the work, after obtaining written permission from the COR or BIA Representative. BIA will locate fences and gates to be removed. The time schedule for removal of fences shall be approved in advance by the COR or BIA Representative.

### **3.05 TEMPORARY FENCES**

- A. Where fences and gates are removed, provide temporary fence protection for adjacent lands to prevent agricultural stock crossing, access to potentially steep side slopes, vertical drop offs and other harmful areas.
- B. If the Contractor does not provide necessary temporary fencing or protection within a reasonable time after need for fencing or protection arises, the CO will cause the work to be performed and backcharge the Contractor for such work.
- C. Remove temporary fencing and protection as a part of cleanup operations prior to final acceptance of completed work.

### **3.06 FENCE REBUILDING**

- A. Install fences and gates shown on the drawing in accordance with Section 32 31 10 – Security Gates and Fencing.
- B. Where fences and gates are removed to accommodate construction in areas not shown on the drawings, rebuild at original locations and as directed by the COR or BIA Representative.

- C. Construct rebuilt fencing and gates with new materials. The new fencing and gates shall be similar in design to the original fencing. New fence gate designs, and locations shall be approved by the COR or BIA Representative.

### **3.07 PROTECTION**

- A. Enclose work area to prevent dust, spalls, chips, grit, and other foreign material from endangering personnel and contaminating or damaging equipment.
- B. Provide protection for personnel and existing facilities from harm due to the Contractor's operations. Protection shall be subject to approval of the BIA or BIA Representative.
- C. Arrange protective installations to permit operation of existing equipment and facilities by the BIA and BIA Representative while work is in progress.
- D. Enclosures shall be subject to approval of the BIA or BIA Representative.

### **3.08 MAINTENANCE AND REMOVAL**

- A. Maintain temporary fence until work in area is complete and accepted by the COR or BIA Representative.
- B. Obtain permission from COR or BIA Representative to remove temporary fence.
- C. Repair, at Contractor's expense, damage to existing installations due to Contractor's operations or Contractor's failure to provide proper protection. At the BIA's option, damage may be repaired by the BIA, and the Contractor will be backcharged repair costs.
- D. Remove protective installations after purpose has been served. Materials furnished by the Contractor to provide protection remain property of the Contractor.
- E. Remove and dispose of temporary fence and existing fence that is replaced with new fence in accordance with Section 01 74 00 - Cleaning and Waste Management.

**END OF SECTION**

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**SECTION 01 57 20**  
**ENVIRONMENTAL PROTECTION**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work, except as specified.
  2. Costs for repair or treatment of injured vegetation and replacement of trees or shrubs are the Contractor's responsibility.

**1.02 REFERENCE STANDARDS**

- A. Bureau of Reclamation (USBR)
1. RSHS-2009 Reclamation Safety and Health Standards
- B. Code of Federal Regulations (CFR)
1. 40 CFR, Part 112 Oil Pollution Prevention
- C. Public Law
1. Sections 311, 402, and 404 Clean Water Act (Public Law 92-500, as amended)
- D. Bureau of Indian Affairs Western Region
1. Integrated Noxious Weed Management Plan and Programmatic Environmental Assessment for Weed Control Projects on Indian Lands (most recent version).

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 57 20-1, Vegetation Protection Plan:
1. Description of protective barriers or other methods used to protect vegetation from damage or injury caused by construction operations.
- C. RSN 01 57 20-2, Pollution Prevention Plan:
1. As required by the stormwater permit for discharges from construction sites.
  2. Include copy of permit(s).
- D. RSN 01 57 20-3, Spill Prevention, Control, and Countermeasure (SPCC) Plan:
1. Submit when SPCC Plan is required in accordance with 40 CFR, Part 112.

- a. SPCC Plan is required where release of oil and oil products could reasonably be expected to enter into or upon navigable waters of the United States or adjoining shorelines in quantities that may be harmful (40 CFR, Part 110), and aggregate on site oil storage capacity is over 1,320 gallons. Only containers with capacity of 55 gallons and greater are included in determining on site aggregate storage capacity.
  2. Reviewed and certified by a registered professional engineer in accordance with 40 CFR, Part 112, as required by section 311 of the Clean Water Act (Public Law 92-500 as amended).
- E. RSN-01 57 20-4, Spread of Noxious Weed Prevention
1. Description of methods used to prevent the spread of noxious weeds, including the location of inspection and washout, in accordance with BIA requirements.

#### **1.04 PROJECT CONDITIONS**

- A. Certain native species in the State of New Mexico located on private and public land and within the Navajo Nation are species of special concern. These species are protected under Federal and Tribal statutes such as the Endangered Species Act, Migratory Bird Treaty Act, Navajo Endangered Species List, and the Navajo Sensitive Species List.
- B. The Final Environmental Assessment for the proposed project area resulted in negative findings for these species.
- C. The bald eagle is considered a delisted species of interest. If it is encountered during construction, stop everything, walk away, and wait for the bird to leave especially while the bird is wintering.
- D. The contractor is responsible to comply with provisions of the Migratory Bird Treaty Act.
- E. Contractor shall not harass eagles or other migratory birds.
- F. Local habitat supports nesting of migratory birds. Tree removal shall not occur between March 15<sup>th</sup> and August 15<sup>th</sup> without conducting a migratory bird nesting survey prior to the work. Trees with migratory birds' nests shall not be removed between March 15<sup>th</sup> and August 15<sup>th</sup>.

#### **1.05 REGULATORY REQUIREMENTS**

- A. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

- 
- B. Construction Safety Standards:
1. Comply with sanitation and potable water requirements of section 7 of RSHS.
  2. Comply with NNOSHA.
- C. Laws, Regulations, and Permits:
1. Perform construction operations to comply, and ensure subcontractors comply, with:
    - a. Applicable Federal, Navajo Nation, and local laws, orders, regulations, and Water Quality Standards concerning control and abatement of water pollution; and terms and conditions of applicable permits issued by permit issuing authority.
    - b. If conflict occurs between Federal, Navajo Nation, and local laws, regulations, and requirements, the most stringent shall apply.
- D. Contractor Violations:
1. If noncompliance should occur, immediately (verbally) report noncompliance to the CO. Submit specific written information within 2 days.
  2. Violation of applicable Federal, Navajo Nation, or local laws, orders, regulations, or Water Quality Standards may result in the CO stopping site activity until compliance is ensured.
  3. The Contractor shall not be entitled to extension of time, claim for damage, or additional compensation by reason of such a work stoppage.
  4. Corrective measures required to bring activities into compliance shall be at the Contractor's expense.
  5. Contractor shall be responsible for damages resulting from dust originating from Contractor operations in accordance with clause at FAR 52.236-7, Permits and Responsibilities.

## **1.06 REQUIRED PERMITS**

- A. Wastewater Discharge Permit:
1. Permit:
    - a. Prior to discharging wastewater or other pollutants, secure a permit to discharge pollutants as required under section 402 of the Clean Water Act (Public Law 92-500 as amended).
  2. Terms and Conditions: Comply with terms and conditions as stated in the permit.

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3. Monitoring and Treatment:
    - a. Provide monitoring and water treatment, if necessary, to achieve compliance with permit conditions
    - b. Provide recordkeeping required of the section 402 permittee, as stated in the section 402 permit.
  4. Sampling: Include sampling in monitoring required of the Contractor to meet section 402 requirements, as well as required laboratory tests to determine effluent characteristics.
  5. Monitoring Results:
    - a. Provide monitoring results to the COR or BIA Representative 2 weeks prior to submittal deadline to appropriate Navajo NNOSHA and/or Environmental Protection Agency (EPA) Regional Administrator.
    - b. Send copies of all information transmitted to EPA and/or the Navajo Nation to the CO and COR.
- B. Dredge and Fill Permit:
1. BIA has made application for a permit to discharge dredged or fill material into waters of the United States (including wetlands) as required under section 404 of the Clean Water Act (Public Law 92-500 as amended).
  2. Bureau of Indian Affairs is the section 404 dredge and fill permit holder (permittee). The Contractor must comply with the requirements of the permit.
- C. Stormwater Discharge Permit Associated With a Construction Site:
1. Notice of Intent (NOI):
    - a. The Contractor shall sign the NOI to obtain coverage under a stormwater general permit to control stormwater discharges from the construction site as required under section 402 of the Clean Water Act (Public Law 92-500, as amended).
  2. Pollution Prevention Plan:
    - a. The Contractor shall prepare a Pollution Prevention Plan as required by the permit.
    - b. Comply with terms and conditions to obtain and maintain this stormwater discharge permit.
  3. Monitoring and Water Treatment:
    - a. Provide monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards.
    - b. Provide the recordkeeping required by the stormwater discharge permit associated with construction activity.



D. Navajo Nation Forestry Woodcutting Permit

1. The Contractor is required to obtain the Navajo Nation Forestry Woodcutting Permit from the Navajo Nation.

**1.07 CONTRACTOR RESPONSIBILITIES**

A. Permits:

1. Any permits obtained by the BIA are exceptions to the clause at FAR 52.236-7, Permits and Responsibilities, which requires the Contractor to obtain necessary licenses and permits.
2. As appropriate, BIA will designate the Contractor as the operator or holder of the permit. The Contractor is responsible for royalty payments and associated permit fees.

B. Monitoring:

1. Conduct monitoring in order to meet the requirements of the permits which may include:
  - a. Sampling,
  - b. Site inspections, and
  - c. Required laboratory tests to determine effluent characteristics.

C. Reporting Results:

1. The BIA will report required monitoring results to appropriate agencies. The section 402 wastewater discharge permit has specific reporting requirements for the permittee for noncompliance when effluent limitations are exceeded.

D. Recordkeeping:

1. Retain records and data required by permits.

E. Dust Control

1. Provide dust control and abatement during performance of work.
2. Prevent, control, and abate dust pollution on rights-of-way provided by BIA or elsewhere during performance of work.
3. Provide labor, equipment, and materials, and use efficient methods wherever and whenever required to prevent dust nuisance or damage to persons, property, or activities, including, but not limited to, crops, orchards, cultivated fields, wildlife habitats, dwellings and residences, agricultural activities, recreational activities, traffic, and similar conditions.

F. Air Pollution Control

1. Use reasonably available methods and devices to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.
  2. Do not operate equipment and vehicles that show excessive exhaust gas emissions until corrective repairs or adjustments reduce such emissions to acceptable levels.
- G. Noise Control
1. Construction activities are limited to the hours between 6:00a.m. and 6:00p.m. unless otherwise approved by the COR or BIA Representative.
  2. Equipment mufflers required.
- H. Light Control
1. Direct stationary floodlights to shine downward at an angle less than horizontal.
  2. Shield floodlights so that floodlights will not be a nuisance to surrounding areas.
  3. Direct lighting so that residences are not in direct beam of light.
  4. Correct lighting control problems when they occur as approved by the COR or BIA Representative.

## **PART 2 PRODUCTS**

### **2.01 REPLACEMENT TREES AND SHRUBS**

- A. Species: Species as approved by the COR or BIA Representative.
- B. Size: Same size as removed tree or shrub, or maximum practicable size that can be planted and sustained in the particular environment as approved by the COR or BIA Representative.

## **PART 3 EXECUTION**

### **3.01 POLLUTION CONTROLS**

- A. Control pollutants by use of sediment and erosion controls, wastewater and stormwater management controls, construction site management practices, and other controls including Navajo Nation and local control requirements.
- B. Sediment and Erosion Controls:
  1. Establish methods for controlling sediment and erosion which address vegetative practices, structural control, silt fences, straw dikes, sediment controls, and operator controls as appropriate.
  2. Institute stormwater management measures as required, including velocity dissipators, and solid waste controls which address controls for building materials and offsite tracking of sediment.

C. Wastewater and Stormwater Management Controls:

1. Pollution prevention measures:

- a. Use methods of dewatering, unwatering, excavating, or stockpiling earth and rock materials which include prevention measures to control silting and erosion, and which will intercept and settle any runoff of sediment-laden waters.
- b. Prevent wastewater from general construction activities such as drainwater collection, aggregate processing, concrete batching, drilling, grouting, or other construction operations, from entering flowing or dry watercourses without the use of approved turbidity control methods.
- c. Divert stormwater runoff from upslope areas away from disturbed areas.

2. Turbidity prevention measures:

- a. Use methods for prevention of excess turbidity which include, but are not restricted to, intercepting ditches, settling ponds, gravel filter entrapment dikes, flocculating processes, recirculation, combinations thereof, or other approved methods that are not harmful to aquatic life.
- b. Wastewaters discharged into surface waters shall meet conditions of section 402, the National Pollutant Discharge Elimination System (NPDES) permit.
- c. Do not operate mechanized equipment in waterbodies without having first obtained a section 404 permit, and then only as necessary to construct crossings or perform the required construction.

D. Construction Site Management:

1. Contractor construction operations:

- a. Perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes into streams, flowing or dry watercourses, lakes, wetlands, reservoirs, or underground water sources.
  - 1) Pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.

2. Stockpiled or deposited materials:

- a. Do not stockpile or deposit excavated materials or other construction materials, near or on, stream banks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff, or can in any way encroach upon the watercourse.

3. Petroleum product storage tanks management:
  - a. Place oil or other petroleum product storage tanks at least 20 feet from streams, flowing or dry watercourses, lakes, wetlands, reservoirs, and any other water source.
  - b. Do not use underground storage tanks.
  - c. Construct storage area dikes at least 12 inches high or graded and sloped to permit safe containment of leaks and spills equal to storage tank capacity located in the area plus sufficient freeboard to contain the 25-year rainstorm.
    - 1) Line diked areas with an impermeable barrier at least 50 mils thick.
  - d. Areas for refueling operations: Lined with impermeable barrier at least 10 mils thick covered with 2 to 4 inches of soil.

### **3.02 VEGETATION PRESERVATION AND PROTECTION**

- A. Preserve natural landscape and preserve and protect existing vegetation not required or otherwise authorized to be removed.
  1. Submit requests to remove vegetation not specifically required to be removed to the COR or BIA Representative.
- B. Conduct operations to prevent unnecessary destruction, scarring, or defacing of natural surroundings in the vicinity of the work.
- C. Move crews and equipment within the rights-of-way and over routes provided for access to the work in a manner to prevent damage to grazing land, crops, or property.
- D. Protect vegetation from damage or injury caused by construction operations, personnel, or equipment by the use of protective barriers or other methods approved by the COR or BIA Representative.
- E. Minimize, to the greatest extent practicable, clearings and cuts through vegetation. Irregularly shape authorized clearings and cuts to soften undesirable aesthetic impacts.
- F. Do not use trees for anchorages except in emergency cases or as approved by the COR or BIA Representative.
  1. For such use, wrap the trunk with a sufficient thickness of approved protective material before rope, cable, or wire is placed.
  2. Submit requests to use trees for anchorage, except for emergencies. Include description of protective material.
- G. Use safety ropes where tree climbing is necessary; do not use climbing spurs.

### **3.03 VEGETATION REPAIR, TREATMENT, OR REPLACEMENT**

- A. The Contractor is responsible for injuries to vegetation caused by Contractor operations, personnel, or equipment.
- B. Employ the services of an experienced arborist or licensed tree surgeon to direct repair, treatment, and replacement of injured vegetation. Submit qualifications of experienced arborist or licensed tree surgeon to COR and BIA Representative prior to employment.
- C. Repair or treat injured vegetation without delay and as recommended by and under direction of an experienced arborist or licensed tree surgeon.
- D. Remove and dispose of trees or shrubs not required or otherwise authorized to be removed by the COR or BIA Representative.
- E. Replace removed tree or shrub with tree or shrub approved by the COR or BIA Representative.
  - 1. For a period of 1 year, guy as required, water, and maintain replacement trees and shrubs.
  - 2. Remove and replace any replacement tree or shrub that dies within the 1-year period, and maintain such replacements for a period of 1 year from the date of replacement.

**END OF SECTION**

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**SECTION 01 57 90**  
**PRESERVATION OF ARCHAEOLOGICAL DATA**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work.

**1.02 DEFINITIONS**

- A. Cultural Resources: Includes prehistoric, historic, architectural, and traditional cultural properties. These include, but are not limited to, human skeletal remains, archaeological artifacts, records, and material remains related to such property.
- B. Cultural Items: Native American cultural items (i.e., funerary objects, sacred objects, objects of cultural patrimony, or human remains) for which protection is prescribed under the Native American Graves Protection and Repatriation Act (NAGPRA) - Public Law 101-601; 104 Stat. 3042, Section 3(d); and 43 CFR Part 10.4.
- C. Human Remains: Physical remains of the body of a person.
- D. Funerary Objects: Native American items that, as part of the death rite or ceremony of a culture, are reasonably believed to have been placed intentionally at the time of death or later with or near individual human remains.
- E. Native American: Of, or relating to, a tribe, people, or culture that is indigenous to the United States.
- F. Sacred Objects: Native American items that are specific ceremonial objects needed by traditional Native American religious leaders for the practice of traditional Native American religions by their present-day adherents. These items are specifically limited to objects that were devoted to a traditional Native American religious ceremony or ritual and which have religious significance or function in the continued observance or renewal of such ceremony.
- G. Objects of Cultural Patrimony: Native American items having ongoing historical, traditional, or cultural importance central to the Indian tribe itself, rather than property owned by an individual tribal member. These objects are of such central importance that they may not be alienated, appropriated, or conveyed by any individual tribal member.

**1.03 PROJECT CONDITIONS**

- A. Federal legislation provides for protection, preservation, and collection of scientific, prehistorical, historical, and archeological data, including relics and specimens, which

- might otherwise be lost due to alteration of terrain as a result of any Federal construction project.
- B. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archeological resource on public lands of the United States is subject to arrest and penalty of law.
- C. Discovery of Resources:
1. When the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in performance of this contract discover cultural resources on any lands:
    - a. Immediately cease work at that location.
    - b. Immediately notify the COR orally, giving the location and nature of the findings.
    - c. Follow with written confirmation to the COR within 2 days.
  2. In addition to notifying the COR:
    - a. Immediately notify Navajo Nation Historic Preservation Department by telephone at 928-871-7198. Follow with written confirmation to Navajo Nation Historic Preservation Department, P.O. Box 4950, Window Rock, AZ 86515; Fax number 928-871-7886, within 2 days.
    - b. For additional information contact the archeologist from the Navajo Nation.
  3. Exercise care so as not to disturb or damage cultural resources uncovered during construction activities and provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the CO.
  4. Do not resume work in the area of discovery until receipt of written notice to proceed from the COR.
  5. Site boundaries shall be flagged prior to any construction activities in the area or after they have been identified.
  6. Site shall be avoided by at least 50 feet of any construction related activities.
  7. Any construction activities within 50 feet of the site shall be monitored by a qualified archeologist.
- D. If human remains are found, work must stop immediately in the area where the remains are located and the area shall be protected. The CO must be contacted immediately as well the Navajo Historic Preservation Department (NHPD). Until the remains can be definitely confirmed as human, all work in the immediate area must cease. If the remains are human, work in the area shall not proceed until the remains have been removed by a qualified archaeologist or personnel from the NHPD.
- E. Where appropriate by reason of discovery, the CO may order delays in time of performance or changes in work, or both. When such delays or changes are ordered, an



equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

F. Insert this section in subcontracts which involve performance of work on jobsite terrain.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

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**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. When the schedule includes a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the schedule for the item.
2. When the schedule does not include a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the schedule for work for which the material is required.

**1.02 REFERENCE STANDARDS**

A. American Society of Mechanical Engineers (ASME)

1. ASME B1.1-2008 Unified Inch Screw Threads, (UN and UNR Thread Form)
2. ASME B1.20.1-1983(2006) Pipe Threads, General Purpose, Inch

B. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

**1.03 DEFINITIONS**

- A. Essential Characteristics: As used in these specifications, the term "essential characteristics" is synonymous with the term "salient characteristics."
- B. Salient Characteristics: Those qualities of an item that are essential to ensure that the intended use of the item can be satisfactorily realized.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Transport and handle manufactured products in accordance with manufacturer's instructions.
- B. Store and protect manufactured products in accordance with manufacturer's instructions and RSHS. Obtain instructions from the manufacturer before delivery of materials to jobsite. Maintain a copy of instructions at jobsite.
- C. Remove and replace damaged items with new items.

- D. Protect materials subject to adverse effects from moisture, sunlight, ultraviolet light, or weather during storage at jobsite.
- E. Store curing compounds, sealants, adhesives, paints, coatings, sealers, joint compounds, grouts, and similar products at the temperature and environmental conditions recommended by manufacturer.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Provide materials required for completion of work
- B. Provide type and quality described in these specifications. Make diligent effort to procure specified materials from all available sources.
- C. Furnish new materials conforming to referenced standards unless otherwise specified.
- D. For materials not covered by these or referenced specifications, furnish materials of standard commercial quality.
- E. If materials to be used deviate from or are not covered by recognized specifications and standards, submit, for approval, justification for and exact nature of the deviation, and complete specifications for materials proposed for use.
- F. Make parts accurately to standard gauge where possible.
  - 1. Use unified screw threads conforming to ASME B1.1 or B1.20.1 for threads, including but not limited to those of bolts, nuts, screws, taps, pipes, and pipefittings.
  - 2. For internal connections only, the Contractor may deviate from ASME standards, provided a complete set of taps and dies are furnished as required to facilitate repair or replacement.
- G. Permanently mark fasteners with a symbol identifying the manufacturer and with symbol(s) indicating grade, class, type, and other identifying marks in accordance with reference or applicable standard.

### **2.02 SUBSTITUTIONS**

- A. If materials required by these specifications become unavailable, because of BIA priorities or other causes, substitute materials may be used.
- B. Obtain written approval to use substitute materials from the COR or BIA Representative. State in the request for approval the amount of the adjustment, if any, to be made in favor of the BIA.

- C. The COR or BIA Representative's determination as to whether substitution will be permitted and as to what substitute materials may be used, shall be final and conclusive.
- D. If approved substitute materials are of less value to the BIA or involve less cost to the Contractor than specified material, a contract adjustment will be made in favor of the BIA. Where the amount involved or the importance of substitution warrants, a deductive modification to the contract will be issued.
- E. No payments in excess of prices offered in the schedule will be made because of substitution of one material for another or because of use of one alternate material in place of another.

### **2.03 WORKMANSHIP**

- A. Accurately manufacture and fabricate materials in accordance with best modern practice and requirements of these specifications, notwithstanding minor errors or omissions therein.
- B. Use liberal factors of safety and adequate shock-absorbing features in designs, especially for parts subjected to variable stress or shock, including alternating or vibrating stress or shock.
- C. Include provisions which prevent components from loosening for shock-absorbing features and parts subject to vibration.

### **2.04 SOURCE QUALITY ASSURANCE**

- A. Materials will be subject to inspection in accordance with clause at FAR 52.246-12, Inspection of Construction, at any one or more of the following locations, as determined by the CO:
  - 1. At place of production or manufacture.
  - 2. At shipping point.
  - 3. At jobsite.
- B. To allow sufficient time to provide for inspection, submit at time of issuance, copies of purchase orders, including drawings and other pertinent information, covering material on which inspection will be made as advised by the CO, or submit other evidence if such purchase orders are issued verbally or by letter.
- C. Inspection of materials at any location specified above or waiving of inspection shall not be construed as being conclusive as to whether materials and equipment conform to contract requirements under the clause at FAR 52.246-12, Inspection of Construction, nor shall the Contractor be relieved thereby of the responsibility for furnishing materials meeting the requirements of these specifications.
- D. Acceptance of materials will be made only at the jobsite.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's recommendations unless otherwise specified.

**3.02 FIELD QUALITY ASSURANCE**

- A. Final inspection and acceptance of materials will be made only at the jobsite after installation and testing.

**END OF SECTION**

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**SECTION 01 71 20**  
**SURVEYING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work.

**1.02 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 71 20-1, Surveying Plan:
1. Describe work layout and survey methods.
  2. Include surveying schedule.
- C. RSN 01 71 20-2, Resume:
1. Engineer or surveyor responsible for supervising and directing survey work.
- D. RSN 01 71 20-3, Accuracy Check Results:
1. Accuracy check of BIA-established primary control.
- E. RSN 01 71 20-4, Completed and Reduced Survey Notes:
1. Copy of completed and reduced survey notes for a survey or portion of survey.
- F. RSN 01 71 20-5, Survey Books or Electronic Data.
- G. RSN 01 71 20-6, Quantity Survey Notes and Computations:
1. Copies required for progress payment. Include itemized statement for work covered by notes and computations.
- H. RSN 01 71 20-7, Workday's Survey Notes:
1. Copies when requested by the COR or BIA Representative.

**1.03 PRIMARY CONTROL**

- A. The BIA or BIA Representative will establish primary control to be used for establishing work lines and grades.
- B. Primary control will consist of bench marks and horizontal control points in work vicinity as shown on drawings.

- C. Check and verify primary control and resolve discrepancies with COR or BIA Representative before beginning work.
- D. Preserve and maintain primary control points until otherwise authorized. COR or BIA Representative may reestablish damaged or destroyed primary control points and backcharge reestablishment cost to the Contractor.

#### **1.04 QUALIFICATIONS**

- A. Surveyors: Experienced construction surveyors under supervision and direction of engineer or surveyor with minimum of 2 years experience in charge of construction surveys for construction similar in nature to that required by this contract.

### **PART 2 PRODUCTS**

#### **2.01 SURVEYING MATERIALS AND EQUIPMENT**

- A. Provide materials and equipment required for surveying work, including, but not limited to, instruments, stakes, spikes, steel pins, templates, platforms, and tools.
- B. Except as required to be incorporated in work or left in place, surveying materials and equipment will remain property of Contractor.

#### **2.02 LAYOUT OF WORK SURVEYS**

- A. Establish lines and grades for work layout from the established primary control points.
- B. Establish measurements required for work execution to specified tolerances.
- C. Provide stakes, markers, and other survey controls necessary to control, check, and guide construction.

#### **2.03 QUANTITY SURVEYS**

- A. Where required for measurement of quantities for payment perform surveys and computations to determine quantities of work performed or placed during each progress payment period.
- B. Perform quantity surveys in presence of the COR or BIA Representative unless specifically waived. Notify the COR and BIA Representative at least 24 hours before performing a quantity survey.

#### **2.04 SURVEY REQUIREMENTS**

- A. Alignment Staking: Each 50 feet on tangent and each 25 feet on curves.
- B. Slope Staking: Each 50 feet on tangent and each 25 feet on curves, restake every 10 feet in elevation.



- C. Structures: Stake out of structures and checkouts before and during construction.
- D. Roads: Blue tops each 50 feet on tangent and each 25 feet on curves.
- E. Cross-sections: Original, final, and intermediate as required, for structure sites and other locations as necessary for quantity surveys. Survey borrow areas before and after removal of materials, but before final shaping.
- F. As-builts: As required for structures and other features of work.

## **2.05 ACCURACY**

- A. Degree of Accuracy:
  - 1. Alignment of Tangents and Curves: Within 0.1-foot.
  - 2. Structure Points: Set within 0.01-foot, except where installation or operation considerations require tighter tolerances.
  - 3. Blue Tops: Set within - 0.1-foot.
  - 4. Cross-Section Points: Locate within 0.10-foot, horizontally and vertically.
  - 5. Vertical Elevation Surveys: Close within 0.05-foot times the square root of the circuit length in miles.

## **2.06 FIELD RECORDS**

- A. Record original field notes, computations, and other surveying data in fieldbooks.
- B. Record survey data in accordance with recognized professional surveying standards.
  - 1. Notes or data not in accordance with standard formats will be rejected.
  - 2. Illegible notes or data or erasures on any page of a fieldbook will be sufficient cause for rejection of part or all of fieldbook.
  - 3. Corrections by ruling or lining out errors will be permitted.
  - 4. Copied notes or data will not be permitted.
  - 5. Rejection of part or all of a fieldbook may necessitate resurveying.
- C. Data and notes may be collected on electronic data collection devices with prior approval of the COR or BIA Representative.
  - 1. Electronic files of notes: In approved format.
  - 2. Include electronic files and paper copies of notes in submittals.

**END OF SECTION**

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**SECTION 01 74 00**  
**CLEANING AND WASTE MANAGEMENT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work except as specified.
  2. Cost of post-construction site assessments are the Contractor's responsibility.

**1.02 REFERENCE STANDARDS**

- A. Bureau of Reclamation (USBR)
1. RSHS-2009 Reclamation Safety and Health Standards
- B. Code of Federal Regulations (CFR)
1. 40 CFR 261.3 Definition of Hazardous Waste
  2. 49 CFR 171-179 Transportation - Hazardous Waste Regulations

**1.03 DEFINITIONS**

- A. Hazardous Waste: Defined as hazardous by 40 CFR 261.3; or by other Federal, State, or local laws or regulations.

**1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 74 00-1, Waste Production and Disposal Records:
1. Include certifications that waste was properly disposed.
- C. RSN 01 74 00-2, Hazardous Wastes Manifest.
- D. RSN 01 74 00-3, Environmental Consultant Resume:
1. Describe experience on similar project.
- E. RSN 01 74 00-4, Post-Construction Site Assessment.

**1.05 QUALIFICATIONS**

- A. Environmental Consultant: Minimum 2 years experience in conducting environmental site assessments for similar construction.

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## **1.06 REGULATORY REQUIREMENTS**

- A. Comply with Federal, State, and local laws and regulations.
- B. Comply with RSHS.
- C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

## **1.07 PROJECT CONDITIONS**

- A. Report waste materials discovered at jobsite to COR or BIA Representative.
  - 1. Cease work in areas where waste may be hazardous until waste materials are investigated by the BIA or BIA Representative.
  - 2. If waste is hazardous, the CO may order delays in time of performance or changes in work, or both.
  - 3. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

### **3.01 PROGRESS CLEANING**

- A. Keep work and storage areas free from accumulations of waste materials and rubbish.

### **3.02 FINAL CLEANUP**

- A. Remove temporary plant facilities, buildings, concrete footings and slabs, rubbish, unused materials, concrete forms, and other similar materials which are not part of permanent work.
- B. Leave building “broom clean”.
- C. Clean equipment and fixtures to a sanitary condition.
- D. Clean debris from roofs, gutters, downspouts and drainage systems.
- E. Rake clean landscaped areas.
- F. Clean debris from roof and drainage systems.

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### **3.03 DISPOSAL**

- A. Nonhazardous Waste Disposal:
  - 1. Dispose by removal from jobsite.
  - 2. Recycle waste materials whenever possible. Place materials for recycling in a receptacle designated for that purpose.
  - 3. Dispose of nonhazardous waste materials that are not recycled at appropriately permitted disposal facilities.
- B. Hazardous Waste Disposal:
  - 1. Dispose by removal from jobsite.
  - 2. Recycle hazardous waste whenever possible.
  - 3. Dispose of hazardous waste materials at appropriately permitted treatment or disposal facilities.
  - 4. Transport hazardous waste in accordance with 49 CFR 171-179.
- C. Certification: Certify that wastes are disposed of in accordance with Federal, State, and local regulations.

### **3.04 SITE ASSESSMENT**

- A. Upon completion of work, perform site assessment at following areas for work done under these specifications:
  - 1. Hazardous waste accumulation areas.
  - 2. Petroleum dispensing and storage areas where aggregate storage of petroleum at jobsite was over 110 gallons.
  - 3. Hazardous material storage areas.
- B. Employ qualified environmental consultant to perform assessments.
- C. Demonstrate and document by appropriate analytical sampling that site contamination is less than State action cleanup levels.

### **3.05 RECORDS**

- A. Keep records of types and amounts of waste materials produced.
- B. Keep records of waste material disposal and recycled materials.

**END OF SECTION**

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**SECTION 01 78 30**  
**PROJECT RECORD DOCUMENTS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in prices offered in the schedule for other items of work.

**1.02 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 01 78 30-1, Final As-Built Drawings:
1. Certified marked sets.

**1.03 RECORD DRAWINGS**

- A. Maintain the number of sets of full-size prints of contract drawings marked to show accurate and complete records of as-built conditions as required in Table 01 33 00A – List of Submittals. Keep drawings at the jobsite and mark as work progresses.
1. Mark and dimension to show variations between actual construction and that indicated or specified in contract documents.
    - a. Include buried or concealed construction and utilities.
    - b. Include existing items, topographic features, and utility lines revealed during construction which differ from those shown on contract drawings.
  2. Mark to define construction actually provided where choice of materials or methods is permitted in specifications, or where variations in scope or character of work from that of the original contract are authorized.
- B. Use standard drafting practice to represent changes and include supplementary notes, legends, and details necessary to clearly portray as-built construction.
- C. Mark as-built drawings in the following colors.
1. Red – Additions to original drawings.
  2. Green – Deletions to original drawings.
  3. Blue – Notations necessary for explanation of as-built markings.
- D. Allow the COR/BIA Representative to review the drawings at all times.
- E. Upon completion of work, sign marked prints as certified correct.

**PART 2      PRODUCTS**

Not Used

**PART 3      EXECUTION**

Not Used

**END OF SECTION**



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**SECTION 02 41 07**

**REMOVAL AND DISPOSAL OF EXISTING STRUCTURES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

**A. Removal and Disposal of Existing Structures:**

1. Payment: Lump sum price offered in the schedule.
  - a. Includes excavation, removal, hauling, and offsite disposal of the following structures:
    - 1) Trees marked by COR, see Section 31 11 00 – Clearing and Grubbing.
    - 2) Existing irrigation structures, including all concrete associated with the New Mexico Canal turnout, gates, downstream check structure, and section of CMP pipe within disturbed crossing area shown on Drawings.
    - 3) Embedded power poles in the embankment.
    - 4) Existing irrigation line.
    - 5) Designated livestock structures downstream of the dam, which include a shed, an outhouse, and a wood shed near residence.
    - 6) Existing metal conduits, fencing, and cattle guard.
  - b. Includes removal and stockpiling of the following structures:
    - 1) Existing fencing downstream of the dam.
    - 2) Existing pipe gates at the intersection of the Access Road and BIA Route 112.
  - c. Does not include removal of the above ground EWS structure, which will be removed by others.

**B. Removal and Placement of Structures for Fish Habitat**

1. Payment: Lump sum price offered in the schedule.
  - a. Includes excavation, removal, hauling, stockpiling, and placement of concrete structures and concrete piping for reuse as fish habitat within the existing reservoir, at direction of the COR or BIA Representative.
    - 1) Existing concrete outlet works pipes and appurtenant concrete structures.
    - 2) Old, previously abandoned concrete discharge conduit.
    - 3) Visible portions of the abandoned outlet works concrete.

- 4) Emergency Warning System (EWS) foundation slab.

## **1.02 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 02 41 07-1, Removal and Disposal of Existing Structures Plan:
  1. Including but not limited to the following:
    - a. Equipment to be used.
    - b. Transportation methods for debris.
    - c. Disposal Location of debris.
- C. RSN 02 41 07-2, Previously Abandoned Structures Removal and Disposal Plan:
  1. Describe methods and equipment to be used to remove and either dispose of or place within the reservoir abandoned structures.

## **1.03 PROJECT CONDITIONS**

- A. It is reported that the dam has outlet works other than those that are currently visible. The alignment, depth, and condition of the abandoned outlet works is assumed based on historical data and results of a geophysical investigation performed in 2015, which is included as an appendix to the Design Summary Report. The approximate location of the abandoned structures is shown on the Drawings and should be verified by exploratory trenching at the upstream and downstream embankment slopes per Section 31 23 24 – Exploratory Trench Excavation.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Verify required items of demolition with the COR or BIA Representative prior to preparation of the Removal of Existing Structures Plan submittal.
- B. Verify required items of removal with the COR or BIA Representative in accordance with Section 31 23 23 –Excavation prior to preparation of the Previously Abandoned Structures Removal and Disposal Plan submittal.

### **3.02 REMOVAL**

- A. Blasting will not be permitted for removal of existing structures.

- B. Remove all materials associated with the features identified on the drawings and as directed by the COR or BIA Representative.
- C. Remove concrete in pieces as intact as possible with a maximum dimension of 8 feet in any direction. Cut off steel reinforcement so that it does not extend more than six inches beyond any surface.

### **3.03 FISH HABITAT STRUCTURE PLACEMENT**

- A. Place concrete rubble in locations as shown on Drawings A-08. Rubble should be placed in a piles approximately 25 feet long, 5 feet wide and about 18 inches tall. Lean sections of concrete pipe on the piles. Embed the end of the pipe slightly into the existing lake bottom to keep the pipe from shifting.
- B. Place the rubble pile such that the long axis is oriented east to west.

### **3.04 DISPOSAL**

- A. All construction debris shall be disposed of as specified in Section 01 74 00 – Cleaning and Waste Management.

### **3.05 BACKFILLING**

- A. Backfill shall meet the requirements of Zone 1A material as specified in Section 31 24 00 – Fill and Backfill.
- B. Excavations required to remove features shown on the drawings shall be backfilled in accordance with Section 31 24 00 – Fill and Backfill.

**END OF SECTION**

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**SECTION 03 11 10**  
**CONCRETE FORMWORK**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include cost of furnishing and constructing forms in prices offered in schedule for concrete items for Structural Concrete.

**1.02 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI)
1. ACI 318-11 Building Code Requirements for Structural Concrete and Commentary Building Code Requirements for Structural Concrete and Commentary
- B. APA – The Engineered Wood Association (APA)
1. APA PS 1-09 Structural Plywood
- C. Bureau of Reclamation (USBR)
1. RSHS-2009 Reclamation Safety and Health Standards
- D. Western Wood Products Association (WWPA)
1. WWPA G5-2011 Western Lumber Grading Rules '05

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 03 11 10-1, Formwork Design and Drawings for Concrete Structures.

**PART 2 PRODUCTS**

Not Used

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## **PART 3 EXECUTION**

### **3.01 FORM MATERIALS**

- A. Sheathing or Lining: Conform to Table 03 11 10A – Form Sheathing or Lining Materials, or provide other materials which will produce equivalent results.

Table 03 11 10A - Form Sheathing or Lining Materials

Finish	Wood sheathing or lining	Steel sheathing or lining
F1	Any grade common board or plywood	Steel sheathing permitted Steel lining permitted
F2	No. 2 common or better, shiplap, or plywood	Steel sheathing permitted Steel lining permitted if approved
F3	Plywood	Steel sheathing permitted Steel lining not permitted

- B. Steel sheathing is steel sheets not supported by wood backing. Steel lining is thin sheets supported by wood backing.
- C. Wood Sheathing or Lining: Softwood or plywood of such kind and quality and treated or coated so that deterioration or discoloration of formed concrete surfaces due to chemical action, contamination, or uneven absorption of water from concrete is prevented.
- D. Plywood: APA PS 1, Exterior, Grade B-B Concrete Form, Class I, mill oiled and edge sealed.
- E. Softwood Lumber:
1. Meet requirements of WWPA G5 for dressed lumber or worked lumber of specified grade.
  2. Use common boards surfaced on both edges (S2E) in accordance with WWPA G5.
  3. Use 6- or 8-inch wide lumber for shiplap forms.
  4. Use same lumber width in forms for F2 finishes.
- F. F3 Finish Forms: Use material with basic modular size of 4 by 8 feet.

### **3.02 INSTALLATION**

- A. Construct forms to confine and shape concrete to required lines so that completed work meets specified structural deviations, surface tolerances, and finish requirements.

- 
- B. A Professional Engineer (PE) shall approve and sign detailed design calculations and working drawings for all formwork or vertical shoring installations for all walls and piers. This is an amendment to RSHS-2009.
  - C. Construct forms with sufficient strength to withstand pressure from placing and vibrating concrete. Maintain in proper position.
  - D. Adjust formwork design and concrete placing rate to compensate for the following:
    - 1. Hydraulic pressures exerted on forms by concrete with high fluidity.
    - 2. Chemical Admixtures.
    - 3. Plasticizers.
  - E. Where form vibrators are to be used, construct forms with sufficient rigidity to effectively transmit energy from form vibrators to concrete without damaging formwork or altering form position.
  - F. Seal surfaces and joints of forms to prevent absorption of water into forms or loss of mortar from concrete.
  - G. Place chamfer strips in corners of forms and at tops of wall placements to bevel edges of permanently exposed concrete surfaces. Do not bevel interior angles of intersecting concrete surfaces and edges of construction joints except as indicated on drawings.
  - H. Install sufficient plumb and string lines to monitor formwork positions before concrete placement. Monitor plumb and string lines during concrete placement and correct deficiencies in formwork.
  - I. F2 Finish:
    - 1. Use one type of form sheathing or lining material for exposed F2 surfaces.
    - 2. Construct forms to produce a uniform and consistent texture and pattern on face of concrete. Metal patches on forms are not permitted.
    - 3. Place form sheathing or lining so that horizontal form marks are continuous across entire surface.
    - 4. For forms constructed of plywood form lining or shiplap panels, make vertical form marks continuous for entire height of surface.
    - 5. For forms constructed of shiplap which is not paneled, cut boards square, stagger vertical joints in boards, and place vertical joints at studs.
  - J. F3 Finish:
    - 1. Use one type of form sheathing or lining material for F3 surfaces. Fabricate filler panels for corners, soffits, and similar offsets from same material as used for forms.
    - 2. Construct forms to produce a uniform and consistent texture and pattern on face of concrete. Metal patches on forms are not permitted.
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3. Align sheathing or lining horizontally and vertically and place to minimize joint marks on surfaces.
4. Place form sheathing or lining so that horizontal form marks are continuous across entire surface.
5. Make vertical form marks continuous for entire height of surface.
6. Fill and smooth finish voids at joints in plywood form lining or sheathing.
7. Do not construct forms continuously from lift to lift. Remove forms after concrete in a lift has hardened and reset forms for next lift.
8. Reset forms to overlap hardened concrete in previous lift by 1-inch, maximum.
9. Tighten forms snugly against hardened concrete so that forms will not spread and cause offsets or loss of mortar at construction joints when concrete placement is resumed. Provide additional bolts or form ties required to hold reset forms tight against hardened concrete.

K. Cleaning and Oiling Forms:

1. Clean form surfaces of encrustations of mortar, grout, or other foreign material.
2. Coat form surfaces with form oil which will prevent sticking and will not soften or stain concrete surfaces or cause concrete surface to become chalky or dust producing.

### 3.03 REMOVAL

A. Remove forms within 24 hours after concrete has gained sufficient strength to prevent damage by form removal.

1. Nonsupporting forms such as sides of beams, walls, columns, and similar items: Remove after cumulatively curing at not less than 50 degrees Fahrenheit for 24 hours from time of concrete placement when:
  - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
  - b. Curing protection is maintained.
2. Forms for elevated structural slabs or beams: Remove in accordance with ACI 318, Chapter 6, and when concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength, as determined by test cylinders.
3. Forms on upper sloping faces of concrete, such as forms on waterside of warped transitions: Remove as soon as concrete has attained sufficient stiffness to prevent sagging.
4. Wood forms for wall openings: Loosen as soon as loosening can be accomplished without damage to concrete to prevent excessive stress in concrete from swelling of forms. Construct forms for openings to facilitate loosening.



- B. Do not remove forms until concrete strength is such that form removal will not result in perceptible cracking, spalling, or breaking of edges or surfaces, or other damage to concrete.
- C. Remove forms in a manner which prevents damage to concrete.
- D. Repair damaged concrete in accordance with Section 03 30 00 – Cast-in-Place Concrete.
- E. Begin required repair and curing immediately after form removal.

**END OF SECTION**

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**SECTION 03 15 12**  
**PVC WATERSTOP**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. Include in prices offered in the schedule for Structural Concrete.

**1.02 REFERENCE STANDARDS**

A. ASTM International (ASTM)

1. ASTM D 638-10 Tensile Properties of Plastics
2. ASTM D 746-07 Brittleness Temperature of Plastics and Elastomers by Impact
3. ASTM D 747-10 Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
4. ASTM D 1203-10 Volatile Loss From Plastics Using Activated Carbon Methods

B. United States Army Corps of Engineers (COE)

1. COE CRD-C-572-74 Polyvinylchloride Waterstop

**1.03 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 15 12-1, Purchase Orders:

1. Copies of purchase orders for waterstop.

C. RSN 03 15 12-2, Samples:

1. Two-foot-long sample of each size and type of waterstop to be used in work.

D. RSN 03 15 12-3, Certifications:

1. Manufacturer's certification for PVC compound used to fabricate waterstop.
  - a. Include physical property test data on compound from tests performed by manufacturer or other laboratory within 18 months before submittal.
2. Sampling certification that samples are representative of waterstop to be used in work.

- E. RSN 03 15 12-4, Instructions:
1. Manufacturer's recommendations for installing and splicing waterstop.

#### 1.04 QUALIFICATIONS

- A. Use skilled workmen to make splices.
- B. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled to fabricate required splices.

### PART 2 PRODUCTS

#### 2.01 PVC WATERSTOPS

- A. PVC Compound:
1. Domestic virgin PVC with additional resins, plasticizers, stabilizers, or other materials required to meet specified requirements.
  2. Do not use reclaimed PVC or manufacturer's scrap.
- B. Meet physical characteristic requirements specified in Table 03 15 12A - PVC Waterstop Physical Characteristics.

Table 03 15 12A - PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Tensile test, minimum	ASTM D 638, speed D, specimen type IV	2,000 lbs/in <sup>2</sup>
Ultimate elongation, minimum	ASTM D 638, speed D, specimen type IV	300 percent
Stiffness in flexure, minimum	ASTM D 747	600 lbs/in <sup>2</sup>
Low temperature brittleness at -35 degrees Fahrenheit	ASTM D 746	No cracking or chipping
Volatile loss, change in weight, maximum	ASTM D 1203, method A, 0.08-inch-thick specimen	0.50 percent
Tensile strength after accelerated extraction test, percent of tensile strength before extraction test, minimum	COE CRD-C-572	80 percent
Ultimate elongation after accelerated extraction test, percent of ultimate elongation before extraction test, minimum	COE CRD-C-572	80 percent

Table 03 15 12A - PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Change in weight after effect of alkalis test	COE CRD-C-572	+0.25 percent -0.10 percent
Change in Shore durometer hardness after effect of alkalis test	COE CRD-C-572	±5 percent

- C. Prepare test specimens in accordance with COE CRD-C-572.

## 2.02 FABRICATION

- A. Mold or extrude so that cross section will be dense, homogeneous, and free from porosity and other imperfections.
- B. Four-inch, Six-inch and Nine-inch waterstops shall conform to detail dimensions and tolerances indicated on contract drawings.
- C. Factory fabricate corners, ells, tees and crosses.

## 2.03 FACTORY SPLICING

- A. Splices other than 180 degree butt splices shall be factory made.
  - 1. Where splices are required between waterstops of different sizes, make splices as recommended by manufacturer.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install waterstops at locations shown on drawings.
- B. Install in accordance with manufacturer's recommendations.
- C. Embed waterstop so that one-half of waterstop width will be embedded on each side of concrete joint.
- D. Position waterstop and secure during installation so that a continuous watertight diaphragm will be formed in joint unless otherwise shown on drawings. Do not nail, puncture, or cut waterstop.
- E. Support and protect waterstop during work.
- F. Protect waterstop from oil, grease, and curing compound.

- G. Remove large pieces of aggregate near waterstop by hand so that complete contact is maintained between waterstop and surrounding concrete.
- H. Vibrate concrete surrounding waterstop with additional vibration so that waterstop is completely embedded in concrete.

### **3.02 SPLICING**

- A. Splice waterstops at joints in waterstop sections and at intersections of waterstops.
  - 1. Splice PVC waterstop at joints in waterstop sections. Field splicing is only permitted for straight butt joints. Factory miter fabrication is required for other configurations.
- B. Make neat splices with waterstop ends joined in true alignment.
- C. Use a miter-box guide and portable saw to make cuts so that ends to be joined will be in proper alignment and contact will be maintained between joined surfaces.
- D. Splice by heat sealing adjacent surfaces in accordance with manufacturer's recommendations.
  - 1. Use a thermostatically controlled electric heat source.
  - 2. Use correct temperature to melt material.
  - 3. Do not char material.
- E. Make splice so that cooled splice when bent by hand to a 180 degree angle shows no sign of separation.

**END OF SECTION**

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**SECTION 03 20 00**  
**CONCRETE REINFORCEMENT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include cost of concrete reinforcement in price offered in the schedule for Structural Concrete.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM A 36/A 36M Standard Specification for Carbon Structural Steel
  2. ASTM A 615/A 615M-09b Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  3. ASTM A 706/A 706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 03 20 00-1, Reinforcement Diagrams and Lists:
1. Bar-placing diagrams, bar lists, and bar-bending diagrams required for reinforcement fabrication and placement.
    - a. Prepare bar-placing diagrams, bar lists, and bar-bending diagrams in accordance with drawings.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting.
- B. Protect from contaminants such as grease, oil, and dirt.
- C. Provide for identification after bundles are broken and tags removed.

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## **PART 2 PRODUCTS**

### **2.01 STEEL REINFORCEMENT**

- A. Reinforcing Bars:
1. Plain Dowels: ASTM A 36.
  2. Deformed steel bars: ASTM A 615, Grade 60; or ASTM A 706, Grade 60.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Clean reinforcement surfaces of heavy, flaky rust; loose mill scale; dirt; grease; and other foreign substances before placement.
- B. Accurately place and secure in position so that reinforcement will not be displaced during concrete placement.
- C. Field bending not allowed unless approved by COR or BIA Representative.
- D. Do not weld or tack weld reinforcing bars unless shown on drawings.
1. All welded reinforcing bars shall be ASTM A 706, Grade 60.
- E. Place reinforcement with a clear distance of 1-inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on drawings.
- F. Tolerances:
1. Maintain concrete cover over reinforcement within 1/2-inch of specified cover where specified cover is greater than 2-1/2 inches.
  2. Maintain concrete cover over reinforcement within 1/4-inch of specified cover where specified cover is 2-1/2 inches or less.
  3. Maintain spacing of reinforcing bars within 1-inch of required spacing.
- G. Plain Dowels:
1. Place dowels per contract drawings.
  2. Position dowels parallel to each other and to concrete surface.
  3. Maintain dowels accurately in position during concrete placement.

**END OF SECTION**



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**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Structural Concrete:

1. Payment: Lump sum price offered in the schedule. Includes cost of work and materials for structural concrete except as specified.
  - a. Concrete structures, outlet works concrete encasement, outlet works vent pipe and carrier pipe encasement, and leveling slab and mass concrete are measured separately.

**1.02 REFERENCE STANDARDS**

A. American Concrete Institute (ACI)

1. ACI 301 Standard Specification for Structural Concrete
2. ACI304R-00 Measuring, Mixing, Transporting and Placing Concrete
3. ACI 305R Hot Weather Concreting
4. ACI 306.1-90 Cold Weather Concreting

B. ASTM International (ASTM)

1. ASTM C 31/C 31M Making and Curing Concrete Test Specimens in the Field
2. ASTM C 33/C 33M Concrete Aggregates
3. ASTM C 39/C 39M Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C 42/C 42M Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5. ASTM C 94/C 94M Ready-Mixed Concrete
6. ASTM C 114 Chemical Analysis of Hydraulic Cement
7. ASTM C 117 Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
8. ASTM C 136 Sieve Analysis of Fine and Coarse Aggregates
9. ASTM C 138/C 138M Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
10. ASTM C 143/C 143M Slump of Hydraulic-Cement Concrete

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11.	ASTM C 150	Portland Cement
12.	ASTM C 171	Sheet Materials for Curing Concrete
13.	ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
14.	ASTM C 260	Air-Entraining Admixtures for Concrete
15.	ASTM C 295	Petrographic Examination of Aggregates for Concrete
16.	ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
17.	ASTM C 494/C 494M	Chemical Admixtures for Concrete
18.	ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
19.	ASTM C 1017/C 1017M	Chemical Admixtures for Use in Producing Flowing Concrete
20.	ASTM C 1064/C 1064M	Temperature of Freshly Mixed Hydraulic Cement Concrete
21.	ASTM C 1074	Estimating Concrete Strength by the Maturity Method
22.	ASTM C 1260-07	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
23.	ASTM C 1293-08b	Determination of Length Change of Concrete Due to Alkali-Silica Reaction
24.	ASTM C 1315-11	Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
25.	ASTM C 1567 -11	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
26.	ASTM C 1602/C 1602M	Mixing Water Used in the Production of Hydraulic Cement Concrete
27.	ASTM D 1751-04(2008)	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
28.	ASTM D 1752-04a	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
C.	Bureau of Reclamation (USBR)	
1.	USBR M-47	Standard Specifications for Repair of Concrete, August 1996 (Appendix A of "Guide to Concrete

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- Repair” available at  
[http://www.usbr.gov/pmts/materials\\_lab/repairs/guide.pdf](http://www.usbr.gov/pmts/materials_lab/repairs/guide.pdf))
2. USBR Concrete Manual Concrete Manual, Part 2, Ninth Edition, Reprint, 1992
- D. Corps of Engineers
1. CRD C662-10 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method) International Concrete Repair Institute (ICRI)

### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 03 30 00-1, Material Approval Data:
1. Mix Design: For each concrete mix design.
- a. Mixture proportions, materials sources, and physical properties.
- 1) Field test data meeting requirements of ACI 301 4.2.3.2.a, within 12 months or
- 2) Compressive strength results from trial batches made within 6 months.
- a) Trial mix test results, three 6-inch diameter cylinders each at 7, and 28 days.
- b) Average compressive strength of trial batch cylinders at designated design age.
- b. Admixtures to be used in the mix shall be incorporated into the mix design submitted for approval.
- c. Identify admixtures to be used in mix by manufacturer and product name.
- d. Re-submit mix design for change in material source or type.
2. Name and manufacturer of each cementitious material, aggregate source, admixture, curing compound, and joint filler.
- a. The COR and BIA Representative reserve the right to require submission of manufacturer’s test data and certification of compliance with specifications.
3. Cementitious materials certifications and test reports:

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- a. Manufacturer's certification and test reports for each lot from which shipments are drawn.
  - b. Certify materials were tested during production or transfer in accordance with specified reference specification.
  - c. Submittal of certification and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirements
4. Aggregate certification:
    - a. Producer's physical property, gradation and ASR testing reports for each aggregate source, less than 6 months old.
    - b. Submittal of certification and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirements.
- C. RSN 03 30 00-2, Concrete Placement Drawings:
1. For approval.
  2. Drawings for each individual concrete placement. An individual concrete placement is defined as a portion of concrete work placed in one continuous operation between specified lines or joints.
  3. Show locations, dimensions, blockouts, openings, recesses, waterstops, and finishes.
  4. Show details of items embedded in or associated with placement except reinforcing steel.
  5. Include a separate drawing showing placement sequence.
  6. List reference drawings from which details shown on placement drawing were obtained on each drawing.
  7. Reference related steel reinforcement drawings associated with placement on each drawing.
- D. RSN 03 30 00-3, Concrete Placement Schedule:
1. Written plan describing location, sequence, and date of concrete placements scheduled. Include anticipated haul times to site and provisions to account for long hauls.
  2. Complete, detailed concrete placement schedule showing the Contractor's plan for placement of individual features, units, and other elements of concrete work.
  3. Show submittal of detail drawings and placement of reinforcement and embedded items.
- E. RSN 03 30 00-4, Certifications:
1. Batch Plant: National Ready Mixed Concrete Association (NRMCA) Certification of Production Facilities.

2. Mix Designer: Licensed professional engineer with a minimum of 5 years of experience in the design of concrete mixes.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Furnish batch ticket with each batch of concrete in accordance with ASTM C 94. Deliver ticket to COR or BIA Representative at jobsite during batch delivery.
- B. Sponge Rubber Joint Filler Storage:
  1. Store in protected area at temperature of 70 degrees Fahrenheit (21 degrees Celsius) or less.
  2. Do not expose to direct sun.

### **PART 2 PRODUCTS**

#### **2.01 CEMENTITIOUS MATERIALS**

- A. Cementitious Materials Options:
  1. Specified portland cement plus percent by weight specified pozzolan specified in Table 03 030 00A - Mix Table.
- B. Portland Cement:
  1. ASTM C 150, Type V:
    - a. Meet equivalent alkalis requirements of ASTM C 150 - Table 2.
      - 1) The low-alkali limitation for portland cement and mortar bar expansion limit for supplementary cementitious materials may be waived by COR or BIA Representative when concrete aggregate source does not contain potentially deleterious amounts of particles as determined by the use of the guide and test methods listed below.
        - a) ASTM C 295.
        - b) ASTM C 1260.
        - c) ASTM C 1293.
        - d) ASTM C 1567.
    - b. Meet false-set requirements of ASTM C 150 - Table 4.
- C. Pozzolan:
  1. ASTM C 618, Class F, except,
    - a. Sulfur trioxide, maximum: 4.0 percent.
    - b. Calcium oxide, maximum: 8.0 percent.

- c. Loss on ignition, maximum: 2.5 percent.
- d. Test for effectiveness in controlling alkali-silica reaction under supplementary optional physical requirements in Table 3 of ASTM C 618. Use low-alkali cement for test.
- e. Does not decrease sulfate resistance of concrete by use of pozzolan.
  - 1) Demonstrate pozzolan will have an “R” factor less than 2.5.
  - 2)  $R = (C-5)/F$
  - 3) C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C 114.
  - 4) F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C 114.

## **2.02 WATER**

- A. ASTM C 1602, including optional requirements of Table 2.

## **2.03 AGGREGATE MATERIALS**

- A. Fine Aggregate: ASTM C 33, except allowable fines content (material passing No. 200 sieve) less than 3 percent.
- B. Coarse Aggregate: ASTM C 33, Size No. indicated in Table 03300A - Mix Table.
- C. Assure aggregates are not deleteriously alkali-silica reactive (ASR).
  - 1. Test coarse and fine aggregate in accordance with ASTM C 1260 for the potential for deleterious alkali-silica reaction.
    - a. Expansion at 16 days does not exceed 0.10 percent: the coarse or fine aggregates will be acceptable.
    - b. Expansion at 16 days is greater than 0.10 percent, but less than 0.20 percent, aggregates are acceptable if petrographic examination shows the expansion is not due to ASR.
      - 1) Otherwise, test specimens according to ASTM C 1567 using all components (e.g., coarse aggregate, fine aggregate, cementitious materials, and/or specific reactivity reducing chemicals) in the proportions proposed for the mixture design and retest.
        - a) Expansion of the proposed mixture design test specimens, tested in accordance with ASTM C 1567 does not exceed 0.10 percent at 16 days from casting, the aggregates will be acceptable.
        - b) Expansion of the proposed mixture design test specimens is greater than 0.10 percent at 16 days, the aggregates will not be acceptable unless adjustments to the mixture design can

reduce the expansion to less than 0.10 percent at 16 days, or new aggregates shall be evaluated and tested, or testing by ASTM C 1293 indicates the aggregates will not experience deleterious expansion.

- c. Expansion at 16 days is greater than 0.20 percent.
  - 1) Aggregate will not be acceptable, unless a combination of cement, aggregate, and supplemental cementitious materials is found to effectively mitigate the expansion using ASTM C 1567.
- 2. Substitution of ASTM C 1293 test results for ASTM C 1260 test results.
  - a. Acceptable but the average concrete prism expansion shall be less than 0.04 percent at one year

## **2.04 ADMIXTURES**

- A. Admixtures may be required if significant haul times are anticipated.
- B. Air-Entraining Admixture:
  - 1. ASTM C 260.
  - 2. Compatible with all other admixtures.
- C. Chemical Admixtures:
  - 1. Allowable chemical admixtures:
    - a. ASTM C 494, Type A, B, C, D, E, F, G, or S.
    - b. ASTM C 1017, Type I or II.
  - 2. Do not use chemical admixtures, which contain more than 0.1 percent chloride, by weight.
  - 3. Admixtures shall be compatible with each other as certified by the manufacturers.

## **2.05 CURING MATERIALS**

- A. Water: ASTM C 1602, including optional requirements of Table 2.
- B. Curing Compound:
  - 1. Curing Compound: ASTM C 1315, type II (white pigmented).
  - 2. ASTM C 309, Type ID, clear with fugitive dye.
  - 3. Moisture Loss: 0.40 kg/square meter/72 hours maximum.
  - 4. Capable of meeting moisture retention at manufacturer's specified application rate.
- C. Polyethylene Film: ASTM C 171.
- D. White Burlap-Polyethylene Sheeting: ASTM C 171.

**2.06 ACCESSORIES**

- A. Sponge Rubber Joint Filler:
  - 1. ASTM D 1752, Type I, except as specified.
  - 2. Test specimen compression load: 50 to 150 pounds per square inch.
- B. Joint Filler Adhesive: Nonbituminous adhesive recommended by filler manufacturer.

**2.07 MIX PROPORTIONS**

- A. The Contractor shall design concrete mixes.
- B. Design mix in accordance with Table 03300A – Mix Table:

Table 03 30 00A – Mix Table

Mix No	Feature	f'c (lb/in <sup>2</sup> )	Max. w/cm*	NMSA (inches)*	Percent Pozzolan*** Class F Ash	Slump	Air Content	Notes
1	Typical Structural Concrete	4,500 @ 28 days	0.45	3/4	20 ± 5	3 – 5	5-8 percent	--
2	Mass Concrete	2,500@ 28 days	0.65	--	--	5 – 8	3-7 percent	--
3	CLSM	500@ 28 days	0.65	--	--	5 – 7	3-7 percent	--

\*Maximum water/cementitious ratio. Cementitious to mean cement plus pozzolan.

\*\*Nominal Maximum Size Aggregate

\*\*\* Percent of specified cementitious by weight.

- C. Slump: In accordance with ASTM C 143.
- D. Air Entrainment: Percent air by volume of concrete as discharged at placement, in accordance with ASTM C 231.
- E. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field performance methods as specified in ACI 301. For the trial batch method, mix must be proportioned and stamped by a professional engineer.
- F. Use set-retarding admixtures during hot weather only when approved by COR or BIA Representative.

**2.08 BATCHING, MIXING, AND TRANSPORTING**

- A. Batch, mix and deliver to site in accordance with ASTM C 94.
- B. Comply with ACI 304, “Guide for Measuring, Mixing, Transporting, and Placing Concrete,” and as specified.



- C. Deposit concrete at its final destination within 90 minutes from the introduction of cement to water or aggregates, or as directed by COR or BIA Representative.
- D. For hauls longer than 1-1/2 hours extended set control admixtures may be used if approved by COR or BIA Representative.
- E. Prevent appreciable segregation of ingredients.

## **2.09 CONCRETE TEMPERATURE**

- A. Batch concrete as necessary to achieve placement temperatures between 50°F and 90°F.
- B. Use materials and/or procedures necessary to achieve required placement temperatures; including, but not limited to, the following:
  - 1. Replace all or a part of the mixing water with chilled water.
  - 2. Replace all or a part of the mixing water with ice.
  - 3. Introduce liquid nitrogen into the concrete as it is batched.
- C. When air temperature has fallen to or is expected to fall below 40 degrees Fahrenheit, prepare ingredients and mix in accordance with ACI 306.1
  - 1. Uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees and not more than 85 degrees Fahrenheit at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.

## **PART 3 EXECUTION**

### **3.01 FORMWORK**

- A. See Section 03 11 10.

### **3.02 STEEL REINFORCEMENT**

- A. See Section 03 20 00.

### **3.03 WATER STOPS**

- A. See Section 03 15 12.

### **3.04 CONCRETE PLACEMENT**

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Provide one day notification to COR and BIA Representative for each scheduled pour.

1. Seven days minimum between adjacent placements, or as approved by COR or BIA Representative.
  2. Do not place concrete without approval of the COR or BIA Representative.
  3. Place in presence of COR or BIA Representative.
- B. The Contractor will only be allowed to add water to the batched concrete once at the site, before any concrete is discharged, if the specified water to cement ratio is not exceeded, and addition of water is approved by the COR or BIA Representative.
1. Concrete shall be mixed for at least 20 revolutions of the mixer drum at mixing speed.
  2. Additional water should be recorded on the batch ticket to the nearest gallon.
- C. The Contractor will only be allowed to add air entraining admixtures to the batched concrete once at the site as approved by the COR or BIA Representative.
1. After the admixture is added, the concrete shall be re-mixed for a minimum of 20 revolutions of the mixer drum at mixing speed.
  2. Contractor quality testing and quality assurance tests by the COR or BIA Representative will be taken after the addition and additional revolutions.
  3. Additional air entraining admixture should be recorded on the batch ticket to the nearest ounce.
- D. Do not use concrete which has become so stiff that concrete cannot be properly placed.
- E. Thoroughly moisten surfaces of absorptive foundations to be covered with concrete so that moisture will not be drawn from fresh concrete.
- F. Convey concrete from mixer to the place of final deposit rapidly by methods that prevent segregation or loss of ingredients and will insure the required quality of concrete. Use conveying equipment, conveyors, hoppers, baffles, chutes, pumps that are sized and designed to prevent cold joints from occurring and prevent segregation in discharged concrete. Clean conveying equipment before each placement.
1. Do not use aluminum pipes and chutes for placing or pumping concrete.
- G. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- H. Clean, roughen, and surface dry surfaces of construction joints and existing concrete to be covered with fresh concrete.
1. Remove laitance, loose or defective concrete, coatings, sand, curing compound, and other foreign material.

2. Sandblast, steel shotblast, or high-pressure water jet surfaces, or use other method approved by COR or BIA Representative to create a surface equivalent to or larger than CPS 5 in accordance with ICRI 310.2. Wash surface thoroughly, and surface dry immediately before placement of adjoining concrete.
  3. Wash surface thoroughly, and surface dry immediately before placement of adjoining concrete.
  4. Do not use a mortar layer on construction joints.
- I. Vibrate concrete until concrete has been consolidated to maximum practical density, is free from pockets of coarse aggregate, and closes snugly against surfaces of forms and embedded materials.
- J. Deposit concrete in forms in horizontal layers with proper consolidation into previous layers and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints. For high wall pours (above 12 feet), Contractor must show its experience and demonstrate its proficiency before Contracting Officer will permit pours in excess of 12 feet.
1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
  3. Make construction joints only where located on Drawings unless otherwise approved by Contracting Officer. Plan pours to continuously place concrete from one construction joint to another.
- K. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleed-water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- L. Hot Weather: Place concrete in accordance with ACI 305R.
1. When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
    - a. Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
    - b. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
- M. Cold Weather: Place concrete in accordance with ACI 306.1, as appropriate.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade on subgrade containing frozen materials.

### **3.05 FINISHING**

- A. Where finishes are not specified or shown on drawings for a particular surface, finish concrete as specified for similar work.
- B. Notify COR and BIA Representative before finishing concrete.
- C. Finish concrete in presence of COR or BIA Representative unless inspection is waived in each specific case.
- D. Formed Surfaces:
1. Finish class is designated by symbols F1, F2, F3, and F4.
  2. Finish F1:
    - a. Applies to formed surfaces to be covered by fill material, grout, or concrete, and construction joint surfaces as specified in Table 03 30 00E – Formed Surfaces.
    - b. Protect form tie rod ends on surfaces in contact with fill material from moisture where they will be below the water table or waterline.
      - 1) Recess tie rod ends and fill recess with dry pack or other material approved by COR or BIA Representative.
    - c. Cut off flush with formed surface form tie rod ends on surfaces in contact with concrete or fill material and above maximum water table or waterline elevation.

- 
3. Finish F2:
    - a. Applies to exposed formed surfaces not permanently concealed by fill material, grout, or concrete, and not required to receive finish F3 or F4, and to contraction joint surfaces and expansion joint surfaces as specified in Table 03 30 00E – Formed Surfaces.
      - 1) Recess tie rod ends and fill recess with dry pack or other material approved by COR or BIA Representative.
  4. Finish F3:
    - a. Applies to formed surfaces with special appearance requirements, such as surfaces exposed to view, and not required to receive finish F4, as specified in schedule below.
    - b. Within 24 hours of removing the forms perform required patching and correction of imperfections then, sack rub surface as follows:
      - 1) Thoroughly wet surface and sack rub while surface is still damp.
      - 2) Use mortar consisting of 1 part cement; 2 parts, by volume, of sand passing a No. 16 screen; and enough water so that mortar has consistency of thick cream. Blend standard cement with white cement as necessary to obtain a color which will match surrounding concrete surface.
      - 3) Thoroughly rub mortar over area with clean burlap or a sponge rubber float to fill pits, bugholes, and other defects.
      - 4) While mortar in pits is still plastic, rub surface with a dry mix of above proportions and material to remove excess plastic material and place enough dry material in the pits to stiffen and solidify mortar so that filling will be flush with surface. Remove material remaining on surface except material within pits.
      - 5) Continue curing surface as specified.
  5. Finish F4:
    - a. Applies to formed surfaces with accurate alignment and evenness of surface requirements to eliminate destructive effects of water as specified in Table 03 30 00E – Formed Surfaces.
- E. Unformed Surfaces:
1. Do not use dry cement or additional water during troweling. The surface shall not be excessively troweled.
  2. Do not use “jitterbugs” or other special tools designed for the purpose of forcing coarse aggregate away from the surface.
-

3. Finish class is designated by symbols U1, U2, and U3.
4. Finish U1 (Screeded Finish):
  - a. Applies to unformed surfaces to be covered by fill material, grout, or concrete as specified in schedule below.
  - b. Use as first stage of finish U2 and U3.
  - c. Level and screed concrete to produce even uniform surfaces.
5. Finish U2 (Floated Finish):
  - a. Applies to unformed surfaces not permanently concealed by fill material, grout, or concrete, and not required to receive finish U3, as specified in Table 03 30 00F – Unformed Surfaces.
  - b. Place, consolidate, strike off, and level concrete with a bullfloat, darby, or highway straightedge, eliminating high and low spots, and screed marks. Do not work concrete further until it is ready for finishing by use of a float.
  - c. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared, and the surface has stiffened sufficiently to permit the operation.
  - d. Produce a finish that will meet tolerance requirements, then refloat the slab immediately to a uniform texture.
  - e. Finish surface with minimum floating necessary to produce a surface that is free of screed marks and is uniform in texture.
  - f. Use as second stage of finish U3. Continue until a small amount of mortar without excess water is brought to the surface, so as to permit effective troweling.
6. Finish U3 (troweled finish):
  - a. Immediately after concrete has received a U2 floated finish.
  - b. Air entrained concrete cannot be finished with a steel trowel or fresno.
  - c. Applies to unformed surfaces where appearance and porosity is considered by BIA to be of special importance as specified in Table 03 30 00F – Unformed Surfaces.
  - d. Begin steel troweling after bleed water has disappeared and floated surface has sufficiently hardened to prevent an excess of fine material from being drawn to surface.
  - e. Trowel with firm pressure to flatten sandy texture of floated surface.
  - f. Trowel to a dense uniform surface free from blemishes and trowel marks.
7. Broomed finish:
  - a. Immediately after concrete has received a U2 floated finish.

- b. Edge transverse joints before brooming.
  - c. Produce a scored surface by brooming with a -bristle brush in a direction transverse to that of the traffic with adjacent strokes slightly overlapping.
  - d. Finished surface shall have a uniform appearance and shall be free of abrupt corrugation exceeding 1/8-inch in depth.
  - e. Brooming shall eliminate the flat surface left by the surface face of the edger.
  - f. Air entrained concrete cannot be finished with a steel trowel or fresno prior to applying a broomed finish.
8. Slope interior surfaces for drainage where shown on drawings or as directed by COR or BIA Representative. Slope surfaces exposed to the weather for drainage as directed by COR or BIA Representative.
  9. Slope narrow surfaces, such as tops of walls and curbs, approximately 3/8-inch per foot of width, unless use of other slopes or level surface is indicated on drawings or is directed by the COR or BIA Representative.
  10. Slope broader surfaces; such as walks, platform, and decks; approximately 1/4-inch per foot unless use of other slopes or level surfaces is indicated on drawings or is directed by the COR or BIA Representative.

### **3.06 JOINTS AND EDGES**

#### **A. Construction joints (CJ):**

1. Construction joints are joints which are purposely placed in concrete to facilitate construction, reduce initial shrinkage stresses and cracks, allow time for installation of embedded metalwork, or allow for subsequent placing of other concrete.
2. Bond is required at construction joints regardless of whether or not reinforcement is continuous across joint.
3. Locate construction joints where shown on drawings or approved by COR or BIA Representative.
4. Relocation, addition, or elimination of construction joints will be subject to approval by COR or BIA Representative.
5. Clean, roughen, and surface dry surfaces of construction joints to be covered with fresh concrete. See Preparation article.
6. Do not use a mortar layer on construction joints.

#### **B. Contraction joints (Cr. J):**

1. Contraction joints are joints placed in concrete to provide for volumetric shrinkage of a monolithic unit or movement between monolithic units.
2. Construct contraction joints so no bond exists between concrete surfaces forming the joint.

- a. Construct contraction joints by placing concrete on one side of joint and allowing it to set before concrete is placed on other side of joint.
  - b. Coat surface of concrete first placed at contraction joint with curing compound that prevents bond before placing concrete on other side of joint.
  3. Except as provided for dowels, reinforcement is never continuous across a contraction joint.
- C. Partial Control Joints (Partial Cr. J):
1. Partial control joints are joints placed in concrete to provide dissipate shrinkage and control cracking.
  2. Construct joints so that up to a maximum of 50 percent of the reinforcing steel is continuous through the joint. No bond breaker shall be applied between concrete placements.
  3. Waterstop is required at partial contraction joints as indicated on the drawings.
- D. Control Joints (CTJ):
1. Control joints are joints placed in concrete to provide for control of initial shrinkage stresses and cracks of monolithic units.
  2. Construct control joints same as contraction joints above, except make reinforcement continuous across control joints.
- E. Expansion joints (EJ):
1. Cut sponge rubber joint filler to size and shape of joint surface to receive filler.
  2. Adhere filler to concrete in accordance with adhesive manufacturer's recommendations.
  3. Butt sections of filler with tight-fitting butt joints to prevent mortar from seeping through joint.
- F. Saw Cut Joints:
1. Saw cut joints shall be completed within 24 hours following concrete placement.
  2. Joints shall have straight, sharp edges and cut to the minimum width possible with the type of saw used.
  3. The minimum depth of saw cuts shall be 1/4 of the depth of the concrete unless otherwise indicated on the drawings.
- G. Edges:
1. Chamfer edges of permanently exposed concrete, except slabs and top edges of curbs, with a 45 degree bevel 3/4-inch by 3/4-inch; unless otherwise shown of drawings.



H. Tooled Edges: Tool exposed edges of slabs and top edges of curbs to a radius of 1/4-inch.

I. Preformed joints consisting of plastic or metal strips not allowed.

### **3.07 STRUCTURAL DEVIATIONS AND SURFACE TOLERANCES**

A. Structural deviations are defined as allowable variations from specified lines, grades, and dimensions.

B. Surface tolerances are defined as maximum allowable magnitude of surface irregularities.

C. Specified structural deviations and surface tolerances are consistent with modern construction practice and governed by effects that permissible variations may have upon a structure. COR and BIA Representative reserves the right to diminish specified structural deviations and surface tolerances where such variations impair structural action, operational function, or architectural appearance of a structure or portion of structure.

D. Construct concrete within stated variations even though more than one may be specified.

1. Specified variation for one element of a structure will not apply when it will permit another element of same structure to exceed its allowable variation.

2. Where variations are not specified or shown on drawings for a particular structure, variations shall be those specified for similar work. As an exception to clause at FAR 52.236-21 "Specifications and Drawings for Construction," specific tolerances shown on drawings in connection with any dimension shall govern.

E. Structural Deviations:

1. Check variations from specified lines, grades, and dimensions in hardened concrete to determine that structures are within tolerances specified in Table 03 30 00B – Deviations from Specified Lines, Grades, and Dimensions.

2. Variation is distance between actual position of structure or any element of structure and specified position in plan for structure or particular element.

a. Plus or minus variations, shown as (+/-), indicate a permitted actual position up or down and in or out from specified position in plan.

b. Variations not designated as (+) or (-) indicate maximum deviation permitted between designated successive points on completed element of construction.

3. Specified position in plan is defined as lines, grades, and dimensions described in these specifications, shown on drawings, or prescribed by COR or BIA Representative.

Table 03 30 00B - Deviations from Specified Lines, Grades, and Dimensions

A. DAM STRUCTURES		
1.	Footings for walls and similar members:	
(a)	Variation in length and width of dimensions from those specified.....	-1/2 inch +2 inches
(b)	Horizontal misplacement or eccentricity .....	2 percent of footing width indirection of misplacement but not more than 2 inches
(c)	Reduction in thickness from that specified.....	5 percent of specified thickness not to exceed 1 inch
2.	Variation of controlling dimensions for each structure from specified position in plan with reference to dam axis:	
(a)	Overall dimensions.....	Exposed: ±1 inch Buried: ±2-1/2 inches
3.	Variation from centerline specified in plan for spillway:	
(a)	For overall length, except for buried construction...	±1 inch
(b)	For buried construction.....	± 2 inches
(c)	For any span less than 20 feet except for buried construction.....	±1/2 inch
4.	Variation from specified grade for spillway:	
(a)	For ogee crest of uncontrolled hydraulic structures .....	±1/2 inch
(b)	For all other surfaces.....	±1 inch
(c)	For any span less than 10 feet.....	1/2 inch

Table 03 30 00B - Deviations from Specified Lines, Grades, and Dimensions

5.	Variation from plumb, specified batter, or specified curved profile for lines and surfaces of walls, vertical joint grooves, and arrises:
(a)	Exposed construction, when overall height of line or surface is:
	Less than 10 feet ..... $\pm 1/2$ inch
	10 feet or more ..... $\pm 3/4$ inch
(2)	For any two successive intermediate points on the line or surface separated by:
	10 to 20 feet, inclusive ..... $1/2$ inch
	More than 20 feet ..... $3/4$ inch
(b)	Buried construction:
(1)	When overall height of line or surface is:
	Less than 10 feet ..... $\pm 1$ inch
	10 feet or more ..... $\pm 1-1/2$ inch
(2)	For any two successive intermediate points on the line or surface separated by:
	10 to 20 feet, inclusive ..... 1 inch
	More than 20 feet ..... $1-1/2$ inch

Table 03 30 00B - Deviations from Specified Lines, Grades, and Dimensions

6.	Variation from level or specified grades for slabs, horizontal joint grooves, and arrises:	
	(a) Exposed construction:	
	(1) When overall length of line or surface is:	
	Less than 10 feet .....	±1/4 inch
	10 feet or more .....	±1/2 inch
	(2) For any two successive points on the line or surface separated by:	
	10 to 20 feet, inclusive .....	1/4 inch
	More than 20 feet.....	1/2 inch
	(b) Buried construction:	
	(1) When the overall length of line or surface is:	
	Less than 10 feet .....	±1/2 inch
	10 feet or more .....	±1 inch
	(2) For any two successive points on the line or surface separated by:	
	10 to 20 feet, inclusive .....	1/2 inch
	More than 20 feet.....	1 inch
7.	Variation in the thickness of slabs, walls, and similar members from that specified.....	-1/4 inch +1/2 inch
8.	Variation in location from specified position in plan of sleeves, floor openings, and wall openings.....	±1/2 inch
9.	Variation in sizes from those specified for sleeves, floor openings, and wall openings.....	±1/4 inch

F. Surface Irregularities:

1. Bulges, depressions, and offsets are defined as surface irregularities or roughness.
2. Surface irregularities are classified as “abrupt” or “gradual” and allowable tolerances are specified in Table 03 30 00D – Surface Tolerances.
  - a. A surface tolerance is designated by a capital “T” followed by a number 1 through 5.
  - b. Surface tolerance designations are separate from surface finishes and structural deviations.

3. Abrupt surface irregularities:
  - a. Abrupt surface irregularities are defined as offsets such as those caused by misplaced or loose forms in which maximum dimension of irregularity perpendicular to surface is greater than maximum dimension of irregularity in plane of surface.
  - b. Abrupt surface irregularities include all incidences of isolated surface irregularities which exceed specified gradual irregularities.
4. Gradual surface irregularities:
  - a. Gradual surface irregularities are defined as bulges and depressions resulting in gradual changes on surface.
  - b. Gradual surface irregularities are further defined as isolated undulations on surface. Maximum dimension of undulation perpendicular to surface is small relative to maximum dimension of undulation in plane of surface.
5. Check magnitude of surface irregularities of formwork and finished surfaces to ensure that surfaces are within specified tolerances.

G. Surface Tolerances:

Table 03 30 00D - Surface Tolerances

Concrete surface	Maximum allowable surface irregularity tolerance	
	Abrupt	Gradual
T1	1 inch	1/4 inch/inch
T2	1/2 inch	1/8 inch/inch
T3	1/4 inch	1/16 inch/inch
T4	1/8 inch	1/32 inch/inch
T5	1/32 inch	1/120 inch/inch

- H. Repair of hardened concrete not within specified tolerances:
1. Repair hardened concrete which is not within specified tolerances to bring it within those tolerances.
  2. Perform repair after consultation with a BIA inspector regarding method of repair. Notify COR and BIA Representative as to time when repair will be performed.
  3. Repair concrete which will be exposed to view in a manner which will result in a concrete surface with uniform appearance.
    - a. When grinding surfaces exposed to view, limit depth of grinding such that no aggregate particles are exposed more than 1/16-inch in cross section at finished surface.

- b. Where grinding has caused or will cause exposure of aggregate particles greater than 1/16-inch in cross section at finished surface, repair concrete by excavating and replacing concrete.

I. Field Verification of Surface Tolerances:

1. Determine compliance of a surface with specified surface tolerances.
2. Evaluate surface roughness.
  - a. Measure roughness height or depth and check for compliance with values specified in Table 03 30 00D - Surface Tolerances and Table 03 30 00C – Deviations from Specified Lines, Grades, and Dimensions.
  - b. When measured height or depth of roughness is less than value in abrupt tolerance specification and height or depth of roughness does not cause structure to exceed any applicable value specified in Table 03 30 00C – Deviations from Specified Lines, Grades, and Dimensions, surface roughness is acceptable.
  - c. When roughness height or depth exceeds abrupt tolerance specification, determine roughness slope for comparison to gradual tolerance specification.
    - 1) Measure roughness length and determine roughness slope by dividing roughness height or depth by roughness length (see Figure 1).
    - 2) When roughness slope is greater than slope specified by gradual tolerance specification, surface roughness is unacceptable.
    - 3) When roughness slope is less than gradual slope specified and gradual roughness does not cause structure to exceed allowable structural deviations, surface roughness is acceptable.

J. Prevention of Repeated Failure to Meet Tolerances:

1. When concrete placements result in hardened concrete which does not meet specified tolerances, submit to COR and BIA Representative an outline of preventive actions such as modifications to forms, modified procedure for setting screeds, and different finishing techniques to be implemented to avoid repeated failures. Submit when requested by COR or BIA Representative.
2. BIA reserves the right to delay concrete placements until preventive actions which have been approved by COR or BIA Representative are implemented.

### 3.08 CURING

A. Water Curing:

1. Keep concrete surface wet for 14 days, minimum, from time concrete has attained sufficient set to prevent detrimental effects to surface.

2. Cure methods:
  - a. Water-saturated material.
  - b. System of perforated pipes, mechanical sprinklers, or porous hose.
  - c. Other methods which will keep surfaces wet.
  - d. Subject to approval by COR or BIA Representative.
- B. Curing with Curing Compound:
  1. Apply to concrete surface to provide a water-retaining film. Reapply as necessary to maintain a continuous, water-retaining film on surface for 28 days.
  2. Thoroughly mix compound and spray apply in one coat to provide a continuous, uniform film over surface.
  3. Do not exceed manufactures recommended coverage rate. Decrease coverage rate on rough surfaces as necessary to obtain required continuous film.
  4. Ensure ample coverage on edges, corners, and rough surfaces.
  5. Spray equipment and equipment performance will be subject to approval by COR or BIA Representative. Repair or replace equipment when directed by COR or BIA Representative.
  6. Use personnel qualified in using specified spray technique, as determined by COR or BIA Representative, to perform application.
- C. Polyethylene Film or White Burlap-Polyethylene Sheeting Curing Method:
  1. Thoroughly moisten concrete surface by lightly spraying with water as soon as concrete has hardened sufficiently to prevent damage.
  2. Completely cover concrete surface with polyethylene film to provide an airtight, water-retaining film over entire surface.
  3. Lap edges of polyethylene sheets to seal adjacent sheets.
  4. Place tightly against concrete surface at extreme edge of curing area.
  5. Secure film to withstand wind and prevent circulation of air inside curing film.
  6. Keep surface covered for 14 days, minimum.

### **3.09 PROTECTION**

- A. Protect concrete from damage until final acceptance by COR or BIA Representative.
  1. Do not load, remove forms or shoring, or backfill against concrete until concrete has gained sufficient strength to safely support its weight and imposed loads.
  2. Protect fresh concrete against erosion from rain, hail, sleet, or snow; contamination from foreign materials; and damage from foot traffic until the concrete has hardened.

3. Protect concrete from heavy foot traffic and other construction activities by covering with plywood or other suitable material. Remove and dispose of temporary covering when no longer required.
- B. Protect Concrete when Freezing Temperatures are Imminent:
1. Maintain concrete at a temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater for 72 hours, minimum, after placement. Vent heater and prevent concrete from drying where artificial heat is employed.
  2. Protect concrete from freezing during water curing. After discontinuance of water curing, maintain at a temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater for next 72 hours.
  3. Discontinue protection against cold weather such that the drop in temperature of the concrete will be gradual and will not exceed 5 degrees Fahrenheit per hour and 40 degrees Fahrenheit in 24 hours for thin sections, and 5 degrees Fahrenheit per hour and 20 degrees Fahrenheit in 24 hours for massive sections greater than 36 inches.

### 3.10 REPAIR

- A. Repair concrete in accordance with USBR M-47.
- B. Use repair or replacement method directed by COR or BIA Representative.

### 3.11 FINISH, SURFACE TOLERANCES, AND CURING SCHEDULES

Table 03 30 00E - Formed surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Surfaces upon or against which fill material will be placed	F1	T1	Water, White wax-base, or white water-emulsified resin-base curing compound
Surfaces not permanently concealed by fill material or concrete where appearance is not critical	F2	T3	Water, White wax-base, or white water-emulsified resin-base curing compound
Construction joints and surfaces to be covered by grout	F1	T3	Water, White wax-base curing compound
Expansion joints	F2	T3	Water, White wax-base or white water-emulsified resin-base curing compound



Table 03 30 00E - Formed surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Contraction joints	F2	T3	White wax-base curing compound
Concrete in contact with water	F2	T3	Water, Aquatic Curing Compound

Table 03 30 00F - Unformed surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Surfaces to be covered by fill material or concrete	U1	T1	Water White wax-base or white water-emulsified resin-base curing compound Polyethylene film
Concrete in contact with water	U2	T3	Water, Aquatic Curing Compound
Spillway slabs	U2 Plus broom finish	T3	Water White wax-base or white water-emulsified resin-base curing compound Polyethylene film

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor is responsible for field quality control. Contractor shall engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified herein.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
    - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
  7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
    - a. Test two field-cured specimens at 7 days and two at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to COR and BIA Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Work identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by COR and BIA Representative but will not be used as sole basis for approval or rejection of concrete.
- F. Moisture Vapor Emission Test: Standard test method meeting ASTM F 1869.
- G. Alkalinity (pH Level) Testing: Standard test required for floor slabs and all wall and ceiling surfaces to receive painted finishes.
- H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other

requirements have not been met, as directed by COR or BIA Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by COR or BIA Representative.

**END OF SECTION**

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**SECTION 03 63 00**  
**EPOXY GROUT FOR METAL WORK**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. Include in prices offered in the schedule for items of work requiring epoxy grout.

**1.02 REFERENCE STANDARDS**

A. ASTM International (ASTM)

- |    |                   |  |
|----|-------------------|--|
| 1. | ASTM C 307        | Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing, and Polymer Concretes                                   |
| 2. | ASTM C 531        | Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes |
| 3. | ASTM C 579        | Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes                                   |
| 4. | ASTM C 580        | Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes           |
| 5. | ASTM D 696        | Coefficient of Linear Thermal Expansion of Plastic Between -30 degree C and 30 degree C with a Vitreous Silica Dilatometer               |
| 6. | ASTM D 732        | Shear Strength of Plastics by Punch Tool   |
| 7. | ASTM C 882/C 882M | Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear   |
| 8. | ASTM C 884/C 884M | Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear   |
| 9. | ASTM D 2240       | Rubber Property-Durometer Hardness   |

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.

- B. RSN 03 63 00-1, Approval Data:
  - 1. Grout manufacturer's product data.
  - 2. Grout manufacturer's environmental, product storage, preparation, mixing, installation and curing instructions.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver epoxy materials to jobsite in manufacturer's original unopened packaging with labels and seals intact.
- B. Store epoxy materials in protected area in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 EPOXY GROUT**

- A. Three-part flowable epoxy grout; resin, hardener, and aggregate filler.
  - 1. Pro-Poxy 2000, Manufactured by Unitex, 3101 Gardner Avenue, Kansas City, MO 64120, telephone 800-821-5846, Website: [www.unitex-chemicals.com](http://www.unitex-chemicals.com) or equal, having following essential characteristics:
    - a. ASTM C 579 Compressive Strength @ 7 days: 13,430 pounds per square inch.
    - b. ASTM C 579 Compressive Strength @ 14 days: 16,793 pounds per square inch (modified cure schedule).
    - c. ASTM C 579 Compressive Modulus: 2,156,000 pounds per square inch.
    - d. ASTM C 531 Coefficient of Thermal Expansion Temperature:  $23 \times 10^{-6}$  in/in/degrees Fahrenheit.
    - e. ASTM D 696 Coefficient of Thermal Expansion:  $7.4 \times 10^{-6}$ /degrees Celsius.
    - f. ASTM C 307 Tensile Strength @ 14 days: 2,418 pounds per square inch.
    - g. ASTM C 580 Flexural Strength @ 14 day: 5,304 pounds per square inch.
    - h. ASTM C 580 Flexural Modulus @ 14 days: 1,779,000 pounds per square inch.
    - i. ASTM C 882 Bond Strength @ 14 days: 3,620 pounds per square inch.
    - j. ASTM D 732 Shear Strength: 1,929 pounds per square inch.
    - k. ASTM D-2240 Hardness, Shore D: 91.
    - l. Pot Life: 3 hours @ 75 degrees Fahrenheit.
    - m. Shelf Life: 2 years.
- B. Aggregate filler as recommended by manufacturer.

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## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Mix and install epoxy grout in accordance with manufacturer's instructions to completely fill space to be grouted.
1. Concrete shall be a minimum of 28 days old.
  2. Clean and roughen concrete surfaces.
  3. Remove dirt, dust, oil, grease, debris, paint, curing compounds, sealers, and unsound concrete.
  4. Mechanically prepare concrete surfaces in accordance with manufacturer's instructions to give surface profile of a minimum of 1/8-inch (3 mm) and expose coarse aggregate of concrete.
  5. Concrete shall have an open surface texture.
- B. Placement:
1. Place epoxy grout at air temperature between 50 degrees Fahrenheit (4 degrees Celsius) and 90 Degrees Fahrenheit (32 degrees Celsius).
  2. Bring materials to be epoxied to 70 +/- 2 degrees Fahrenheit (21 degrees Celsius).
  3. Do not place epoxy grout over frozen concrete.
  4. Mix epoxy grout components in accordance with manufacturer's instructions and technical data sheet.
  5. Place epoxy grout in accordance with manufacturer's instructions.
  6. Finish surface of epoxy grout in accordance with manufacturer's instructions.
- C. Protection:
1. Protect placed epoxy grout from damage during construction.
  2. Maintain epoxy grout at a temperature of 50 degrees Fahrenheit or greater for 72 hours, minimum, after placement unless otherwise recommended by manufacturer. Vent heater and prevent epoxy grout from drying where artificial heat is used.
  3. Discontinue protection against cold weather such that the drop in temperature of the epoxy grout will be gradual and will not exceed 5 degree Fahrenheit per hour and 40 degree Fahrenheit in 24 hours.
  4. The more stringent of the epoxy grout manufacturer's recommendation or these specifications shall apply.
  5. Initial loading:
    - a. Loads shall not be applied to the epoxy grout sooner than 72 hours after placement and shall be applied only after the epoxy grout has attained a compressive strength of at least 3,000 pounds per square inch.

- b. The time required for the epoxy grout used to attain this strength will be determined by the COR or BIA Representative.
  - c. Care shall be taken when applying loads on the hardened epoxy grout, and the Contractor shall be responsible for any damage thereto resulting from impact loads when positioning equipment or metalwork.
- D. Protect from movement until epoxy grout has fully cured.

**END OF SECTION**



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**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Miscellaneous Metalwork:

1. Payment: Lump sum price offered in the schedule.
  - a. Does not include pipe gates. Refer to Section 32 31 10 – Security Gates and Fencing.
  - b. Does not include pullboxes. Refer to Section 26 05 19 – Electrical Conduit.
  - c. Does not include access hatch, ladder, grab bar, grating and supports, air vent steel pipe, and weir plate for inspection wells. Refer to Section 31 09 12 – Instrumentation.

B. List of Metal Fabrications covered by this section:

1. Intake and Outlet Structures:
  - a. Gratings and trashracks.
  - b. Seat angles and support beams for gratings.
  - c. Barriers.
  - d. Staff Gauge
2. Meter Box:
  - a. Access hatch.
3. Ladders
  - a. Compatible with inspection well covers.
  - b. Compatible with roof hatches.
  - c. Hand rails for ladders.
4. EWS Structure:
  - a. Grating.

**1.02 REFERENCE STANDARDS**

A. Aluminum Association (AA)

1. AA ADM Aluminum Design Manual

B. American Institute of Steel Construction (AISC)

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|----|----------|--|
| 1. | AISC 325 | Steel Construction Manual - 13th Edition |
|----|----------|--|
- C. American Society of Mechanical Engineers (ASME)
- |    |              |   |
|----|--------------|---|
| 1. | ASME B1.1    | Unified Inch Screw Threads (UN and UNR Thread Form)   |
| 2. | ASME B18.2.1 | Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series) |
- D. ASTM International (ASTM)
- |     |                   |  |
|-----|-------------------|--|
| 1.  | ASTM A 36/A 36M   | Carbon Structural Steel  |
| 2.  | ASTM A 53/A 53M   | Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless   |
| 3.  | ASTM A 108-07     | Steel Bar, Carbon and Alloy, Cold-Finished   |
| 4.  | ASTM A 123/A 123M | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products  |
| 5.  | ASTM A 153/A 153M | Zinc Coating (Hot-Dip) on Iron and Steel Hardware  |
| 6.  | ASTM A 193/A 193M | Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications |
| 7.  | ASTM A 307        | Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength  |
| 8.  | ASTM A 385/A 385M | Providing High-Quality Zinc Coatings (Hot-Dip)   |
| 9.  | ASTM A 500/A 500M | Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes  |
| 10. | ASTM A 501        | Hot-Formed Welded and Seamless Carbon Steel Structural Tubing  |
| 11. | ASTM A 666        | Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar   |
| 12. | ASTM A 563        | Carbon and Alloy Steel Nuts  |
| 13. | ASTM A 780/A 780M | Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings  |
| 14. | ASTM A 786/A 786M | Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates  |
| 15. | ASTM A 992/A 992M | Structural Steel Shapes  |
| 16. | ASTM B 209        | Aluminum and Aluminum-Alloy Sheet and Plate  |
| 17. | ASTM B 221        | Aluminum and Aluminum-Alloy Extruded Bars,Rods, Wire, Profiles, and Tubes  |
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- 18. ASTM D 412 Vulcanized Rubber and Thermoplastic Elastomers – Tension
  - 19. ASTM D 2240 Rubber Property - Durometer Hardness
  - 20. ASTM F 436 Hardened Steel Washers
  - 21. ASTM F 844 Washers, Steel, Plain (Flat), Unhardened for General Use
- E. American Welding Society, Inc. (AWS)
- 1. AWS D1.1/D1.1M Structural Welding Code – Steel
- F. Commercial Item Description (CID)
- 1. CID A-A-1923A Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
- G. Federal Specifications (FS)
- 1. FS RR-C-271D(1) Chains and Attachments, Welded and Weldless
- H. International Code Council (ICC)
- 1. ICC ES AC 308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete, November 2009
  - 2. ICC IBC – 2012 International Building Code
- I. National Association of Architectural Metal Mfrs. (NAAMM)
- 1. NAAMM 531 Metal Bar Grating Manual
- J. Society of Protective Coatings (SSPC)/NACE International (NACE)
- 1. SSPC SP6/NACE NO.-3 Commercial Blast Cleaning

### **1.03 DEFINITIONS**

- A. Miscellaneous Metalwork: Where either shown on the drawings or specified elsewhere in this section or these specifications, “miscellaneous metalwork” means metal fabrications as used in this section.

### **1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- 1. RSN 05 50 00-1, Approval Drawings and Data:
    - a. Detail shop and erection drawings:
      - 1) In COR Format.

- 2) Show dimensions, type, grade of materials, fabrication details, and coatings.
  - 3) Show bill of material, including description, size, length, weight, and number of pieces required.
  - 4) Include marking and positioning for members and joints, anchorage details, field fabrications, and installation details.
- b. Product Data:
- 1) Adhesive anchors:
    - a) Include manufacturer's certification that adhesive, threaded rods, nuts, and washers meet specified requirements.
    - b) Manufacturer's preparation and installation instructions.
2. RSN 05 50 00-2, Final Drawings:
- a. Detail shop and erection drawings with revisions and changes shown through completion of fabrication.

## **1.05 QUALIFICATION OF WELDERS**

- A. Qualify welders in accordance with AWS D1.1 and AWS D1.2 using procedures, materials, and equipment of the type required for the work.

## **1.06 DELIVERY, STORAGE, AND PROTECTION**

- A. Protect from corrosion, deformation, and other types of damage.
- B. Store items in an enclosed area free from contact with soil and weather.
- C. Remove and replace damaged items with new items.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Aluminum: ASTM B 209, alloy 6061-T6 (plates) and ASTM B 221, alloy 6061-T6 (shapes, tubes).
- B. Arc-Welding Electrodes:
  1. Use filler metal and shielding gases suitable for base materials, positions, and other conditions.
  2. Filler metal and required shielding gases or fluxes: AWS D1.1 and AWS D1.2.
  3. Use filler metal with a minimum tensile strength of 70,000 pounds per square inch for steel.

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4. Aluminum alloy filler metal: AWS classification 4043.
- C. Structural Steel:
1. Channel and angle sections: ASTM A 36.
  2. Pipe sections: ASTM A 53 Grade B
  3. Hollow structural shapes: ASTM A 500 Grade B
  4. Wide flange sections: ASTM A 992.
  5. Plates and bars: ASTM A 36.
- D. Bolts, Nuts, and Washers:
1. Nuts: ASTM A 563.
  2. Washers:
    - a. Unhardened for general use: ASTM F 436.
  3. Bolts:
    - a. ASTM A 307, except studbolts.
    - b. Length of bolt threads: ASME B18.2.1.
    - c. Thread class: 2 free-fit, American National coarse-thread series.
- E. Steel Floor Plate: ASTM A 786, pattern 1, 2, 3, or 4, with material conforming to ASTM A 36.
- F. Grating: NAAMM MBG 531, aluminum, as shown on drawings.
1. Welded grating (steel) or press-locked grating (aluminum).
  2. Where safety grating is required, provide serrated-edge grating.
  3. Banding bar: Same size as bearing bars for both steel and aluminum grating.
  4. Provide banding bars around cut portions of grating.
- G. Steel Pipe: ASTM A 53, type E or S, grade B.
1. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
  2. BIA inspection at the mill and hydrostatic tests will not be required.
- H. Neoprene Gaskets:
1. Hardness: ASTM D 2240, "A" durometer 60 plus or minus 10.
  2. Tensile strength, minimum: 1,200 pounds per square inch when tested in accordance with ASTM D 412.
  3. Elongation, minimum at break: 300 percent when tested in accordance with ASTM D 412.
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4. Bond gasket to metal with manufacturer's standard adhesive.
- I. Stainless Steel Weir Plates: ASTM A 666, Type 304.
  - J. Cover Hinges: Blank, surface mount aluminum 4" x 4" x 0.12, with nonremovable pin, equal to McMaster-Carr No. 1609A23.
  - K. Foam Rubber Bulb Seals:
    1. EPDM foam rubber.
    2. Adhesive back.
    3. 5/8-inch overall width and 5/8-inch overall height with interior hole.
    4. Seals resist alkalis, acids, detergents, weather, salt, UV radiation, and ozone.
    5. Temperature range 20 to 150 degrees Fahrenheit.
  - L. Standard Door Sweeps:
    1. Type 304 stainless steel flange.
    2. Neoprene insert material.
  - M. Hinges:
    1. Load-rated forged steel with a load capacity of 1,000 pounds based on two hinges per door.
    2. Surface-mount right-hand mounting hinge without holes to install by welding.
    3. Security hinge with removable pin.
    4. Nonadjustable with bearings and an oil hole for lubricating the bearings.
  - N. Nonshrink Epoxy Grout: In accordance with Section 03 63 00 –Epoxy Grout for Metal Work.

## **2.02 SPLICE LOCKS**

- A. Model No. 923, as manufactured by Julius Blum Company, P.O. Box 816, Carlstadt, NJ 07072; TFCO splice lock No. SL-1 as manufactured by Thompson Fabrication Company, P.O. Box 170160, Birmingham AL 35217; splice locks as manufactured by Tri Tech, Incorporated, 5710 Harrison Avenue, Austell GA 30001; or equal, having the following essential characteristics:
  1. Weldless end-to-end connection of pipe guardrail.
  2. Internal expansion-type lock expanded by use of a set screw.

## **2.03 ANCHORS**

- A. Adhesive Anchors: Drilled type, installed with a chemical adhesive system.

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1. Seismic qualified per ICC IBC and ICC AC 308 for seismic design category A through F and cracked concrete conditions.
  2. Adhesive: HIT-RE 500-SD epoxy adhesive manufactured by HILTI, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
    - a. Injectable two-component epoxy adhesive.
    - b. Dual packaging system designed for automatic mixing during injection.
    - c. Weathering resistant.
    - d. Resistant against high temperatures.
    - e. Suitable for use in diamond cored or pneumatic drilled holes.
    - f. Extended temperature range from 41 degrees Fahrenheit to 120 degrees Fahrenheit.
  3. Threaded carbon steel anchor rod: HAS Super rod manufactured by HILTI, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
    - a. Rod material: ASTM A 193, Grade B7.
    - b. Thread: ASME B1.1, continuously threaded (all-thread).
    - c. Fabricate with 45-degree chisel point on one end to facilitate insertion into adhesive-filled hole.
    - d. Hot-dip galvanized.
  4. Standard steel nuts: ASTM A 563, Grade DH.
    - a. Hot-dip galvanized.
  5. Standard steel washers: ASTM F 436, Type 1.
    - a. Hot-dip galvanized.
- B. Expansion Anchors:
1. Not permitted for exterior use.
  2. CID A-A-1923, Type 4, galvanized steel, except use stainless steel expansion anchors for installing weir plates and grating supports in inspection wells.
  3. Bolt length: As shown on drawings. If not shown, provide bolt length with 3-1/2-inch minimum embedment.
- C. Headed Concrete Anchors: ASTM A 108.
1. Flux-filled ends suitable for end welding to steel with automatically timed stud-welding equipment.

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## 2.04 LADDERS

### A. Metal Safety Steps for Ladders:

1. "Tread-Grip" No. 11-gauge sheet steel ladder rungs, as manufactured by Morton Manufacturing Company, P.O. Box 640, Libertyville, IL 60048; "One Diamond Ladder Rung", as manufactured by GS Metals Corporation, P.O. Box 7, Pinckneyville, IL 62274; 1-inch-square "Mebac" solid ladder rungs, as manufactured by IKG Industries, 270 Terminal Avenue, Clark, NJ 07066; or equal, having the following essential characteristics:
  - a. Concentrated design load at center of rung: 200 pounds.
  - b. Raised button, serrated-edge, or metal bonded encapsulated grit surface.

### B. Safety Posts:

1. "Ladder-Up" ladder extensions as manufactured by The Bilco Company, P.O. Box 1203TR, New Haven, CT 06505; or equal, having the following essential characteristics:
  - a. High-strength galvanized steel.
  - b. Tubular section that provides upward and downward movement and locks automatically when fully extended in up position.
  - c. Upward and downward movement controlled by stainless steel springs.
  - d. Operates in corrosive environment.
2. Attach securely to ladder rungs.
3. Extend a minimum of 42 inches above walking surface.

## 2.05 FABRICATION

- A. Fabricate metalwork in accordance with AISC 316, AA ADM, and these specifications.
  1. Perform welding and related work in accordance with AWS D1.1 and AWS D1.2.
  2. Grind all welds on ladders and pipe guardrails smooth.
- B. If straightening is necessary, use methods that will not injure the metal.
- C. After shop work completion and before galvanizing, if required, clean material of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.
- D. Fabricate ladders and pipe guardrails from standard weight pipe with diameter shown on drawings.
- E. Galvanizing:



1. Galvanize items of metalwork as specified or shown on drawings. Use hot-dip galvanizing, where required after fabrication, in accordance with ASTM A 123 and ASTM A 385.
2. Galvanize bolts, anchors, nuts, and washers in accordance with ASTM A 153. Remove excess spelter by centrifugal spinning.
3. Fabricator's Galvanizing Repair:
  - a. Redip material with damaged galvanizing unless damage is local and can be repaired in accordance with ASTM A 780, using zinc-based alloy repair rods.
  - b. If the galvanized coating becomes damaged after being dipped twice, material will be rejected.
    - 1) Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Where locations and dimensions of miscellaneous metalwork shown on drawings are tentative or subject to change, dependent upon equipment furnished, confirm locations and dimensions prior to fabrication of miscellaneous metalwork.

### **3.02 INSTALLATION**

- A. Embedded Metalwork:
  1. Clean surfaces of metalwork to be in contact with or embedded in concrete in accordance with SSPC SP6/NACE NO.-3.
  2. Attach headed concrete anchors to the following metalwork items prior to embedment:
    - a. Angles for roof hatch covers.
    - b. Angles for door frame.
    - c. HSS frames for stationary louvers.
  3. Accurately locate metalwork to be embedded in concrete. Hold metalwork in correct position and alignment. Protect metalwork from damage and displacement during placing and setting of concrete.
  4. Unless otherwise specified, use only metal braces, supports, and other items to position and align embedded metalwork, which will be embedded in concrete. Do not use wooden braces, supports, or other items to position and align embedded metalwork if they will also be embedded in concrete.

B. Anchors:

1. Drill holes for anchors straight and true and of diameter recommended by anchor manufacturer.
2. Install anchors in accordance with manufacturer's recommendations.
3. Follow manufacturer's recommendations when embedded steel or reinforcement is encountered during drilling for anchors.
4. When drilling water is used, clean surfaces of concrete to remain exposed immediately to prevent discoloration.
5. Following drilling, clean holes with water to remove cuttings, followed by air to ensure holes are dry.

C. Installer's Galvanizing Repair:

1. Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.

D. Epoxy Grout:

1. Where shown on drawings, fill spaces under metalwork completely as required with nonshrink epoxy grout in accordance with Section 03 63 00 – Epoxy Grout for Metal Work.
2. Clean surfaces of metalwork to be in contact with or embedded in concrete or nonshrink grout in accordance with SSPC SP6/NACE NO.-3.

E. Holes in Metalwork:

1. Drill, or drill and tap as required, holes in metalwork required for installation.

**END OF SECTION**

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**SECTION 07 55 00**  
**MODIFIED BITUMEN MEMBRANE ROOF SYSTEM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Base Sheet Application
- B. Roof Membrane Application
- C. Roof Flashing Application

**1.02 RELATED SECTIONS**

- A. Section 07 62 00 - Sheet Metal Flashing and Trim

**1.03 REFERENCE STANDARDS**

- 1. American Society for Testing and Materials (ASTM).
- 2. Factory Mutual Engineering Research Corp. (FM).
- 3. National Roofing Contractors Association (NRCA).
- 4. Certified Roofing Torch Applicators (CERTA).
- 5. Occupational Safety and Health Administration (OSHA).
- 6. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- 7. Underwriters Laboratories (UL).
- 8. U.S. Environmental Protection Agency (US EPA).
- 9. U.S. Green Building Council (USGBC).

**1.04 SUBMITTALS**

- A. All submittals which do not conform to the following requirements will be rejected.
- B. Submittals Prior to Contract Award:
  - 1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.
  - 2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the Manufacturer's requirements in order to qualify the project for the specified guarantee.

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## 1.05 QUALITY ASSURANCE

- A. **Acceptable Products:** Provide primary roofing products, including each type of sheet, all manufactured in the United States, supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.
- B. **Product Quality Assurance Program:** Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001 audit process. A certificate of analysis for reporting/confirming the tested values of the actual material being supplied for the project will be required prior to project close-out.
- C. **Agency Approvals:** The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.
  - 1. Underwriters Laboratories Class C acceptance of the proposed roofing system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings.
  - 2. Factory Mutual Approval Standard 4470 listing for the proposed membrane system. The roof membrane configuration shall be approved by FM Global for Class 1-SH (severe hail) exposure. The roof shall be approved by FM Global for minimum 1-60 wind uplift construction.
- D. **Project Acceptance:** Submit a completed manufacturer's application for roof guarantee form along with shop drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain all the technical information applicable to the project including deck types, roof slopes, base sheet and/or insulation assemblies (with method of attachment, and fastener type), and manufacturer's membrane assembly proposed for installation. The form shall also contain accurate and complete information requested including proper names, addresses, zip codes and telephone numbers. The project must receive approval, through this process, prior to shipment of materials to the project site.
- E. **Scope of Work:** The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.
- F. **Local Regulations:** Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.

- G. **Manufacturer Requirements:** The primary roofing materials manufacturer shall provide direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conduct a final inspection upon successful completion of the project.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. **Delivery:** Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.
- B. **Storage:** Store materials out of direct exposure to the elements. Store roll goods on a clean, flat and dry surface. All material stored on the roof overnight shall be stored on pallets. Rolls of roofing must be stored on ends. Store materials on the roof in a manner so as to preclude overloading of deck and building structure. Store materials such as solvents, adhesives and asphalt cutback products away from open flames, sparks or excessive heat. Cover all material using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings are not acceptable.
- C. **Handling:** Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.
- D. **Damaged Material:** Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, removed and replaced at the Contractor's expense.

#### **1.07 PROJECT/SITE CONDITIONS**

- A. **Requirements Prior to Job Start**
1. **Notification:** Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
  2. **Safety:** Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.
- B. **Environmental Requirements**
1. **Precipitation:** Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.
  2. **Temperature Restrictions - asphalt:** At ambient temperatures of 40°F (4°C) and below, special precautions must be taken to ensure that the specified Type IV asphalt maintains a minimum acceptable 400°F (204°C) at the point of sheet application. The asphalt must not be overheated to compensate for cold conditions. The use of insulated handling equipment is strongly recommended.

Hot luggers, mop carts, and kettle-to-roof supply lines should be insulated. Hand mops should be constructed with a smaller yarn head to facilitate short moppings. Luggers and mop carts should never be more than half filled at all times.

3. Temperature Restrictions - cold adhesive: At low temperatures, the specified cold adhesive becomes more viscous, making even distribution more difficult. The optimal temperature of the adhesive at point of application is 70°F (21°C). To facilitate application when ambient temperatures are below 50°F (10°C), store the adhesive and roll goods in a warm place immediately prior to use. Roll or broom the sheets to ensure contact with the underlying adhesive. Suspend application in situations where the adhesive cannot be kept at temperatures allowing for even distribution.
4. Temperature Restrictions – self-adhesive sheets: The minimum required substrate temperature at point of application is 60°F (15°C). Maintain a minimum roof membrane material temperature above 60°F (15°C). In low temperature conditions, materials should be kept warm prior to application. Suspend application in situations where the self-adhered base ply cannot be kept at temperatures allowing for proper adhesion.

C. Protection Requirements

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.
2. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.
3. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.
4. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

**1.08 GUARANTEE**

- A. Roof System Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the roof system manufacturer's 10 year labor and materials roof system guarantee. The roof system guarantee shall include both the roofing and flashing membranes, and base sheet fasteners. All repair or replacement costs covered under the guarantee shall be borne by the roofing membrane manufacturer. The guarantee shall be a term type, without

deductibles or limitations on coverage amount, and be issued at no additional cost to the Owner. Specific items covered under the roof system guarantee include:

1. The actual resistance to heat flow through the roof insulation will be at least 80% of the design thermal resistance, provided that the roofing membrane is free of leaks;
2. Should a roof leak occur, the insulating performance of the roof insulation will be at least 80% of the design thermal resistance within a 2 year period following repair of the leak.
3. The roof insulation will remain in a reroofable condition should the roof membrane require replacement (excluding damage caused by fastener pullout during removal of the old membrane.)
4. The roof insulation material will not cause structural damage to the building as a result of expansion from thermal or chemical action.
  - a. Siplast 10-year Roof System Guarantee

## **PART 2 PRODUCTS**

### **2.01 DESCRIPTION OF SYSTEMS**

A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Both reinforcement mats shall be impregnated/saturated and coated each side with an SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that embosses the surface with a grooved pattern to provide optimum burn off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

1. Siplast Paradiene 20 TG/30 CR FR TG torchable roof system
2. Modified Bitumen Base and Stripping Ply
  - a. Thickness (avg): 114 mils (2.9 mm) (ASTM D 5147)
  - b. Thickness (min): 110 mils (2.8 mm) (ASTM D 5147)
  - c. Weight (min per 100 ft<sup>2</sup> of coverage): 76 lb (3.7 kg/m<sup>2</sup>)
  - d. Maximum filler content in elastomeric blend: 35% by weight

- e. Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
  - f. Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
  - g. Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
  - h. Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
  - i. Dimensional Stability (max): 0.1% (ASTM D 5147)
  - j. Compound Stability (min): 250°F (121°C) (ASTM D 5147)
  - k. Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
  - l. Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
3. Siplast Paradiene 20 - torchable grade
4. Modified Bitumen Finish Ply
- a. Thickness (avg): 110 mils (2.8 mm) (ASTM D 5147)
  - b. Thickness at selvage (coating thickness) (avg): 98 mils (2.5 mm) (ASTM D 5147)
  - c. Thickness at selvage (coating thickness) (min): 94 mils (2.4 mm) (ASTM D 5147)
  - d. Weight (min per 100 ft<sup>2</sup> of coverage): 75 lb (3.6 kg/m<sup>2</sup>)
  - e. Maximum filler content in elastomeric blend: 35% by weight
  - f. Low temperature flexibility @ -15° F (-26° C): PASS (ASTM D 5147)
  - g. Peak Load (avg) @ 73F (23C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
  - h. Peak Load (avg) @ 0F (-18C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
  - i. Ultimate Elongation (avg.) @ 73F (23C): 55% (ASTM D 5147)
  - j. Dimensional Stability (max): 0.1% (ASTM D 5147)
  - k. Compound Stability (min): 250F (121 C) (ASTM D 5147)
  - l. Solar Reflectance: = 0.70% (ASTM D 1549)
  - m. Thermal Emittance: = 0.80% (ASTM D 1371)
  - n. Approvals: UL Class listed (product shall bear seals of approval)
  - o. Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
  - p. Surfacing: white synthetic chips
    - 1) Siplast Paradiene 30 CR FR - torchable grade Cementitious Materials Options:



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## 2.02 ROOF ACCESSORIES

### A. Roofing Adhesives

1. Mopping Asphalt: Type IV asphalt certified for full compliance with the requirements listed in Table I, ASTM D 312. Each container or bulk shipping ticket shall indicate the equiviscous temperature, EVT, the finished blowing temperature, FBT, and the flash point, FP. Mopping asphalt shall be approved in writing by the roof membrane manufacturer.
  - a. Siplast PA-100 Asphalt by Siplast
2. Membrane Cold Adhesive: A blend of special adhesive asphalts and safe, high-flash, quick drying solvents that meets or exceeds ASTM D 4479, Type II requirements.
  - a. Siplast PA-311 Adhesive by Siplast
3. Membrane Cold Adhesive: A blend of special adhesive asphalts and safe, high-flash, quick drying solvents that meets or exceeds ASTM D 4479, Type II requirements.
  - a. Siplast PA-311 LS Adhesive by Siplast
4. Solvent-Free Membrane Adhesive: A single component, solvent-free modified asphalt adhesive designed for application of the specified roof membrane system.
  - a. Siplast SFT Adhesive by Siplast
5. Solvent-Free Flashing Adhesive: A single-component, solvent-free modified adhesive. The adhesive blend shall be formulated in a grade for application of flashing materials.
  - a. Siplast SFT Cement by Siplast

### B. Bituminous Cutback Materials

1. Primer: An asphalt/solvent blend meeting ASTM D 41, South Coast Air Quality District and Ozone Transport Commission requirements.
  - a. Siplast PA-917 LS Primer by Siplast
2. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D 41 requirements.
  - a. Siplast PA-1125 Asphalt Primer by Siplast
3. Primer for Self-Adhesive Sheets: A quick drying, low-VOC, water-based, high-tack primer specifically designed to promote adhesion of roofing and waterproofing sheets to approved substrates. Primer shall meet South Coast Air Quality District and Ozone Transport Commission requirements.
  - a. Siplast TA-119 Primer by Siplast

4. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.
  - a. Siplast PA-1021 Plastic Cement by Siplast
- C. Sealant: A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:
  1. Siplast PS-304 Elastomeric Sealant by Siplast

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.

### **3.02 SUBSTRATE PREPARATION**

- A. Base Sheet Securement to Prepared Substrate: Lay the base sheet over entire area to be roofed, lapping sides 3 inches and ends 6 inches. Using the specified fasteners, fasten each sheet every 9 inches through laps and stagger fasten the remainder of the sheet in 2 rows on nominal 12 inch centers with fasteners in each row on 12 inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% at the corners.
- B. Base Sheet Securement to Prepared Substrate: Lay the base sheet over entire area to be roofed, lapping sides 3 inches and ends 6 inches. Using the specified fasteners, fasten each sheet every 7 1/2 inches through laps and stagger fasten the remainder of the sheet in 2 rows on nominal 12 inch centers with fasteners in each row on 10 inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% at the corners.

### **3.03 Water Stops**

- A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.
- B. Aesthetic Considerations: Construction of an aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. synthetic chips), and exercise care in ensuring that the finished application is acceptable to the Owner.

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- C. Priming: Prime metal, concrete, wood walls and curbs, and masonry surfaces with a uniform coating of the specified primer.
  - D. Kettles and Tankers: Kettles and tankers shall be equipped with accurate, fully readable thermometers. Do not heat asphalt to or above its flash point. Avoid heating at or above the FBT, should conditions make this impractical, heating must be no more than 25°F below the EVT and no more than 25°F above EVT.
  - E. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525°F (274°C). Minimum application temperature shall be 400°F (204°C).
  - F. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 lb./square. Mopping shall be total in coverage, leaving no breaks or voids.
  - G. Membrane Adhesive Application: Membrane adhesive can be applied by roller, squeegee or spray unit. Apply cold adhesive in a smooth, even, continuous layer without breaks or voids. Utilize an application rate of 2 to 2 1/2 gal/sq (0.6 to 1.0 l/m<sup>2</sup>) over irregular or porous substrates. Utilize an application rate of 1 1/2 to 2 gal/sq (0.6 to 0.8 kg/m<sup>2</sup>) for interply applications. Double the adhesive application rate at the end laps of granule surfaced sheets. In the areas surrounding details that are to receive the catalyzed acrylic resin primer and flashing system, apply membrane plies in a full coating of the specified elastomeric sealant in lieu of the solvent based adhesive a minimum 8 inches from the base of the penetration or curb.
  - H. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
  - I. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.
    - 1. Apply all layers of roofing perpendicular to the slope of the deck.
    - 2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the \*[asphalt/torch/cold adhesive] applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
    - 3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the \*[asphalt/torch/cold adhesive] applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.

4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
- J. Flashing Application: Cut the cant backing sheet into 12 inch widths and peel the release film from the back of the sheet. Set the sheet into place over the primed substrate extending 6 inches onto the field of the roof area and 6 inches up the vertical surface utilizing minimum 3 inch laps. Set the non-combustible cant into place dry prior to installation of the roof membrane base ply. Flash walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, prime the base ply surfaces to receive the reinforcing sheet. Fully adhere the reinforcing sheet, utilizing minimum 3 inch side laps onto the primed base ply surface and up the primed wall or curb to the desired flashing height. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall or curb to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the vertical/horizontal surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers. (See manufacturer's schematic for visual interpretation).
- K. Catalyzed Acrylic Resin Flashing System: Install the liquid-applied primer and flashing system in accordance with the membrane system manufacturer's printed installer's guidelines and other applicable written recommendations as provided by the manufacturer.
- L. Water Cut-Off: At end of day's work, or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.
- M. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

### **3.04 FIELD QUALITY CONTROL AND INSPECTIONS**

- A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment and related items after completion of job.

- B. Notification of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.
- C. Final Inspection/Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.
- D. Issuance of the Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

**END OF SECTION**

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**SECTION 07 62 00**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section describes complete systems using proven details to exclude water from the building at copings, base flashings, parapet walls and other locations commonly closed by sheet metal.

**1.02 RELATED SECTIONS**

- A. Section 07 55 00 – Modified Bitumen Membrane Roof System

**1.03 REFERENCE STANDARDS**

1. Factory Mutual Engineering Research Corp. (FM).
  - a. FM Data Sheet 1-49: Perimeter Flashing
2. Sheet Metal and Air Conditioning Contractors's National Association, Inc. (SMACNA).
  - a. SMACNA Architectural Sheet Metal Manual

**1.04 SYSTEM DESCRIPTION**

- A. Allow for field adjustments for proper anchoring or joining to other items.
- B. The requirements shown by the details are intended to establish basic dimensions, profiles and sightlines. Within these limitations, the Contractor shall be responsible for the design of the sheet metal flashing and trim assemblies and may make whatever modifications of and additions to the details as may be required to prevent water and air penetration. Maintain the visual design concept as shown, including member sizes, profiles and alignment of components.
- C. Conform to criteria described in FM data sheets 1-49.

**1.05 SUBMITTALS**

- A. Submit the following.
1. RSN 07 62 00-1, Product Data:
    - a. Submit metal manufacturer's specifications, installation instructions and general recommendations for flashing and trim applications, with complete list of materials proposed for use.
  2. RSN 07 62 00-2, Shop Drawings:

- a. Show the manner of forming, jointing and securing the metal to form flashings and trim. Show waterproof connections to adjoining work and at obstructions and penetrations. Identify adjoining materials.
- b. Clearly identify design modifications recommended under System Description article above.

## **1.06 PROJECT CONDITIONS**

- A. Scheduling: Promptly cover exposed edges of completed roofing.

## **1.07 WARRANTIES**

- A. Extend the warranty for one year beyond the one-year warranty period.
- B. Submit written statement agreeing to above terms and conditions, signed by installer and Contractor.

## **PART 2 PRODUCTS**

### **2.01 SYSTEM PERFORMANCE**

- A. Performance Criteria:
  1. Sheet metal flashing and trim shall be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.
  2. Comply with fabrication details recommended by FM, SMACNA, NRCA and the requirements of the sheet metal flashing and trim manufacturer, and as shown on approved Shop Drawings.

### **2.02 MATERIALS**

- A. Sheet Metal Flashing and Trim:
  1. Stainless Steel Sheet metal flashing and trim: Provide 26 gage sheet stainless steel, Type 316, complying with ASTM A 666, with No. 2D dead soft, fully annealed finish, unless required to be harder temper for proper forming and performance for application indicated.
- B. Miscellaneous Materials:
  1. Burning Rod for Lead: Same composition as lead sheet.
  2. Solder for Stainless Steel: ASTM B 32, 60 percent tin and 40 percent lead alloy grade 60A, used with an acid flux of the type recommended by the stainless steel manufacturer. Use a non corrosive rosin flux over tinned surfaces.
  3. Stainless Welding Rods: Type recommended by stainless steel sheet manufacturer for the type of metal sheets furnished.



4. Nails, Screws and Rivets: Same material as flashing sheet, or as recommended by manufacturer of flashing sheet.
5. Cleats: Same metal and gage as sheet being anchored, 2-inches wide, punched for two anchors.
6. Bituminous Coating: SSPC Paint 12, cold applied solvent type bituminous mastic coating for application in dry film thickness of 15-mils per coat.
7. Sealants: Refer to Section 07 92 00, Joint Sealants.
8. Roofing Cement: Provide a medium to heavy trowel-grade, cut-back asphalt mastic roof cement reinforced with non-asbestos fibers, and containing petroleum solvents and special mineral stabilizers, complying with ASTM D 4586, Type II.
9. Base Flashing Felts: Asphalt-coated, polyester/glass scrim reinforced flashing sheet or as recommended by the manufacturer of the built-up bituminous roofing.

## **2.03 FABRICATION**

- A. Fabricated Metal Flashing: Shop-fabricate metal sheet metal flashing and trim to comply with profiles and sizes shown, and to comply with manufacturer's recommended details. Except as otherwise shown or specified, provide soldered flat lock seams, and fold back metal to form a hem on the concealed side of exposed edges. Comply with metal producers' recommendations for tinning, soldering and cleaning flux from metal.
- B. Where fabricator does not recommend grinding welds smooth, comply with SMACNA formed metal details requiring double-lock seamed construction.

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. Verify that substrates are smooth and clean to extent needed for sheet metal work.
- B. Verify that reglets, nailers, cants, and blocking, to receive sheet metal are installed and free of concrete and soil.
- C. Start sheet metal work only after conditions are satisfactory.

### **3.02 INSTALLATION**

- A. General:
  1. SMACNA Details: Except as otherwise shown or specified, comply with applicable recommendations and details of SMACNA's "Architectural Sheet Metal Manual."
  2. Manufacturer's Recommendations: Except as otherwise shown or specified, comply with the recommendations and instructions of the manufacturer of the sheet metal being installed.

3. Separate dissimilar metals as required to prevent electrolysis.
  4. Provide for thermal expansion of running trim, flashing, and other items exposed for more than 15'-0" continuous length.
  5. Install work with lines and corners of exposed units true and accurate, free of waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction. Provide uniform, neat seams with minimum exposure of solder. Fold back the sheet metal to form a hem on the concealed side of exposed edges.
  6. Conceal fasteners and expansion provisions wherever possible in exposed work, and locate so as to minimize the possibility of leakage. Cover and seal work as required for a watertight installation. Provide cleat-type anchorages for metal flashing and trim wherever practical, arrange to relieve stresses from building movement and thermal expansion.
  7. On vertical surfaces, lap flashings a minimum of 3 inches.
- B. Cleats:
1. Spaced Cleats: Space 2'-0" o.c. secure to substrate with 2 fasteners and cover heads with cleat tabs.
  2. Continuous Cleats: Secure to substrate with fasteners spaced 1 foot o.c.
- C. Soldering:
1. Clean and flux metals prior to soldering.
  2. Sweat solder completely through seam width.
- D. Roof Counterflashing:
1. Overlap base flashing 4 inches minimum.
  2. Install bottom edge tight against base flashing.
  3. Lap seam vertical joints 3 inches minimum, and apply sealant.
  4. Miter, lap seam, and close corner joints with solder, not sealant.
- E. S-Lock Seam Metal Siding (Wall Coverings):
1. Vertical Joints: S-Lock seams not over 24 inches o.c.; at least 6 inches from corners.
  2. Horizontal Seams: Not permitted in runs under 15 feet.
  3. Anchor seams to substrate with cleats not over 12 inches o.c.
  4. Overlap base flashing 4 inches minimum.
  5. Install bottom edge tight against base flashing.
- F. Copings:
1. Seams:

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- a. Coping seams (except corners): Provide butt joints with 12 inch long same gage backing sheet with matching profile and set coping in 1/4 inch wide sealant joint with back-up.
  - b. Space seams 8 feet apart maximum, but at least 2'-0" from shop soldered corners.
- 2. Lock exterior edges over continuous cleats secured to substrate.
  - 3. Install roof flange tight against roofing.
  - 4. Attach clips to substrate with concealed fasteners.
  - 5. Reinforce clips by double bending back over bottom edge of roof flange.
- G. Equipment Support Flashing:
- 1. Fully cap support.
  - 2. Overlap base flashing 4 inches.
  - 3. Solder-lap joint.
  - 4. Provide sealant around penetration through flashing.
- H. Flash other trades' work extending through roofing and sheet metal work.
- I. Provide other required sheet metal flashing and trim.

### **3.03 PROTECTION**

- A. Protect completed flashing and trim. Maintain such protection during installation of other work, and also for the remainder of the construction period: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.

**END OF SECTION**

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**SECTION 07 92 00**  
**CAULKING AND SEALANTS**

**PART 1 GENERAL**

**1.01 WORK INCLUDES**

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install joint sealants.
2. Extent of each type of caulking and sealant is shown or indicated and includes the following:
  - a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
  - b. Exposed-to-view joints.
  - c. Joints specified to be recaulked.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before joint sealants.
2. Coordinate final selection of joint sealants so that materials are compatible with all caulking and sealant substrates specified.

**1.02 RELATED SECTIONS**

- A. Section 07 55 00 – Modified Bitumen Membrane Roof System.
- B. Section 07 62 00 – Sheet Metal Flashing and Trim.

**1.03 REFERENCE STANDARDS**

1. ASTM International (ASTM):
  - a. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
  - b. ASTM C661, Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
  - c. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
  - d. ASTM C794, Test Method for Adhesion in Peel of Elastomeric Joint Sealants.

- e. ASTM C920, Specification for Elastomeric Joint Sealants.
  - f. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
  - g. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
  - h. ASTM C1193, Guide for Use of Joint Sealants.
  - i. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.
2. Bay Area Air Quality Management District (BAAQMD):
    - a. BAAQMD Regulation 8, Rule 51.
  3. FS TT S 00227, Sealing Compound: Elastomeric Type, Multi component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
  4. FS TT S 00230 Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
  5. National Science Foundation (NSF)
    - a. NSF/ANSI Standard 61, Drinking Water System Components - Health Effects.
  6. South Coast Air Quality Management District (SCAQMD):
    - a. SCAQMD Rule 1168.
  7. ASTM International (ASTM):
    - a. ASTM C510 Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.

#### **1.04 QUALITY ASSURANCE**

##### **A. Qualifications:**

1. Installer:
  - a. Engage a single installer, approved by product manufacturer, regularly engaged in caulking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.
2. Testing Laboratory:
  - a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

##### **B. Component Supply and Compatibility:**

1. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully

compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

- C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.
1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.
  2. Test other joint sealants for compliance using specified post-construction field adhesion test.
- D. Pre-installation Conference:
1. Prior to installing joint sealants and associated Work, schedule and meet at the Site with caulking and sealant installer, caulking and sealant manufacturer's technical representative, other trades involved in coordinating with caulking and sealant Work, ENGINEER, and OWNER. Record discussions of pre installation conference and decisions, agreements, and disagreements, and furnish copy of record to each party attending conference. Review foreseeable methods and procedures related to caulking and sealant Work, including reviewing:
    - a. Required submittals, both completed and yet to be completed.
    - b. Status of test reports.
    - c. Mock-up construction results.
    - d. Status of substrate and similar considerations.
    - e. Each major caulking and sealant application required.
    - f. Availability of products, tradesmen, equipment, and facilities required for avoiding delays.
  2. Reconvene conference at earliest opportunity if additional information must be developed to conclude subjects under consideration.
  3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

## 1.05 SUBMITTALS

- A. RSN 07 92 00-1, Action Submittals: Submit the following:
1. Shop Drawings:
    - a. Schedule of joint sealants installation, indication each specific surface where caulking or sealants are to be provided and the material proposed for each application.
  2. Product Data:

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- a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, caulking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating that each product complies with the Contract Documents and is intended for the applications shown or indicated.
  - b. Product test reports.
  - 3. Samples:
    - a. Each type of actual cured material of each caulking and sealant specified, in each of manufacturer's standard colors.
    - b. Samples will be reviewed by ENGINEER for color and texture only. Compliance with other requirements is responsibility of CONTRACTOR.
- B. RSN 07 92 00-2, Informational Submittals: Submit the following:
- 1. Certificates:
    - a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
    - b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
    - c. Certify that applicator is approved by manufacturer.
  - 2. Field Quality Control Submittals:
    - a. Results of tests on job mock-ups.
    - b. Pre-construction and post-construction field test reports.
    - c. Compatibility and adhesion test reports.
    - d. CONTRACTOR's Field Test Report Logs:
      - 1) Indicate time present at the Site.
      - 2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
  - 3. Qualifications: Submit qualifications for:
    - a. Installer.
    - b. Testing laboratory, Testing Laboratory Services Furnished by OWNER, or Testing Laboratory Services Furnished by CONTRACTOR.
- C. RSN 07 92 00-3, Closeout Submittals : Submit the following:
- 1. Operation and Maintenance Data:
    - a. Recommended inspection intervals.
    - b. Instructions for repairing and replacing failed sealant joints.



2. Warranty: Submit written warranties as specified in this Section.

## **1.06 DELIVERY, STORAGE AND HANDLING**

### **A. Delivery of Products:**

1. Deliver products in caulking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.
2. Include the following information on label:
  - a. Name of material and Supplier.
  - b. Formula or Specification Section number, lot number, color and date of manufacture.
  - c. Mixing instructions, shelf life, and curing time, when applicable.

### **B. Storage of Products:**

1. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
2. Do not use materials that are outdated as indicated by shelf life.
3. Store sealant tape in manner that will not deform tape.
4. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
5. When high temperatures prevail, store mixed sealants in a cool place.

### **C. Handling:**

1. Do not open containers or mix components until necessary preparatory Work and priming are complete.

## **1.07 JOB CONDITIONS**

### **A. Environmental Conditions:**

1. Do not install joint sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
4. When high temperatures prevail, avoid mixing sealants in direct sunlight.

5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.
6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of caulking, sealants, and painting Work, and areas where OWNER's personnel or construction personnel may work. Properly locate and vent such heat sources to outdoors so that joint sealants and other Work are unaffected by exhaust.

## **1.08 WARRANTY**

- A. Provide written warranty, signed by manufacturer and CONTRACTOR, agreeing to repair or replace sealants that fail to perform as air tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.
  1. Provide manufacturer warranty for period of one year from date of Substantial Completion of joint sealants Work.
  2. Provide installer warranty for period of two years from date of Substantial Completion of joint sealants Work.

## **PART 2 PRODUCTS**

### **2.01 SYSTEM PERFORMANCE**

- A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide colors selected by ENGINEER from caulking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

### **2.02 MATERIALS**

- A. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Potable Water or Water That Will be Treated to Become Potable:
  1. One component Polyurethane Sealant:
    - a. Products and Manufacturers: Provide one of the following:
      - 1) Sikaflex-1a by Sika Corporation.
      - 2) Or equal.

- 
- b. One component, moisture cured, gun grade, polyurethane sealant, complying with:
    - 1) FS TT S 00230C, Type II, Class A; ASTM C920, Type S, Grade NS, Class 25.
    - 2) Adhesion in Peel, FS TT S 00230C, ASTM C794 (minimum five pounds.): Glass, minimum 20 pounds per linear inch; Aluminum, minimum 20 pounds per linear inch; Concrete, minimum 20 pounds per linear inch.
    - 3) Hardness (Standard Conditions), ASTM D2240: 20 to 25 (Shore A).
    - 4) Stain and Color Change, FS TT S 00227E and ASTM C510: No discoloration or stain.
    - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
    - 6) Rheological Vertical Displacement at 120 degrees F, FS TT S 00227E: No sag.
    - 7) VOC Content: 100 g/L, maximum.
    - 8) Listed in NSF/ANSI 61
  - 2. Two component Polyurethane Sealant:
    - a. Products and Manufacturers: Provide one of the following:
      - 1) Sikaflex- 2c NS by Sika Corporation.
      - 2) Or equal.
    - b. Two-component, moisture cured, gun grade, polyurethane sealant, complying with:
      - 1) FS TT S 00227E, Type II, Class A; ASTM C920, Type M, Grade NS, Class 25.
      - 2) Adhesion in Peel, FS TT S 00227E, ASTM C794 (Minimum five pounds per linear inch with no adhesion failure): 18 pounds.
      - 3) Hardness (Standard Conditions), ASTM C661: 25 (Shore A).
      - 4) Stain and Color Change, FS TT S 00227E and ASTM C510: No discoloration or stain.
      - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
      - 6) Rheological Vertical Displacement at 120 degrees F, FS TT S 00227E: No sag.
      - 7) VOC Content: 220 g/L, maximum.
      - 8) Listed in NSF/ANSI 61

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- B. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Wastewater:
1. Two component Polyurethane Sealant:
    - a. Products and Manufacturers: Provide one of the following:
      - 1) Sikaflex- 2c NS by Sika Corporation.
      - 2) Vulkem 227 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
      - 3) Or equal.
    - b. Polyurethane based, two component elastomeric sealant complying with:
      - 1) FS TT S 00227E: Type II (non sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
      - 2) Adhesion in Peel, FS TT S 00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 18 lbs.
      - 3) Hardness (Standard Conditions), ASTM C661: 25 (Shore A).
      - 4) Stain and color change, FS TT S 00227E and ASTM C510: No discoloration or stain.
      - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
      - 6) Rheological Vertical Displacement at 120 degrees F, FS TT S 00227E: No sag.
      - 7) VOC Content: 220 grams per liter, maximum.
- C. Exterior and Interior Vertical Joints; Non-submerged:
1. Two component Polyurethane Sealant:
    - a. Products and Manufacturers: Provide one of the following:
      - 1) Sikaflex- 2c NS by Sika Corporation.
      - 2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
      - 3) Or equal.
    - b. Polyurethane based, two component elastomeric sealant complying with:
      - 1) FS TT S 00227E: Type II (non sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
      - 2) Adhesion in Peel, FS TT S 00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
      - 3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
      - 4) Stain and color change, FS TT S 00227E and ASTM C510: No discoloration or stain.

- 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
- 6) Rheological Vertical Displacement at 120 degrees F, FS TT S 00227E: No sag.
- 7) VOC Content: 100 g/L, maximum.

D. Exterior and Interior Horizontal Joints; Non-submerged:

1. Two-component Polyurethane Sealant:

a. Products and Manufacturers: Provide one of the following:

- 1) Sikaflex- 2c SL by Sika Corporation.
- 2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
- 3) Or equal.

b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:

- 1) FS TT S 00227E, Type I (self leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
- 2) Water Immersion Bond, FS TT S 00227E: Elongation of 50 percent with no adhesive failure.
- 3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
- 4) Stain and Color Change, FS TT S 00227E and ASTM C510: No discoloration or stain.
- 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
- 6) VOC Content: 165 g/L, maximum.

E. Miscellaneous Materials:

1. Joint Cleaner: As recommended by caulking and sealant manufacturer.
2. Joint Primer and Sealer: As recommended for compatibility with caulking and sealant by caulking and sealant manufacturer.
3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with caulking and sealant by caulking and sealant manufacturer, to be applied to sealant contact surfaces where bond to substrate or joint filler must be avoided for proper performance of caulking and sealant. Provide self adhesive tape where applicable.
4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended for compatibility with caulking and sealant by caulking and sealant manufacturer. Provide size and

shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which caulking and sealant Work will be performed, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with caulking and sealant Work until unsatisfactory conditions are corrected.

### **3.02 PREPARATION**

- A. Protection: Do not allow joint sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or caulking and sealant materials.
- B. Joint Surface Preparation:
  - 1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer's written instructions as shown on approved Shop Drawings.
  - 2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
  - 3. Roughen joint surfaces on vitreous coated and similar non porous materials, when sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.

### **3.03 INSTALLATION**

- A. Install joint sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure caulking and sealant joints will not be soiled. Replace caulking and sealant joints soiled after installation.
- B. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.

- C. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.
- D. Confirm that compressible filler is installed before installing sealants.
- E. Do not install sealants without backer rods and bond breaker tape.
- F. Roll back up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.
- G. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete “wetting” of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- H. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
  - 1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8 inch deep or less than 3/8 inch deep.
  - 2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.
- I. Remove excess and spillage of compounds promptly as the Work progresses.
- J. Cure caulking and sealant compounds in compliance with manufacturer’s instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

### **3.04 EXISTING JOINTS**

- A. Mechanically remove existing sealant and backer rod.
- B. Clean joint surfaces of residual sealant and other contaminants capable of affecting sealant bond to joint surface.
- C. Conduct laboratory pre-construction compatibility and adhesion testing on joint surfaces in accordance with Paragraph 3.1.B of this section.
- D. Allow joint surfaces to dry before installing new sealants.

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### 3.05 FIELD QUALITY CONTROL

- A. Post-construction Field Adhesion Testing: Before installing elastomeric sealants, field-test joint sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
    - a. Perform ten tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.
    - b. Perform one test for each 1,000 feet of joint length thereafter, and minimum of one test per each floor per elevation.
    - c. Test Method: Test joint sealants according to Method A, Field-applied Sealant Joint Hand Pull Tab, and Method D, Water Immersion in Appendix X1 of ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately by extending cut along one side and verifying adhesion to opposite side. Repeat procedure for opposite side.
    - d. Inspect joints for complete fill, absence of voids, and joint configuration complying with specified requirements. Record results in a log of field adhesion tests.
    - e. Inspect tested joints and report on whether:
      - 1) Sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
      - 2) Sealants filled the joint cavities and are free of voids.
      - 3) Sealant dimensions and configurations comply with specified requirements.
    - f. Record test results in a log of field adhesion tests. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
    - g. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
    - h. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements will be satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
    - i. Do not proceed with installation of elastomeric sealants over joint surfaces that have been painted, lacquered, waterproofed, or treated with water



repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with FS TT S 00227, has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

**B. Water Leak Testing: Field test for water leaks as follows:**

1. Flood the joint exposure with water directed from a 3/4 inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.
2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of ENGINEER, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.
3. Where nature of observed leaks indicates potential of inadequate joint bond strength, ENGINEER may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

**3.06 ADJUSTING AND CLEANING**

- A. Where leaks and lack of adhesion are evident, replace sealant.
- B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.
- C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

**3.07 PROTECTION**

- A. During and after curing period, protect joint sealants from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

**END OF SECTION**

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**SECTION 08 30 00**  
**BULLET RESISTANT DOOR AND FRAMES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This Section includes hollow metal detention security products as shown in the contract drawings.

**1.02 RELATED PRODUCTS FURNISHED IN THIS SECTION**

- A. Hardware.

**1.03 MEASUREMENT AND PAYMENT**

- A. Bullet-Resistant Door and Frames:  
1. Payment: Include in prices offered for other items of work.

**1.04 REFERENCE STANDARDS**

- A. American National Standards Institute (ANSI)
- |    |                   |   |
|----|-------------------|---|
| 1. | ANSI/SDI A250.8   | Recommended Specifications for Standard Steel Doors and Frames.   |
| 2. | ANSI/SDI A250.4   | Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing. |
| 3. | ANSI/SDI A250.6   | Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.   |
| 4. | ANSI/SDI A250.10  | Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.                             |
| 5. | ANSI/SDI A250.11  | Recommended Erection Instructions for Steel Frames.   |
| 6. | ANSI/BHMA A156.15 | Hardware Preparation in Steel Doors and Frames.   |
| 7. | ANSI/SDI 122      | Installation and Troubleshooting Guide for Standard Steel Doors and Frames.   |
- B. ASTM International (ASTM)

- 
1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  2. ASTM A666-03 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
  3. ASTM A1008 Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
  4. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  5. ASTM C143 Standard Test Method for Slump of Hydraulic Cement Concrete.
  6. ASTM D610 Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces.
  7. ASTM F1450 Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention Facilities.
  8. ASTM F1577 Standard Test Methods for Detention Locks for Swing Doors.
- C. Depart of the Army
1. TM5-885-1 Fundamentals of Design for Conventional Weapons.
  2. TM5-1300 Structures to Resist the Effects of Accidental Explosions.
- D. Federal Specifications (FS)
1. FS FF-S-92B-1975 Screw, Machine, Slotted, Cross Recessed or Hexagon Head
- E. Underwriters Laboratory (UL)
1. UL-752 Bullet-Resisting Equipment

## **1.05 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 08 30 00-1, Product Data:

1. For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, and finishes.
- C. RSN 08 30 00-2, Door Hardware Templates:
1. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finished hardware items.
- D. RSN 08 30 00-3, Shop Drawings:
1. Include the following:
    - a. Elevations of each door design.
    - b. Details of the doors, including vertical and horizontal edge details and metal thicknesses.
    - c. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
    - d. Locations of reinforcement and preparations for hardware.
    - e. Details of each different wall opening condition.
    - f. Details of accessories.
    - g. Details of moldings, removable stops, and glazing.
- E. Samples for Verification:
1. Samples are only required by request of the contract officer and for manufacturers that are not current members of the Steel Door Institute.
- F. Information Submittals:
1. Certificates of Compliance: Submit any information necessary to indicate compliance with this specification section.

## **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Obtain bullet resistant door and frame assemblies through one source from a single manufacturer with a minimum of 5 years of documented experience producing bullet resistant door and frame type work similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Bullet resistant door and fame assemblies to be certified by an independent laboratory to applicable UL Standards.
1. Provide bullet resistant assemblies which meet or exceed UL-752, standard threat level 1 rating.

- C. Pre-Installation Conference: Conduct conference in compliance with requirements in Division 01 Section, with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing bullet resistant doors and frames.

### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Deliver bullet resistant hollow metal work palletized and crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store bullet resistant hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

### **1.08 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

### **1.09 COORDINATION**

- A. Coordinate installation of anchorages for bullet resistant hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

### **1.10 WARRANTY**

- A. Provide manufacturer's written 5 year warranty against defects in materials and workmanship upon final completion and acceptance of Work in this section.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ambico, Ltd.
  - 2. Armortex, Inc.
  - 3. Chicago Bullet Proof Systems.

4. Krieger Specialty Products.
  5. Security Metal Products.
- B. Substitutions: Material from alternate bullet resistant door and frame fabricators will not be accepted on jobsite without prior written and sample approval in accordance with requirements specified in Division 01.

## **2.02 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

## **2.03 BULLET RESISTANT HOLLOW METAL DOORS**

- A. General: Provide 1-3/4 inch doors of type and design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  1. Design: Flush panel.
  2. Core Construction: Manufacturer's standard bullet resistant door core construction designed and tested for the specified UL752 standard Level 1 rating.
  3. Level/Model: Level 1 and Physical Performance Level A (Extra Heavy Duty), Minimum 14 gage (0.067-inch -1.7-mm) thick steel, Model 2 (Fully welded, seamless face and edges).
  4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
  5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 12 gage (0.105-inch -2.7 mm), extending the full width of the door and welded to the face sheet. Finish top and bottom to provide a smooth flush condition.
  6. Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets

## **2.04 BULLET RESISTANT HOLLOW METAL FRAMES**

- A. General: Provide frames of the type and profile indicated, not less than thickness indicated; to comply with ANSI/SDI A250.8.

1. Fabricate frames with mitered corners.
  2. Fabricate frames with "closed and tight" mitered, full depth continuously welded seams, finished smooth with no visible seam unless otherwise indicated. Knock down type frames are not permitted.
  3. Minimum 14 gage (0.067-inch -1.7-mm) thick steel sheet.
- B. Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

## **2.05 FRAME ANCHORS**

- A. Jamb Anchors: Shall be compatible with installation into concrete.
1. Adjustable strap-and-stirrup anchors to suit frame size, not less than 16 gage (0.8 mm) thickness, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long.
- B. Floor Anchors: Floor anchors to be provided at each jamb. Formed from same material as frames, not less than 14 gage (0.067-inch -1.7-mm) thick.
- C. Mortar Guards: Provide minimum 26 gage mortar guards welded to the back of each hardware cutout.

## **2.06 FABRICATION**

- A. Fabricate bullet resistant hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate bullet resistant hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Bullet Resistant Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
  2. Astragals: Provide overlapping astragals on one leaf of pairs of doors where required for bullet resistance level standard. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
  3. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 08 Section, "Door Hardware".



- D. **Bullet Resistant Hollow Metal Frames:** Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. **Welded Frames:** Full depth continuously weld frame seams; grind, fill, dress, and make smooth and flush.
    - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
  2. **High Frequency Hinge Reinforcement:** Provide 12 gage angle reinforcements for butt type hinges on every door and frame assembly.
  3. **Continuous Hinge Reinforcement:** Provide welded continuous 12 gage straps for continuous hinges specified in hardware sets in Division 08 Section, "Door Hardware".
  4. **Floor Anchors:** Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  5. **Jamb Anchors:** Provide number and spacing of anchors as follows:
    - a. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 84 inches high.
- E. **Surface Hardware Preparation:** Factory prepare bullet resistant hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section, "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive non-template, mortised and surface-mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of bullet resistant hollow metal work for hardware.

## **2.07 STEEL FINISHES**

- A. **Prime Finish:** Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
1. **Shop Primer:** Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended

by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## **2.08 HARDWARE**

### **A. Hinges:**

1. Hinges shall be compatible with the Metal Door and Frame.
2. Hinges shall meet requirements of UL-752, Level 1.
3. Hinges shall be Self-Closing type.

### **B. Heavy Duty Mortise Locks**

1. Heavy duty mortise locks shall be 8200/R8200/7800 Series as manufactured by SARGENT Manufacturing Company, New Haven, CT, or approved equal.
2. Locks shall meet or exceed the requirements of ANSI/BHMA A156.2 Series 1000, Operational Grade 1, and Security Grade 1 with all standard trims.
3. Meets or exceeds impact requirements of ASTM F1577-95b Detention Locks for Swinging Doors.
4. Locks shall be easily re-handed without opening the lock body.
5. Locks shall comply with UL10C and UBC 7-2 positive pressure requirements.
6. Construction:
  - a. Lock functions shall be manufactured in a single-sized case formed from 12 gauge steel minimum.
  - b. Lock cases shall be closed on all sides and back.
  - c. Locks shall have field adjustable, beveled, armored front, with a .125" thickness minimum.
  - d. Locks shall have a one piece 3/4" throw anti-frictional stainless steel latch.
  - e. Deadbolts, where specified, shall be full one inch throw made of one-piece hardened stainless steel.
  - f. Where required by Federal Bureau of Prisons, locks can be furnished optionally with stainless steel hubs.
7. Locks shall have a 2-3/4" backset standard.
8. Strikes shall be non-handed with a curved lip.
9. To ensure proper alignment, trim, knobs, or levers shall be through-bolted and fully interchangeable between rose and escutcheon.
10. Locks shall have brass 6-Pin cylinder, standard.
11. Locks shall have a 10 year limited warranty.

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## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded bullet resistant hollow metal frames for squareness, alignment, twist, and plumbness.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

### **3.03 INSTALLATION**

- A. General: Install bullet resistant hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Bullet Resistant Hollow Metal Frames: Install bullet resistant hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
  - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
    - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install door silencers in frames before grouting.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
  3. Concrete Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with appropriate mortar.
  4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame.
- C. Bullet Resistant Hollow Metal Doors: Fit bullet resistant hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - c. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

### **3.04 ADJUSTING AND CLEANING**

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including bullet resistant hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from bullet resistant hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

**END OF SECTION**

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**SECTION 09 96 20**

**COATINGS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. Include in prices offered in the schedule for other items of work.

**1.02 REFERENCE STANDARDS**

A. ASTM International (ASTM)

1. ASTM A 380-06 Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
2. ASTM A 780-09 Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
3. ASTM C 920-11 Elastomeric Joint Sealants
4. ASTM D 522-93a(2008) Mandrel Bend Test of Attached Organic Coatings
5. ASTM D 1141-98(2008) Preparation of Substitute Ocean Water
6. ASTM D 2244-11 Calculation of Color Differences From Instrumentally Measured Color Coordinates
7. ASTM D 2794-93(2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
8. ASTM D 3359-09 Measuring Adhesion by Tape Test
9. ASTM D 3363-05(2011) Film Hardness by Pencil Test
10. ASTM D 4060-10 Abrasion Resistance of Organic Coatings by the Taber Abraser
11. ASTM D 4285-83(2006) Indicating Oil or Water in Compressed Air
12. ASTM D 4541-09 Pull-Off Strength of Coatings Using Portable Adhesion Testers
13. ASTM D 4587-11 Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
14. ASTM D 5894-10 Cyclic Salt Fog/UV Exposure of painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
15. ASTM G 8-96(2010) Cathodic Disbonding of Pipeline Coatings

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- 16. ASTM G 154-06 Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
  
  - B. International Organization For Standardization (ISO)
    - 1. ISO 8502-3-1992 Assessment of dust on Steel Surface Prepared for Painting (Pressure- Sensitive Tape Method)
  
  - C. National Association of Pipe Fabricators (NAPF)
    - 1. NAPF 500-03-04-06 Abrasive Blast Cleaning of Ductile Iron Pipe
  
  - D. The Society for Protective Coatings (SSPC)/NACE International (NACE)
    - 1. SSPC-AB1-2007 Mineral and Slag Abrasives
    - 2. SSPC-AB2-2004 Cleanliness of Recycled Ferrous Metallic Abrasives
    - 3. SSPC-AB3-2004 Newly Manufactured or Re-Manufactured Steel Abrasives
    - 4. SSPC-PA2-2009 Measurement of Dry Paint Thickness with Magnetic Gages
    - 5. SSPC-SP1-2004 Solvent Cleaning
    - 6. SSPC-SP6/NACE NO.3-07 Commercial Blast Cleaning
    - 7. SSPC-SP10/NACE NO.2-07 Near-White Blast Cleaning
    - 8. SSPC-SP11-2004 Power Tool Cleaning to Bare Metal
    - 9. SSPC-VIS1-2004 Guide and Reference Photographs for Steel Surfaces Prepared by Abrasive Blast Cleaning
    - 10. SSPC-VIS3-2004 Visual Standard for Power- and Hand-Tool Cleaned Steel
    - 11. NACE RP 0274-2004 High Voltage Electrical Inspection of Pipeline Coatings
    - 12. NACE RP 0287-2002 Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
    - 13. NACE SP 0188-06 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
  - 1. Include the following information with each set of data or certification:
    - a. Applicable tabulation number from Coating Tabulations.
    - b. Identification of “Items to be coated” including sub-letter and sub-number listed in Coating Tabulations.

B. RSN 09 96 20-1, Approval Data:

1. For each coating material:
  - a. Manufacturer's product data, application, and MSDS sheets.
  - b. Include the following information:
    - 1) Supplier's name, address, and phone number.
    - 2) Manufacturer's designated product name.
    - 3) Applicable tabulation number from Coating Tabulations.
    - 4) Identification of "Items to be coated" including sub-letter and sub-number listed in Coating Tabulations.
2. "Equal" Products:
  - a. For coating materials proposed as "equal" products to specified listed brand name products, submit following with specified approval data:
  - b. List of projects (not less than three) where material has been successfully used in applications similar to this project. Include:
    - 1) Project name and location.
    - 2) Type of structure.
    - 3) Owner's name, address, and telephone number.
    - 4) Application dates.
  - c. Manufacturer's certification substitute coating material meets specified requirements. Include:
    - 1) Manufacturer's name, address, and phone number.
    - 2) Batch number(s) for each material, except thinners.
    - 3) Signature of manufacturer's technical representative and date of signature.
  - d. Certified test reports that demonstrates substitute material meets or exceeds specified coating requirements for physical and performance characteristics from each of following:
    - 1) Coating manufacturer.
    - 2) Independent laboratory.

C. RSN 09 96 20-2, Final Approval Data:

1. For each coating material:
  - a. Purchase orders. Include:
    - 1) Supplier's name, address, and phone number.
    - 2) Purchase order number and date.

- 3) Manufacturer's designated product name.
- 4) Batch number(s) for each material, except thinners.
- 5) Quantities ordered for each material, except thinners.

D. RSN 09 96 20-3, Documentation:

1. Written evidence showing each applicator's qualifications by training or experience for each coating.
  - a. When documenting qualifications by experience,
    - 1) Include list of 3 recent jobs using comparable materials under similar conditions.
    - 2) Include the owners contact information of 3 recent jobs.

#### **1.04 QUALIFICATIONS**

A. Coating Applicators Qualifications:

1. Qualified to apply specified coating materials by one of following:
  - a. Successfully completed training in application of coating materials similar to materials and conditions specified.
  - b. Skilled and experienced in application of coating materials similar to materials and conditions specified.

#### **1.05 DELIVERY, STORAGE, HANDLING**

- A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.
- B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.
- C. Store materials in well ventilated area.
- D. Do not expose to direct sunlight during storage.
- E. Comply with manufacturer's storage instructions.
- F. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).



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## **1.06 AMBIENT CONDITIONS**

- A. Comply with coating manufacturer's environmental restrictions. Comply with most restrictive requirements of coating manufacturer's restrictions and these specifications when coating manufacturer's restrictions conflict with these specifications.
- B. Do not apply coatings under following environmental conditions.
  - 1. Substrate surface temperature less than 5 degrees Fahrenheit above dewpoint.
  - 2. Air and substrate surface temperature less than 50 degrees Fahrenheit or not to exceed manufacturer's recommended minimum and maximum temperature limit.
  - 3. Humidity outside of manufacturer's recommended range.
- C. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.
- D. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heating or cooling, and dehumidification required to maintain temperature and humidity.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. General:
  - 1. Compliance criteria for coating materials:
    - a. Material is of same composition and formulation to meet physical and performance test results for one of following:
      - 1) Submitted batch or previously tested batch materials complies with these specifications.
      - 2) Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.
      - 3) Submitted batch materials complies with manufacturer's QC and QA programs as listed on product data and application sheets.
  - 2. Materials required by these specifications and not listed in Coating Categories are subject to certification and testing in accordance with this Section.
  - 3. Provide compatible products of same manufacturer for coating system components.

B. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1, type I (natural minerals) and type II (slags), class A, except flint minerals are not permitted.
2. SSPC-AB2 for recycled cleanliness.
3. SSPC-AB3 class I (steel) or II (iron) for angular shaped grit.
4. The Contractor is to make every effort commercially available to render the hazardous waste stream non-hazardous.
5. Do not exceed toxicity threshold limit for hazardous materials.

C. Coatings:

1. Specified in Coating Categories.
2. Apply only one coating category per option in Coating Tabulations.
3. Volatile Organic Compounds (VOC):
  - a. Do not exceed maximum permitted by Federal, Navajo Nation, and local air pollution control regulations.
  - b. Do not exceed maximum content as supplied in container or by addition of thinner material.
4. Factory color or tint. Do not color or tint at jobsite.
5. Use thinners recommended by manufacturer for each coating material.
6. Use of accelerator products is not permitted unless approved by COR or BIA Representative.

D. Fillers and Caulks:

1. Flexible gaps or crevices:
  - a. Coating manufacturer's standard flexible filler or caulk material.
  - b. Caulk material: Meet or exceed ASTM C 920-08 type S or M, grade NS, class 25, suitable for water immersion service.
2. Nonflexible gaps or crevices:
  - a. Coating manufacturer's standard filler or caulk material.

## **PART 3 EXECUTION**

### **3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES**

- A. Protect items or surfaces not to be coated and adjacent to surfaces to be cleaned and coated from contamination and damage during cleaning and coating operations.

1. Includes surfaces and equipment in physical contact with areas being cleaned or coated. Examples include: mechanical and electrical equipment (open or enclosed); instruction and similar plates; and wet and newly coated surfaces.
  2. Protect from abrasive blast particles and airborne coating particles.
- B. Do not move newly coated items until coating is thoroughly dry as determined by one of following:
1. Coating manufacturer's instructions for handling.
  2. Coating film cannot be distorted or removed by exerting substantial, but less than maximum, pressure with thumb and turning thumb through 90 degrees in plane of film.

### **3.02 REPAIR OF CONTRACTOR-DAMAGED SURFACES**

- A. Repair items, equipment, or surfaces which are damaged or contaminated as determined by COR or BIA Representative.
1. Repair damaged items or restore manufacturer-coated equipment to original condition and appearance.
  2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

### **3.03 COATING OF METALWORK EMBEDDED IN CONCRETE**

- A. Extend primer coat 6 inches, minimum, into concrete embedment measured from face of concrete and along surface of embedded. Examples include: concrete vaults, floors, and walls.
- B. Extend primer coat continuously through solid concrete structure with burial or immersion service exposure on either side of concrete faces. Examples include: thrust or anchor blocks.
- C. Caulk the concrete/steel interface to seal the gaps.

### **3.04 SURFACE PREPARATION**

- A. Remove or repair weld spatter, slag burrs, porosity, sharp edges, pits, laminations, crevices, or other objectionable surface irregularities before specific surface preparation.
- B. Specific Surface Preparation:
1. See Coating Tabulations.
    - a. Method A: SSPC-SP1.
    - b. Method B: SSPC-SP6/NACE 3.
    - c. Method B-1: Repair of defective or damaged coated areas.

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- 1) To metal substrate:
    - a) SSPC-SP6/NACE 3.
    - b) SSPC-SP11 where abrasive blasting is impractical.
  - 2) To prime or intermediate coat:
    - a) Method A.
    - b) Feather abrupt edges and around repair area by hand or power tool with non-woven pad.
    - c) Roughen or abrade surface in accordance with manufacturer's recommendations.
    - d) Achieve matted or lusterless finish.
  - d. Method C: SSPC-SP10/NACE 2.
  - e. Method F (cast iron): NAPF 500-03-05, Blast Clean No. 4.
  - f. Method G (stainless steel): ASTM A 380.
- C. Surface Profile:
1. Prepare in accordance with manufacturer's instructions for metallic or existing coating surfaces and service environment, unless specified in Coating Tabulations.
  2. Where manufacturer's instruction do not specify a surface profile, prepare blasted surfaces to following profile:
    - a. Atmospheric Service Environments: 1-mil or greater angular profile and less than specified millage of first applied coat.
    - b. Burial and Immersion Service Environments: Angular profile between 2 to 3 mils minimum and less than specified millage of first applied coat.
  3. Perform tests in accordance with surface profile inspection procedures specified.
- D. All welds shall be smooth and continuous, no skip welds. All weld splatter, buckshot, laminations, and slivers shall be removed and ground smooth; undercuts and pinholes shall be ground smooth and filled with weld metal. All projections, sharp edges, high points and fillets shall be ground smooth to a radius of at least 1/8-inch and all corners shall be likewise rounded.
- E. All pitting, gouges, scratches, and other defects shall be repaired either by welding or filling with repair materials that are compatible with the coating system and suitable for the intended service conditions.
- F. Re-clean or perform additional surface preparation of completed metallic or coated surfaces that become contaminated before coating application.
- G. Prepare surface free of moisture, frost, and ice. Heat substrate surface which is not thoroughly dry to remove moisture before coating application.
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- H. Heat cast iron components to between 140 and 180 degrees Fahrenheit to evaporate moisture in crystalline matrix for 2 hours minimum.

### **3.05 APPLICATION EQUIPMENT**

- A. Air Compressor and Spray Application Equipment:
1. Provide appropriate type equipment, adequately sized, and in proper operating order.
  2. Equip with pressure gauges and pressure regulators.
  3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.
  4. Perform tests in accordance with oil and moisture inspection procedures specified.
- B. Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D 4285. Remove oil or water before proceeding with work.

### **3.06 COATING APPLICATION**

- A. Apply in accordance with manufacturer's instructions.
- B. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.
- C. Apply an even film of uniform thickness which tightly bonds to substrate or previous coat.
1. Fill crevices and cover irregularities.
  2. Apply free of runs, pinholes, sags, laps, brush marks, voids, and other defects.
- D. Primer Coats:
1. Cover peaks of surface profile by specified dry film thickness.
  2. Apply stripe coats to edges, bolt heads, welds seams, corners, and similar surfaces.
- E. Intermediate and Topcoats:
1. Apply number of coats and coating thickness specified in Coating Tabulations.
  2. Apply within re-coat window at referenced humidity and temperature recommended by manufacturer.
  3. Tint intermediate coats with manufacturer's standard color to differentiate between coats.

### **3.07 FILLERS AND CAULK APPLICATION**

- A. Apply fillers and/or caulks in a uniform texture, neatness, and color matched appearance.
- B. Apply fillers and/or caulks in accordance with manufacture's instructions which tightly bonds to substrate or previous coats.
  - 1. Fill crevices and other gaps where coatings can not bridge.
  - 2. Apply caulk after the coating has been applied.
  - 3. Areas may include crevices, steel plates butted together, bolts, rivets, seams, skip welds, and conduit through metal.

### **3.08 CONTRACTOR FIELD QUALITY TESTING**

- A. Surface Profile: Inspect surface profile in accordance with NACE RP 0287 for compliance with specified requirements.
  - 1. Use replica tape suitable for surface profile depth range.
- B. Visual Comparison of Prepared Surfaces:
  - 1. Compare prepared steel surfaces to following visual reference photographs for allowable visible contaminants and stains:
    - a. SSPC-VIS1 for abrasive blast cleaning.
    - b. SSPC-VIS3 for power and hand tool cleaning.
  - 2. Remove all dust, grit, or other foreign matter from the surface to be coated by blowing off with clean, dry, oil free compressed air. Vacuum cleaning or other methods are acceptable. The surface shall be clean and dust free before application of coating or lining.
  - 3. Assessment of dust on newly prepared metal surfaces:
    - a. Visually inspect and conduct pressure sensitive clear tape test method in accordance with ISO 8502-3 to verify surface cleanliness at a minimum of three random tests per each blasted section per shift.
    - b. Clear tape test shall meet cleanliness with a No. 3 grade maximum contamination is allowed.
- C. Completed Coating System:
  - 1. Dry Film Thickness (DFT):
    - a. Inspect hardened coating system before re-recoating interval has been exceeded for DFT compliance in accordance with SSPC-PA2 with following modifications:
      - 1) Section 5.2.1: Minimum thickness of 80 percent of specified minimum thickness.

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- 2) Section 5.2.2: Maximum thickness of 120 percent of specified maximum thickness.
  - b. Acceptance Criteria: No single spot measurement in any 100 square foot area less than 80 percent of minimum specified thickness or greater than 120 percent of maximum specified thickness.
  - 2. Discontinuity (Holiday) Testing:
    - a. Burial and Immersion Exposure:
      - 1) Inspect nonconductive coating applied to conductive base metals in accordance with NACE RP 0188.
        - a) Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.
        - b) Use of detergent wetting solution is not permitted.
        - c) Subtract thickness of zinc-rich primer from applied coating systems to determine test voltage.
      - 2) Perform test in presence of COR or BIA Representative.

### **3.09 REPAIR OF DEFECTIVE COATED SURFACES**

- A. Repair within minimum and maximum recoat window time in accordance with coating manufacturer's recommendations and applicable Coating Tabulation under which coating was applied.
- B. Repair pinholes, holidays, laps, voids, and other defects.
- C. Inspect repaired areas for compliance with specifications.

### 3.10 COATING TABULATIONS

Tabulation No. 01		
Items to be coated: a. Metal surfaces of doors, doorframes, and door shoes.		
Shop coating: Shop applied primer and field finish coating system that consists of: 2-mil DFT primer, minimum, and 2-field finish coats compatible with shop applied primer as specified below in coating material options.  1. Repair all damaged areas with same shop applied primer and finish coat materials or compatible materials. 2. Remove stabilizing or storage treatments on galvanizing by one of following (a) SSPC-SP1 and sweep blasting or (b) manufacturer's compatible wash treatment.		
Coating materials - Option 1 Alkyd	Number and thickness of coats	Surface preparation method
For ferrous surfaces:  Shop or repair prime coat:  Category options: AE-A6 AE-A7	1 or more prime coats for uncoated or repair of damaged surfaces.  Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	A: Undamaged coated surfaces to receive additional coats. B: Uncoated surfaces B-1: Damaged coated surfaces
Finish coats:  Shop or field finish coat:  Category options: AE-C3 over AE-A6 AE-C4 over AE-A7  Color and gloss: manufacturer's standard light gray color and gloss	2 or more compatible manufacturer's finish coats.  Apply at 2 to 3 mils DFT, per coat.  Total system, excluding stripe coats: 6-mil DFT, minimum 9-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 Water-borne acrylic	Number and thickness of coats	Surface preparation method



Tabulation No. 01		
<p>For ferrous, galvanized, aluminum, brass, bronze, and copper surfaces:</p> <p>Shop or repair prime coat:</p> <p>Category options:              AE-D1(w)              AE-E1(w)              AE-F1(w)</p>	<p>1 or more prime coats for uncoated or repair of damaged surfaces.</p> <p>Apply at 2 to 3 mils DFT, per coat, plus stripe coats.</p>	<p>A: Undamaged coated surfaces to receive additional coats.            B: Uncoated surfaces            B-1: Damaged coated surfaces</p>
<p>Finish coats:</p> <p>Shop or field finish coat:</p> <p>Category options:              AE-D2(w) over AE-D1(w)              AE-E2(w) over AE-E1(w)              AE-F2(w) over AE-F1(w)</p> <p>Color and gloss:            manufacturer's standard light gray color and gloss</p>	<p>2 or more compatible manufacturer's finish coats.</p> <p>Apply at 2 to 3 mils DFT, per coat.</p> <p>Total system, excluding stripe coats:              6-mil DFT, minimum              9-mil DFT, maximum</p>	<p>Follow manufacturer's surface preparation and application instructions to apply subsequent coats.</p>

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Tabulation No. 02		
<p>Items to be coated:</p> <ol style="list-style-type: none"> <li>a. Drainage sump pumping equipment.</li> <li>b. Sonic flowmeter systems.</li> <li>c. Hydraulic control system and power unit for cast-iron hydraulically-operated slide gate.</li> <li>d. Motor operators for valves.</li> <li>e. Air valve assembly.</li> </ol>		
Coating materials	Number and thickness of coats	Surface preparation method
<p>Shop applied coating system:</p> <ol style="list-style-type: none"> <li>1. Shop's standard surface preparation and permanent coating system.</li> <li>2. Items subject to sunlight, topcoated with ultraviolet (UV) stable materials.</li> <li>3. Color and gloss: Manufacturer's standard color unless a specific color is otherwise specified.</li> <li>4. Unless otherwise specified, unexposed surfaces that require coatings, such as interior of cabinets, enclosures, and equipment, are to be given the manufacturer's standard permanent coated finish.</li> </ol>		
<p>Field Repair: Repair damaged areas of coated surfaces with compatible materials to equal thickness and color match of undamaged areas, unless otherwise tabulated herein.</p>		
<p>NOTE: Do not coat the hook, chain, wheel treads, surfaces of members that will contact wheel treads, galvanized surfaces, stainless steel, bronze, brass, gear teeth, bolt threads, seal and bearing contact surfaces, mating machined surfaces, or seals.</p>		

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Tabulation No. 03		
<p>Items to be coated:</p> <p>a. Exterior surfaces of exposed steel piping and pipe supports.</p> <p>b. Exterior surfaces of exposed steel pipe flanges.</p> <p>c. Exterior surfaces of exposed copper piping and pipe supports for sump pumping unit.</p> <p>d. Coat all fasteners to include nuts, bolts, and washers.</p>		
Coating materials – Option 1 Epoxy/polyurethane	Number and thickness of coats	Surface preparation method
<p>For ferrous surfaces:</p> <p>Base coats:</p> <p>Category options: IE-6AC</p>	<p>2 or more base coats.</p> <p>Apply at 4 to 6 mils DFT, per coat, plus stripe coats.</p>	<p>A followed by C</p>
<p>Finish coats:</p> <p>Category options: AE-1AA over IE-6AC</p> <p>Color and gloss: manufacturer’s standard light gray color and gloss</p>	<p>1 or more compatible manufacturer’s finish coats.</p> <p>Apply at 3 to 4 mils DFT, per coat.</p> <p>Total system, excluding stripe coats: 11-mil DFT, minimum 16-mil DFT, maximum</p>	<p>Follow manufacturer’s surface preparation and application instructions to apply subsequent coats.</p>
Coating materials – Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method
<p>For ferrous surfaces:</p> <p>Category options:  AES-7AIQ (gloss)</p> <p>Color and gloss: manufacturer’s standard light gray color and gloss</p>	<p>1 or more prime coats, apply at 3 to 5 mils DFT, per coat, plus stripe coats.</p> <p>1 or more intermediate coats, apply at 3 to 5 mils DFT, per coat.</p> <p>1 or more topcoats, apply at 1 to 3 mils DFT, per coat.</p> <p>Total system, excluding stripe coats: 7-mil DFT, maximum 13-mil DFT, minimum</p>	<p>A followed by C</p> <p>Follow manufacturer’s surface preparation and application instructions to apply subsequent coats.</p>

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Tabulation No. 04		
<p>New items to be coated:</p> <ol style="list-style-type: none"> <li>Steel trashracks, steel trashrack support beams and angles.</li> <li>Sluice gate, gate frame, and all hardware.</li> <li>All fasteners to include nuts, bolts, and washers.</li> </ol>		
<p>NOTES:</p> <ol style="list-style-type: none"> <li>Do not paint aluminum-brass, bronze, and stainless steel metalwork.</li> <li>Do not coat machined surfaces where paint could interfere with proper operation or fit.</li> <li>Coat exposed machined surfaces after installation and where the coating does not interfere with the operation of the equipment.</li> <li>Seal all steel/concrete interface areas to prevent corrosion.</li> </ol>		
Coating materials – Option 1 Epoxy	Number and thickness of coats	Surface preparation method
<p>For ferrous surfaces:</p> <p>Base coats:</p> <p>Category options: IE-6AC</p> <p>Color: manufacturer’s standard light gray and gloss</p>	<p>3 or more base coats.</p> <p>Apply at 8 to 10 mils DFT, per coat, plus stripe coats.</p> <p>Total system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum</p>	<p>A followed by C for ferrous surfaces or F fore cast iron</p> <p>Follow manufacturer’s surface preparation and application instructions to apply subsequent coats.</p>
Coating materials – Option 2 Abrasion resistant epoxy	Number and thickness of coats	Surface preparation method
<p>For ferrous surfaces:</p> <p>Base coats:</p> <p>Category options: IE-1D238</p> <p>Color: manufacturer’s standard light gray and gloss</p>	<p>3 or more base coats.</p> <p>Apply at 8 to 10 mils DFT, per coat, plus stripe coats.</p> <p>Total system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum</p>	<p>A followed by C for ferrous surfaces or F fore cast iron</p> <p>Follow manufacturer’s surface preparation and application instructions to apply subsequent coats.</p>
Coating materials – Option 3 High solids epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 04		
<p>For ferrous surfaces:</p> <p>Base coats:</p> <p>Category: IES-6D2</p> <p>Color: manufacturer's standard light gray and gloss</p>	<p>1 or more prime coats and 2 or more base coats.</p> <p>Apply at 8 to 12 mils DFT, per coat, plus stripe coats.</p> <p>Total system, excluding stripe coats:                      24-mil DFT, minimum                      36-mil DFT, maximum</p>	<p>A                      followed by                      C for ferrous surfaces                      or                      F fore cast iron</p> <p>Follow manufacturer's surface preparation and application instructions to apply subsequent coats</p>

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Tabulation No. 05		
Galvanized Items to be repaired:		
<ul style="list-style-type: none"><li>a. Louvers.</li><li>b. Ventilating equipment embedded tubular frames.</li><li>c. Exterior surfaces of galvanized piping for sump pumping unit.</li><li>d. Floor grating with support angles and wide flange sections.</li><li>e. Sump grating with support angles.</li><li>f. Hatch covers.</li><li>g. Mounting hardware and supports for sump pumping unit.</li><li>h. Ladders.</li><li>i. Pipe handrail and safety railings.</li><li>j. Damaged galvanized surfaces not otherwise tabulated.</li></ul>		
Coating materials	Number and thickness of coats	Surface preparation method
Repair damaged galvanized surfaces in accordance with ASTM A 780, using zinc-based alloy repair rods, except repair materials containing cadmium and lead are not permitted.		

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Tabulation No. 06		
Items not to be coated and to receive a uniform passivation layer:		
<ul style="list-style-type: none"> <li>a. Stainless steel louver components.</li> <li>b. Stem for hydraulically operated gate hoist.</li> <li>c. Stainless steel clad surfaces not otherwise tabulated herein.</li> </ul>		
Note: Do not coat stainless steel items listed above. New stainless steel surfaces to receive uniform passivation at point of manufacture. Clean and restored uniform passivation layer of damaged, contaminated, or depassivated stainless steel surfaces by methods listed below.		
Coating materials	Number and thickness of coats	Surface preparation method
Do not coat unless specifically listed elsewhere in these tabulations.		G
Repassivation Methods and Inspection Procedures of Contaminated Stainless Steel Surfaces		
Degree of surface contamination	ASTM A 380* Surface preparation method**	ASTM A 380* Surface preparation method**
Locally heavy surface contaminated areas:	Method 5. - "Descaling", General	Method 7.2 - "Gross Inspection"
Contaminated by free iron, oxide scale, or rust related contaminants caused by field welding or cutting.	Method 5.3 - "Mechanical Descaling" by grinding and/or Method 6.3 - "Cleaning of Welds and Weld-Joint Areas"	Methods 7.2.5 - "Tests for Free Iron: Gross Indications"
General surface contaminated areas:	Method 5. - "Descaling," General	Method 7.2 – "Gross Inspection"
Contaminated by free iron, oxide scale, or rust related contaminants.	Method 5.2 - "Chemical Descaling"  Method 5.2.2.(1) - "Chemical Descaling" by swab or spray wetting the surfaces and/or Method 5.3 - "Mechanical Descaling" by grinding	Method 7.2.5 – Tests for Free Iron: Gross Indication

Tabulation No. 06		
<p>General surface contaminated areas:</p> <p>Contaminated by grease, oil, residual chemical films, or other non-free iron related contaminates.</p>	<p>Method 6.2.10 - "Water Jetting"</p> <p>and/or</p> <p>Method 6.4 - "Final Cleaning, or Passivation, or Both", wiping with a clean, solvent-moistened cloth</p>	<p>Method 7.2 - "Gross Inspection"</p> <p>Method 7.2.2 - "Wipe Tests"</p> <p>Where films are not detectable under white light conditions, use</p> <p>Method 7.3 - "Precision Inspection"</p> <p>Method 7.3.2 - "Black Light Inspection"</p>
<p>* Other ASTM A 380 methods may be used instead of above specified surface preparation methods and inspection procedures.</p> <p>** Do not damage attached parts, adjacent parts, or materials by field cleaning and passivation methods of stainless steel.</p>		

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### 3.11 COATING CATEGORIESS

#### Category AE-A6

Carbocoat 115G, primer; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis MO 63144  
314-644-1000, [www.carboline.com](http://www.carboline.com)

or equal, having following essential characteristics:

#### COMPOSITION:

Primer – Red oxide alkyd  
Lead and chromate free.

#### PHYSICAL CHARACTERISTICS:

Solids by volume:	43 percent, minimum
VOC, as supplied:	3.4 pounds per gallon (408 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	2 mils
Recoat time at 60 degrees F and 50 percent humidity:	3 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Brown or red/flat

#### PERFORMANCE REQUIREMENTS:

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	250 milligram loss or less
Direct impact resistance, ASTM D 2794:	150 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	260 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-A7

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Kem Kromik Universal Primer, B50 Series, primer; as manufactured by:  
Sherwin-Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115  
216-566-2000, www.sherwin-williams.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Primer – Phenolic modified alkyd  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	49 percent, minimum
VOC, as supplied:	3.38 pounds per gallon (405 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	4 mils
Recoat time at 60 degrees F and 50 percent humidity:	16 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Brown, buff, off-white, gray/flat

---

**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	250 milligram loss or less
Direct impact resistance, ASTM D 2794:	70 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	260 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-C3

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Carbocoat 30, finish coat; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis MO 63144  
314-644-1000, [www.carboline.com](http://www.carboline.com)

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or equal, having following essential characteristics:

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**COMPOSITION:**

Finish coat – 30 percent, urethane-modified ,silicone alkyd  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	60 percent, minimum
VOC, as supplied:	2.5 pounds per gallon (305 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	3 mils
Recoat time at 60 degrees F and 50 percent humidity:	24 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss

---

**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	190 milligram loss or less
Direct impact resistance, ASTM D 2794:	30 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-C4

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Steel Master 9500, 56-300 Series, finish coat; as manufactured by:

Sherwin-Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115  
216-566-2000, www.sherwin-williams.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Finish coat – 30 percent silicone alkyd  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	60 percent, minimum
VOC, as supplied:	2.59 pounds per gallon (310 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	3 mils
Recoat time at 60 degrees F and 50 percent humidity:	16 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss

---

**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	240 milligram loss or less
Direct impact resistance, ASTM D 2794:	40 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	4H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	260 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-D1(w)

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Carbocrylic 3358 Waterborne Acrylic Primer, primer; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis MO 63144  
314-644-1000, [www.carboline.com](http://www.carboline.com)

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or equal, having following essential characteristics:

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**COMPOSITION:**

Primer coat – 100 percent, waterborne, emulsion, corrosion resistant acrylic  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	35 percent, minimum
VOC, as supplied:	0.76 pounds per gallon (91 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	3 mils
Recoat time at 50 degrees F and 50 percent humidity:	3 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Buff, red/eggshell

---

**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	250 milligram loss or less
Direct impact resistance ASTM D 2794:	150 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-D2(w)

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Carbocrylic 3359, semigloss finish coat, or  
Carbocrylic 3359 DTM Waterborne Acrylic, gloss primer/finish coat; as manufactured by:  
Carboline, 350 Hanley Industrial Court, St. Louis MO 63144  
314-644-1000, [www.carboline.com](http://www.carboline.com)

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or equal, having following essential characteristics:

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COMPOSITION:

Finish coat – Carbocrylic 3359: Waterborne, corrosion resistant, acrylic  
Primer/finish coat – Carbocrylic 3359 DTM: Modified terpolymer acrylic  
Lead and chromate free.

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PHYSICAL CHARACTERISTICS:

Solids by volume:	3359: 34 percent, minimum 3359 DTM: 37 percent, minimum
VOC as supplied:	3359: 0.5 pounds per gallon (60 grams per liter), maximum 3359 DTM: 0.96 pounds per gallon (115 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	3 mils, over primer 3359 DTM: 5-mils direct to metal
Recoat time at 50 degrees F and 50 percent humidity:	3 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss or semigloss

---

PERFORMANCE REQUIREMENTS:

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	260 milligram loss or less
Direct impact resistance, ASTM D 2794:	140 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-E1(w)

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DTM Waterborne Acrylic Primer/Finish, Series B66W1, primer; as manufactured by:  
Sherwin-Williams, 101 Prospect Avenue NW, Cleveland OH 44115  
216-566-2000, www.sherwin-williams.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Primer/finish coat – 100 percent, waterborne, emulsion, corrosion resistant acrylic  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	44 percent, minimum
VOC, as supplied:	1.15 pounds per gallon (138 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	5 mils
Recoat time at 60 degrees F and 50 percent humidity:	4 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	white/flat

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**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	225 milligram loss or less
Direct impact resistance, ASTM D 2794:	140 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-E2(w)

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DTM Acrylic, finish coat, B66-100 Series gloss, or B66-200 Series semigloss; as manufactured by:

Sherwin-Williams, 101 Prospect Avenue NW, Cleveland OH 44115  
216 566-2000, www.sherwin-williams.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Finish coat – 100 percent, water reducible, corrosion resistant, acrylic  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	36 percent, minimum
VOC, as supplied:	1.73 pounds per gallon (208 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	4 mils
Recoat time at 60 degrees F and 50 percent humidity:	4 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss or semigloss

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**PERFORMANCE REQUIREMENTS:**

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	110 milligram loss or less
Direct impact resistance, ASTM D 2794:	160 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-F1(w)

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Devflex 4020PF DTM Waterborne Acrylic, flat primer/finish coat; as manufactured by:  
Devoe High Performance Coatings, Strongsville, Ohio  
800-654-2616, [www.devoecoatings.com](http://www.devoecoatings.com)

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or equal, having following essential characteristics:

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**COMPOSITION:**

Flat primer/finish: Waterborne, corrosion resistant, acrylic  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	44 percent, minimum
VOC as supplied:	0.76 pounds per gallon (91 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	2.5 to 3.5 mils, DFT
Recoat time at 77 degrees F and 50 percent humidity:	2 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	flat white (4020-1000), flat Red (4020-7100)

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**PERFORMANCE REQUIREMENTS:**

Direct impact resistance, ASTM D 2794:	160 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-F2(w)

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Devflex 4216V High Performance Waterborne Acrylic, finish coat, semigloss; as manufactured by:

Devoe High Performance Coatings, Strongsville, Ohio  
800-654-2616, [www.devoecoatings.com](http://www.devoecoatings.com)

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or equal, having following essential characteristics:

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COMPOSITION:

Finish coat – 100 percent, water reducible, corrosion resistant, acrylic  
Lead and chromate free.

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PHYSICAL CHARACTERISTICS:

Solids by volume:	34 percent, minimum
VOC, as supplied:	0.83 pounds per gallon (<100 grams per liter), maximum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	1.5 to 4 mils, DFT
Recoat time at 60 degrees F and 50 percent humidity:	30 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/ semigloss

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PERFORMANCE REQUIREMENTS:

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	40 milligram loss or less
Direct impact resistance, ASTM D 2794:	160 inch-pounds or greater
Flexibility, ASTM D 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff tape, ASTM D 3359:	4A or better

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Category AE-1AA

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Amercoat 450HS; as manufactured by:

PPG Protective & Marine Coatings, One PPG Place, Pittsburgh, Pennsylvania 15272,  
412-434-3131, [www.ppgamercoatus.ppgmc.com](http://www.ppgamercoatus.ppgmc.com)

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Hi-Solids Polyurethane; as manufactured by:

Sherwin Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115, 216-566-  
2000, [www.sherwin-williams.com](http://www.sherwin-williams.com)

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Devthane 379 UVA; as manufactured by:

ICI Devoe Coatings, 4000 Dupont Circle, Louisville KY 40207  
502-897-9861, [www.devoecoatings.com](http://www.devoecoatings.com)

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Carbothane 134 or 134 VOC; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599,  
314/644-1000, [www.carboline.com](http://www.carboline.com)

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Endura-Shield, Series 1074; as manufactured by:

Tnemec Company, 6800 Corporate Drive, Kansas City MO 64141  
800-863-6321, [www.tnemec.com](http://www.tnemec.com)

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or equal, having following essential characteristics:

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COMPOSITION:

Topcoat, two component, aliphatic polyurethane  
Lead and chromate free.

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PHYSICAL CHARACTERISTICS: Depending on manufacturer

VOC, as supplied	Less than 2.8 lbs/gal (340 g/l)
Mixed usable pot life at 75 Degree F:	2 to 6 hours
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	2.5 mils to 5 mils
Recoat time at 50 degrees F and 50 percent humidity:	6 hours to 12 days
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss or semigloss

---

PERFORMANCE REQUIREMENTS:

QUV accelerated weathering test, ASTM D 4587, ASTM G 154:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.
Flexibility, ASTM D 522, 180 degree bend	passes

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Category AE-1AA

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over 1-inch mandrel:

Pencil hardness, ASTM D 3363: 2B, minimum

Pulloff adhesion, ASTM D 4541, annex A2, type II tester: 500 psi or greater

Pulloff tape, ASTM D 3359: Equal to 4A or better

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Category AES-7AIQ

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Use one of following:

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Corothane I Galvapak Zinc, primer; Corothane I Ironox B, intermediate coat; Corothane I HS Aliphatic Finish Coat, topcoat; as manufactured by: Sherwin-Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115, 216-566-2000, [www.sherwin-williams.com](http://www.sherwin-williams.com)

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MC-Zinc, primer; MC-Ferrox B, intermediate coat; MC-Shieldcoat, topcoat; as manufactured by: Wasser High-Tech Coatings, 8401 South 228<sup>th</sup> Street, Building 103, Kent WA 98032, 253-850-2967, [www.wassercoatings.com](http://www.wassercoatings.com)

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or equal, having following essential characteristics:

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COMPOSITION:

Primer – Aromatic, single- or double-component, moisture-cured, zinc-rich urethane

Intermediate coat – Aromatic, single-component, micaceous iron oxide (MIO) pigmented, moisture-cured, urethane

Topcoat – Aliphatic, single-component, moisture-cured, urethane

Lead and chromate free.

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PHYSICAL CHARACTERISTICS, PRIMER:

Solids by volume:	60 percent, minimum
Weight per gallon:	28.3 lbs for Corothane I Galvapak Zinc 23.3 lbs for MC-Zinc
Zinc loading:	83 percent, minimum
VOC, as supplied:	2.8 pounds per gallon (335 grams per liter), maximum
Ambient application temperature:	40 degrees F, minimum
Maximum DFT per coat:	4 mils for Corothane I Galvapak Zinc 5 mils for MC-Zinc
Recoat time at 50 degrees:	6 hours, minimum
Application methods:	Brush, roller, or spray

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PHYSICAL CHARACTERISTICS, INTERMEDIATE COAT:

Solids by volume:	59 percent, minimum
MIO pigment by weight:	3.5 pounds per gallon, minimum
VOC, as supplied:	2.8 pounds per gallon (335 grams per liter), maximum
Ambient application temperature:	40 degrees F, minimum
Maximum DFT per coat:	5 mils
Recoat time at 50 degrees F:	8 hours, minimum
Application methods:	Brush, roller, or spray

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PHYSICAL CHARACTERISTICS, TOPCOAT:

Solids by volume:	59 percent, minimum
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Category AES-7AIQ

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VOC, as supplied:	2.8 pounds per gallon (335 grams per liter), maximum
Ambient application temperature:	40 degrees F, minimum
Maximum DFT per coat:	3 mils for Corothane I HS Aliphatic Finish Coat 2 mils for MC-Shieldcoat
Recoat time at 50 degrees F:	10 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors and safety colors/gloss

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**PERFORMANCE REQUIREMENTS:**

QUV accelerated weathering test, ASTM D 4587, ASTM G 154:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	105 milligram loss or less
Direct impact, ASTM D 2794:	160 inch-pounds or greater
Flexibility ASTM D, 522, 180 degree bend over 1/4-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	HB, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better

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Category IE-1D238

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Devgrip 238; as manufactured by:

International/Devoe Coatings, 15885 Sprague Road, Strongsville, OH 44136  
502-897-9861, www.international-pc.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Self-priming, two component, modified polyamide-amine abrasion resistant epoxy  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Solids by volume:	77 percent, minimum
VOC, as supplied:	1.71 lbs/gal (206 g/lit), maximum
Mix ratio - resin:hardener:	4:1
Mixed usable pot life at 77 degrees F:	4 hours, minimum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	10 mils
Recoat time at 60 degrees F:	9 hours, minimum 30 days, maximum
Full cure time before immersion at 60 degrees F and 50 percent humidity:	14 days, minimum
Application methods:	Brush, roller, or airless spray
Color/finish:	Haze gray, red, or black/semi-gloss

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**PERFORMANCE REQUIREMENTS:**

Fresh/deionized water immersion test, ASTM D 870:	passes, 3,000 hour test at ambient temperature with no blisters on either scribed or unscribed sides.
Salt water immersion test, ASTM D 870; ASTM D 1141 formula A with no heavy metals:	passes, 3,000 hour test at ambient temperature with no blisters on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	3H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1000 psi or greater

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Category IE-1D238

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Pulloff tape, ASTM D 3359:	4A or better
Cathodic disbondment, ASTM G 8:	passes 90 day test

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Category IES-6D2(pw)

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Dura-Plate UHS Epoxy Primer; Dura-Plate UHS Epoxy, intermediate coat and topcoat; as manufactured by:

Sherwin-Williams, 101 Prospect Avenue NW, Cleveland OH 44115  
216-566-2000, www.sherwin-williams.com

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or equal, having following essential characteristics:

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**COMPOSITION:**

Primer – Two-component, ultra high solids, amine, epoxy  
Intermediate coat and topcoat – Two-component, ultra high solids, amine, epoxy  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS, PRIMER:**

Solids by volume:	96 percent, minimum
Solids by weight:	96 percent, minimum
Weight per gallon:	10.5 pounds per gallon, minimum
VOC, as supplied:	0.66 pounds per gallon (80 grams per liter), maximum
Mix ratio – resin:hardener:	4:1
Pot life at 55 degrees F	45 minutes, maximum
Maximum DFT per coat:	8 mils
Recoat time at 55 degrees F:	
Application methods:	Brush, roller, spray
Color:	Gold

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**PHYSICAL CHARACTERISTICS, INTERMEDIATE COAT AND TOPCOAT:**

Solids by volume:	96 percent, minimum
Solids by weight:	96 percent, minimum
VOC, as supplied:	0.66 pounds per gallon (80 grams per liter), maximum
Mix ratio – resin:hardener:	4:1
Pot life at 55 degrees F:	45 minutes, maximum
Maximum DFT per coat:	12 mils for 2-coat system
Recoat time at 55 degrees F:	21 days, maximum
Full cure before immersion service at 55 degrees F and 50 percent humidity:	14 days, minimum
Application methods:	Brush, roller, spray
Color/finish:	Gray-green and white/gloss

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**PERFORMANCE REQUIREMENTS:**

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Category IES-6D2(pw)

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Fresh/deionized water immersion test, ASTM D 870:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Salt water immersion test, ASTM D 870; ASTM D 1141 formula A with no heavy metals:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	21 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1/2-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	3H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Cathodic disbondment, ASTM G 8:	Passes 90 day test

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Category IE-6AC

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Amerlock 400/2; as manufactured by:

PPG Protective & Marine Coatings, One PPG Place, Pittsburgh, Pennsylvania 15272,  
412-434-3131, [www.ppgamercoatus.ppgmc.com](http://www.ppgamercoatus.ppgmc.com)

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Macropoxy 646; as manufactured by:

Sherwin Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115, 216-566-2000,  
[www.sherwin-williams.com](http://www.sherwin-williams.com)

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Bar-Rust 235 or 236; as manufactured by:

ICI Devoe Coatings, 4000 Dupont Circle, Louisville KY 40207  
502-897-9861, [www.devoecoatings.com](http://www.devoecoatings.com)

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Carboguard 691; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599,  
314/644-1000, [www.carboline.com](http://www.carboline.com)

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Hi-Build Epoxoline II, Series N69; as manufactured by:

Tnemec Company, 6800 Corporate Drive, Kansas City MO 64141  
800-863-6321, [www.tnemec.com](http://www.tnemec.com)

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or equal, having following essential characteristics:

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**COMPOSITION:**

Self-priming, two component, solvent borne epoxy  
Lead and chromate free.

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**PHYSICAL CHARACTERISTICS:**

Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/semigloss

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**PERFORMANCE REQUIREMENTS:**

Fresh/deionized water immersion test, ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Direct impact, ASTM D 2794	20 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
Cathodic disbondment, ASTM G 8:	No disbondment 120 day test

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### **3.12 COLOR SCHEDULE**

- A. Color and gloss of finished coats to be selected by COR or BIA Representative.

**END OF SECTION**

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**SECTION 09 96 23**  
**GRAFFITI RESISTANT COATINGS FOR CONCRETE**

**PART 1 GENERAL**

**1.01 COST**

A. Cost:

1. Include in prices offered in the schedule for other items of work.

**1.02 REFERENCE STANDARDS**

A. ASTM International (ASTM)

1. ASTM D 968-05(2010) Method for Abrasion Resistance of Organic Coatings by Falling Abrasive
2. ASTM D 1005-95(2007) Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
3. ASTM D 1308-02(2007) Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
4. ASTM D 1653-03(2008) Methods For Water Vapor Transmission of Organic Coating Films
5. ASTM D 4138-07a Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means
6. ASTM D 4258-05(2012) Surface Cleaning Concrete for Coating
7. ASTM D 4259-88(2012) Abrading Concrete
8. ASTM D 4263-83(2012) Indicating Moisture in Concrete by the Plastic Sheet Method
9. ASTM D 4285-83(2012) Indicating Oil and Moisture in Compressed Air
10. ASTM D 4414-95(2007) Measurement of Wet Film Thickness by Notch Gages
11. ASTM D 5402-06(2011) Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
12. ASTM D 6132-08 Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage
13. ASTM D 6578-08 Determination of Graffiti Resistance

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- 14. ASTM F 1869-11 Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  - B. The Society for Protective Coatings (SSPC)/NACE International (NACE)
    - 1. SSPC-PA2-09 Measurement of Dry Paint Thickness with Magnetic Gages
    - 2. SSPC-SP13/NACE 6-03 Surface Preparation of Concrete
  - C. United States Bureau of Reclamation (USBR)
    - 1. USBR M 47-96 Standard Specifications for Repair of Concrete

### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
  - 1. Include following information with each set of data and/or reports:
    - a. Identification of items to be coated. Include all exposed concrete including spillway, structures related to outlet works, and other areas as indicated in the drawings and at the direction of the COR or BIA Representative.
- B. RSN 09 96 23-1, Approval Data:
  - 1. For each coating material:
    - a. Manufacturer’s product data, application, and MSDS sheets.
    - b. Include the following information:
      - 1) Supplier’s name, address, and phone number.
      - 2) Manufacturer’s designated product name.
      - 3) Identification of items to be coated.
  - 2. “Equal” Products:
    - a. For coating materials proposed as “equal” products to specified listed brand name products, submit following with specified approval data.
    - b. List of projects (not less than three) where material has been successfully used in applications similar to this project. Include:
      - 1) Project name and location.
      - 2) Type of structure.
      - 3) Owner’s name, address, and telephone number.
      - 4) Application dates.

- c. Manufacturer's certification substitute coating material meets specified requirements. Include:
  - 1) Manufacturer's name, address, and phone number.
  - 2) Batch number(s) for each material, except thinners.
  - 3) Signature of manufacturer's technical representative and date of signature.
- d. Certified test reports that demonstrates substitute material meets or exceeds specified coating category requirements for physical and performance characteristics from each of following:
  - 1) Coating manufacturer.
  - 2) Independent laboratory.

C. RSN 09 96 23-2, Final Approval Data:

- 1. For each coating material:
  - a. Purchase orders. Include:
    - 1) Supplier's name, address, and phone number.
    - 2) Purchase order number and date.
    - 3) Manufacturer's designated product name.
    - 4) Batch number(s) for each material, except thinners.
    - 5) Quantities ordered for each material, except thinners.
    - 6) Cleaning recommendations.

D. RSN 09 96 23-3, Documentation:

- 1. Written evidence showing each applicator's qualifications by training or experience for each coating.
  - a. When documenting qualifications by experience,
    - 1) Include list of 3 recent jobs using comparable materials under similar conditions.
    - 2) Include the owners contact information of 3 recent jobs.

## 1.04 QUALIFICATIONS

A. Coating Applicators Qualifications:

- 1. Qualified to apply specified coating materials by one of following:
  - a. Successfully completed training in application of coating materials similar to materials and conditions specified.

- b. Skilled and experienced in application of coating materials similar to materials and conditions specified.

**B. Compliance Criteria for Graffiti Resistant Coating Materials:**

1. Graffiti resistant coating system (primer, base coat, topcoat, and cleaner) shall be supplied by the same manufacturer.
2. Coating material is of same composition and formulation to meet physical and performance test results for one of following:
  - a. Submitted batch or previously tested batch materials complies with these specifications.
  - b. Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.
  - c. Submitted batch materials complies with manufacturer's QC and QA programs as listed on product data and application sheets.

**1.05 DELIVERY, STORAGE, HANDLING**

- A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.
- B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.
- C. Store materials in well ventilated area.
- D. Do not expose to direct sunlight during storage.
- E. Comply with manufacturer's storage instructions.
- F. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).

**1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Comply with coating manufacturer's environmental restrictions. Comply with most restrictive requirements of coating manufacturer's restrictions and these specifications when coating manufacturer's restrictions conflict with these specifications.
- B. Do not apply coatings under following environmental conditions:
  1. Substrate surface temperature less than 5 degrees Fahrenheit above dewpoint.



2. Air and substrate surface temperature less than 50 degrees Fahrenheit and not to exceed manufacturer's recommended maximum temperature limit.
  3. Humidity outside of manufacturer's recommended range.
- C. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.
- D. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heat and dehumidification required to maintain temperature and humidity conditions.

## **1.07 PERFORMANCE REQUIREMENTS**

- A. Provide Anti-Graffiti Coating System complying with the following:
1. Shows no sign of deterioration or change of appearance after graffiti materials removed during the 5-year warranty period.
  2. Capable of removing 100 percent of all types of paint and graffiti materials from the treated surfaces without damaging the coating or the substrate. No evidence of graffiti shall remain on the surface.
  3. Capable of withstanding a minimum of 100 cleaning cycles without measurable coating deterioration.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. General:
1. Provide compatible products of same manufacturer for coating system components.
  2. Compliance criteria for coating materials:
    - a. Material is of same composition and formulation to meet physical and performance test results for one of following:
      - 1) Submitted batch or previously tested batch materials complies with these specifications.
      - 2) Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's QC and QA programs.
      - 3) Submitted batch materials complies with manufacturer's QC and QA programs as listed on product data and application sheets.

B. Coatings:

1. Specified in Coating Categories.
2. Apply only one coating category per option in Coating Tabulations.
3. Volatile Organic Compounds (VOC):
  - a. Do not to exceed maximum permitted by Federal, Navajo Nation, and local air pollution control regulations.
  - b. Do not exceed maximum content as supplied in container or by addition of thinner material.
4. Factory color or tint. Do not color or tint at jobsite.
5. Use thinners recommended by manufacturer for each coating material.
6. Use of accelerator products is not permitted unless approved by CO.

**PART 3 EXECUTION**

**3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES**

- A. Protect items or surfaces not to be coated and adjacent to surfaces to be cleaned and coated from contamination and damage during cleaning and coating operations.
1. Includes surfaces and equipment in physical contact with areas being cleaned or coated.
  2. Protect from abrasive blast particles and airborne coating particles.
  3. Prevent damage from bumping or striking with foreign objects.
- B. Protect newly coated surfaces until coating is thoroughly dry or as determined by coating manufacturer's instructions.

**3.02 REPAIR OF CONTRACTOR-DAMAGED SURFACES**

- A. Repair surfaces which are damaged or contaminated as determined by CO.
1. Repair damaged surfaces to original condition and appearance.
  2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

**3.03 SURFACE PREPARATION**

- A. Before surface preparation and coating application, cure cementitious materials for 28 days, minimum.

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- B. Before coating application, the surface must be structurally sound, clean, dry and free of laitance, dust, dirt, oil, old coatings, form release agents and other contaminants that would interfere with the coating bonding to the concrete.
- C. Remove defective concrete, honeycombs, cavities and other defects to sound material. Smooth concrete surfaces must be cleaned and may be roughened, and made absorptive by abrasive blasting, high pressure water blasting, or mechanical means.
- D. Repair cementitious defects by one of the following:
1. In accordance with manufacturer's product instructions.
- E. Remove fungus, mold, and mildew on concrete surfaces before coating by one of following:
1. Wash brush affected area with solution of 5 ounces of trisodium phosphate, 3 ounces of household detergent, 1.25 percent sodium hypochlorite, and 3 quarts of warm potable water. After 24 hours, thoroughly flush with potable water. Repeat process if growth returns.
  2. Use commercial products formulated and suitable for removal. Follow manufacturer's instructions.
- F. Specific Surface Preparation:
1. Coating manufacturer's recommended standard surface preparation instructions.  
"and/or"
  2. Method T (concrete): SSPC-SP13/NACE 6, except as specified:
    - a. In accordance with ASTM D 4258, Surface Cleaning Concrete for Coating.
    - b. Section 4.3.3: Fractures and micro-cracks caused by impact tools are to be repaired in accordance with ASTM D 4259.
    - c. Following methods are not permitted:
      - 1) Section 4.3.3: Scabbling impact tool.
      - 2) Section 4.4: Chemical surface preparation.
      - 3) Section 4.5: Flame (Thermal) cleaning and blasting.
- G. Surface Profile for Concrete:
1. Prepare in accordance with manufacturer's instructions for cementitious materials and service environment.
  2. Where manufacturer's instructions do not specify a surface profile, prepare surfaces to appearance of medium (100) abrasive paper, minimum or:
    - a. Atmospheric Service Environments: 1-mil or greater angular profile and less than specified millage of first applied coat.

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- H. Moisture Content for Concrete:
    - 1. Test substrate surface for moisture content before applying coating.
    - 2. Perform one test per 1,000 square feet, minimum.
    - 3. Perform tests in accordance with moisture content inspection procedures specified and coating manufacturer allowable moisture content.
  - I. Re-clean or perform additional surface preparation of completed surfaces that become contaminated before coating application.

### **3.04 APPLICATION EQUIPMENT**

- A. Air Compressor and Spray Application Equipment:
  - 1. Provide appropriate type equipment, adequately sized, and in proper operating order.
  - 2. Equip with pressure gauges and pressure regulators.
  - 3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.
  - 4. Perform tests in accordance with oil and moisture inspection procedures specified.

### **3.05 COATING APPLICATION**

- A. Apply in accordance with manufacturer's instructions.
- B. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.
- C. Apply an even film of uniform thickness which tightly bonds to substrate or previous coat.
  - 1. Fill crevices and cover irregularities.
  - 2. Apply free of runs, pinholes, sags, laps, brush marks, voids, and other defects.
- D. Primer Coats:
  - 1. Cover peaks of surface profile with recommended dry film thickness as recommended by the coating manufacturer.
- E. Intermediate and Topcoats:
  - 1. Apply number of coats and coating thickness as recommended by the coating manufacturer.
  - 2. Apply within re-coat window recommended by manufacturer.

F. Cleaner or Remover:

1. Remove graffiti as soon as possible by cleaning small areas at a time.
2. Use coating manufacturer's recommended remover or commercially available removers and apply in accordance with the products recommendations.
3. If high-pressure water is used, care must be taken so as not to etch the substrate and remove the anti-graffiti coatings.

**3.06 CONTRACTOR FIELD QUALITY TESTING**

A. Equipment: Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D 4285. Remove oil or water before proceeding with work.

B. Measure moisture content of cementitious material on substrate surface by one of following methods:

1. Method 1:
  - a. ASTM D 4263.
  - b. Acceptance Criteria: No visible moisture.
2. Method 2:
  - a. ASTM F 1869.
  - b. Acceptance Criteria: Not to exceed 3 pounds of water per 1,000 square feet per 24 hours.
3. Method 3:
  - a. Moisture meter calibrated to manufacturer's recommendation.
  - b. Acceptance Criteria: Not to exceed coating manufacturer's maximum recommendation for moisture content.

C. Wet Film Thickness (WFT) Testing:

1. Inspect wet film thickness immediately after application in accordance with ASTM D 4414.
2. Compensate for reduced thickness to achieve specified thickness in Coating Tabulations.

“and/or”

D. Dry Film Thickness (DFT) Testing and Acceptance:

1. Inspect hardened coating system before re-coating interval has been exceeded for DFT compliance by one of following:
  - a. ASTM D 4138.
  - b. ASTM D 6132.

2. Number of tests and numerical averaging to meet corresponding ASTM inspection method used above:
  - a. ASTM D 4138: Average of 3 tests per 1,000 square feet.
  - b. ASTM D 6132: In accordance with SSPC-PA2.
3. Acceptance Criteria:
  - a. 80 percent of minimum specified thickness.
  - b. 125 percent of maximum specified thickness.
4. Repair areas tested by destructive method.

### **3.07 REPAIR OF DEFECTIVE COATED SURFACES**

- A. Repair within minimum and maximum re-coat window time in accordance with coating manufacturer's recommendations.

### **3.08 WARRANTY**

- A. The coating contractor shall warranty that they have installed the materials in compliance with the coatings manufacturer's manufacturer's recommendations and shall provide a 5-year warranty on the installed products.
- B. The anti-graffiti coating system will perform free from defects under normal un-sacrificial conditions for 5 years. Protection against future graffiti shall remain intact without need to re-apply the topcoat or other coatings.
- C. Defects are defined to include failure to withstand complete graffiti removal, ghosting, shadows, chemical staining, yellowing and any normal environmental effects.

### **3.09 ANTI-GRAFFITI COATING SYSTEMS**

- A. Anti-Graffiti Coating Systems shall be applied using spray, brush, or rolling and shall not be applied to damp or wet concrete. Application rates are dependent on the porosity and surface roughness of the concrete. If necessary apply a test patch to determine the primers actual coverage rate before starting the project.

Table 09 96 23A – Table No. 1

<p>- <u>Surfaces to be coated with Anti-Graffiti resistant coating systems</u> -</p>			
<p>a. Coat exposed concrete surfaces in atmospheric service.</p>			
<p>NOTES:</p> <ol style="list-style-type: none"> <li>1. A clear or non-color is required unless otherwise specified. Should a color be required, the color and gloss are to be selected by the COR or BIA Representative.</li> <li>2. Do not coat prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.</li> <li>3. Follow all manufacturers' standard instructions for application of anti-graffiti coatings.</li> <li>4. Substitutions will be considered in accordance with provisions of Section 1.03 Submittals, B, 1, 2 "Equal Products".</li> </ol>			
<p>COATING TYPE: Solvent borne polyurethane/urethane/silicon modified coatings:</p> <p>Product Qualifications: The anti-graffiti coating shall meet the following requirements:</p> <ol style="list-style-type: none"> <li>1. Solvent: Solvent borne.</li> <li>2. VOC Content: Less than 340 grams per liter.</li> <li>3. Cleaning Cycles: ASTM D 6578; Cleanability Level 1, 2, 3, 4, or 5.</li> <li>4. MEK Double Rub: ASTM D 5402 with 50 rubs; No coating wear through (4 minimum rating).</li> <li>5. Fluid Resistance: ASTM D 1308; no blisters, discoloration, softening or adhesion loss.</li> <li>6. Abrasion Resistance: ASTM D 968 with 1000 liters of sand; no loss of coating thickness per ASTM D 1005.</li> <li>7. Ultraviolet light stability: Excellent.</li> </ol>			
PRODUCT	MANUFACTUER	TYPE	VOC
Tamms AG 400 Permanent Anti-Graffiti Coating	Euclid Chemical Co. 19218 Redwood Rd., Cleveland, OH 44110 1-800-321-7628	two component aliphatic urethane	118g/l basecoat, 330g/l topcoat
MC-Antigraffiti 100	Wasser Corporation 4118 B Pl. NW Suite B, Auburn, WA 98001 1-800-627-2968	single component moisture cure aliphatic urethane	100g/l
FX-441 Anti-Graffiti System	Fox Industries Baltimore, MD 1-8880760-0369	two component aliphatic urethane	340g/l
Blok-Guard & Graffiti Control Ultra	Prosoco 3741 Greenway Circle, Lawrence, KS 66046 1-800-255-4255	single component silicon elastomer	100g/l

**END OF SECTION**

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## SECTION 10 14 00

### SIGNAGE

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

###### A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install signage.
  1. CONTRACTOR shall be responsible for all signage furnished under this Section for the entire Project in accordance with the Contract Documents.
2. Extent of signage is shown and specified.
3. Types of products required include the following:
  1. Exit signs.
  2. Warning, Floor loading and fire extinguisher location signs.
  3. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

###### B. Coordination:

1. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections to ensure compatibility of signage mounting accessories with various surfaces on which signage will be installed.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before signage Work.

##### 1.02 REFERENCE STANDARDS

###### A. Aluminum Association (AA).

1. AA DSA-45, Designation System for Aluminum Finishes.

###### B. American Society of Mechanical Engineers (ASME).

1. ASME A13.1 Scheme for the Identification of Piping Systems.

###### C. American National Standard Institute (ANSI) in cooperation with International Code Council (ICC).

1. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.

###### D. C. American National Standard Institute (ANSI).

1. ANSI Z535.1, Marking Physical Hazards Safety Color Code.

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2. ANSI Z535.2, Environmental and Facility Safety Signs.
  3. ANSI Z535.3, Criteria for Safety Symbols.
- E. ASTM International (ASTM).
1. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
  2. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
  3. ASTM E527, Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS).
- F. Copper Development Association (CDA).
1. CDA, Properties of Cast Copper Alloys.
- G. National Fire Protection Association.
1. NFPA 704, System for the Identification of the Hazards of Materials for Emergency Response.
- H. Underwriter Laboratories (UL).
1. UL 924, Safety of Emergency Lighting and Power Equipment.

### **1.03 QUALITY ASSURANCE**

- A. Qualifications:
1. Signage Manufacturers:
    1. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
    2. Submit to COR name and experience record of manufacturers.
- B. Component Supply and Compatibility:
1. Obtain each separate type of signage from a single Supplier and from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable requirements of the following:
1. OSHA, 29 CFR Part 1910.1200, Hazard Communication Standard.
  2. OSHA, 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances.
  3. OSHA, 29 CFR Part 1910.144, Safety Color Code for Marking Physical Hazards.
  4. OSHA, 29 CFR Part 1910. 145, Specification for Accident Prevention Signs and Tags.

5. United States Access Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines.
6. Americans with Disabilities Act (ADA), Public Law 101-36, 28 CFR Part 36, Appendix A, Accessibility Guidelines for Buildings and Facilities (ADAAG), relative to characters and symbols contrast only.

#### **1.04 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. RSN 10 14 00-1, Shop Drawings:
  1. Schedule of all signage required for the Work, indicating signage type location, and other information to demonstrate compliance with the Contract Documents.
  2. Fabrication and erection information for each type of signage.
  3. Valve schedule for small-diameter valves, in accordance with this Section.
  4. Complete selection of each specified manufacturer's standard and custom graphic layouts and pictograms, colors, and alphabetic/text styles.
  5. Full-size graphic layout drawings for plaques, individual dimensional letters and numbers, and other items where final graphic appearance is necessary prior to signage fabrication, incorporating all required graphic features specified or shown.
  6. Mounting and Installation Data:
    - 1) Drawings of and information on anchorages and accessory items.
    - 2) Submit location template drawings for items supported or anchored to permanent construction.
    - 3) Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plan drawings showing locations of required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by authorities having jurisdiction.
2. RSN 10 14 00-2, Product Data:
  1. Copies of manufacturer's technical data, including catalog information and specifications, for each product specified.
3. RSN 10 14 00-3, Samples:
  1. Each color and finish of exposed materials and accessories required for signage.
  2. Sample Signage:

- 1) Full-size Sample of each type of permanent room and space identification sign, and informational and directional sign incorporating all features specified.
  - 2) Full-sized Sample of each type (such has snap-on, strap-on, and adhesive) of pipe marker proposed for use with mounting accessories.
  - 3) Full-sized Sample equipment nameplate, valve tag, pipe tag, and accessories. Stamp valve tag with information shown on valve schedules. When not indicated in the Contract Documents, information on the type of coding system will be furnished to CONTRACTOR by ENGINEER.
  - 4) Full-sized Sample right-to-know signs, labels and tags.
  - 5) Full-size representative sample of each individual-type letter and number specified, demonstrating alphabetic style/text type, material, color and finish specified.
3. ENGINEER's review of Samples will be for color and texture only. Compliance with other requirements is CONTRACTOR's responsibility.

B. RSN 10 14 00-4, Manufacturer's Instructions:

1. Templates for anchorages to be installed in concrete or masonry.
2. Manufacturer's instructions and recommendations for support and foundations of signs installed outdoors.

C. RSN 10 14 00-5, Warranty Documentation:

1. General and special warranties required under this Section.

## 1.05 WARRANTY

A. General Warranty: The special warranty specified for each type of sign in this Article shall not deprive BIA of other rights or remedies BIA may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by COR under the Contract Documents. The obligations of COR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.

B. Special Warranty on Products:

1. Provide each signage manufacturer's written warranty, running to the benefit of BIA, agreeing to correct, or at option of BIA, remove or replace materials specified in this Section found to be defective during a period of five years after the date of Substantial Completion.
2. Special warranty shall cover defective Work that includes, but is not limited to, the following:

1. Deterioration of metal and polymer finishes beyond normal weathering.
2. Deterioration of embedded graphic image colors and sign lamination.

## **PART 2 PRODUCTS**

### **2.01 SYSTEM PERFORMANCE**

#### **A. General:**

1. Details shown or indicated for signage, such as alpha-numeric and text type representation, letter spacing, designs of borders, and other graphic features, are generic and intended only to establish text, general positions, and symbols.
2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.

### **2.02 PHOTO-LUMINESCENT EXIT SIGNS**

#### **A. Products and Manufacturers: Provide one of the following:**

1. Series 90.8924 Photoluminescent Exit Signs by EverGlow NA, Inc.
2. Series 2002 by Active Safety Corporation.
3. Or equal.

#### **B. Photo-luminescent Exit Signs:**

1. Provide photo-luminescent exit signs with single- and double-face dimensions of nine inches by 14.25 inches by 3/4-inch deep.
2. Sign housing shall consist of an AA-A42 color anodized extruded aluminum frame and legend protected by a temper-resistant polycarbonate shield.
3. Size, graphics, and background colors of sign legend shall comply with Laws and Regulations.
4. Sign Letters and Directional Arrows. Furnish signs with photo-luminescent luminous letters and directional arrows.
5. Signs shall comply with UL 924 and be constructed for 15-year service life each.
6. Rated Viewing Distance: 75 feet.
7. Provide manufacturer's standard universal mounting brackets, extended wall and ceiling mounting brackets, pendant mounting brackets, and recessed mounting brackets as required by mounting surface and exiting conditions, or as shown.

### **2.03 PANEL SIGNS –WARNING, FLOOR LOADING, AND FIRE EXTINGUISHER LOCATION**

- #### **A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade-resistant embedded graphics.**

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- B. Products and Manufacturers: Provide one of the following:
1. Graphic Blast Word and Picture Series, by Best Sign Systems, Inc.
  2. Blast Etched Fiberglass Signs, by Visigraph Corporation.
  3. Or equal.
- C. General:
1. Size and Thickness: 0.125-inch thick; 10 inches by 14 inches, unless otherwise shown or indicated.
  2. Graphics and Text: Standard Helvetica Medium characters and matching arrow type-face; upper and lower case, one-inch high capitals and, in addition, Grade 2 Braille alphabet message designations and other text.
  3. Exposure: As recommended by sign manufacturer for both indoor and outdoor use and with an upper service temperature limit of 190degrees F. Average durability for outdoor use shall be 15 years.
- D. Danger Signs: Standard color of sign background shall be white; panel shall be black with red insert with white letters and numbers. Letters and numbers used against white background shall be black.
- E. Warning Signs: Standard color of sign background shall be orange; panel shall be black with orange insert with black letters and numbers. Letters and numbers used against orange background shall be black.
- F. Floor Loading Signs: Standard color of sign background shall be white; panel shall be blue with white letters and numbers. Letters and numbers used against white background shall be black.
1. Floor Loading: 250 Pounds per Square Foot (PSF)
- G. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of sign background shall be red with white letters and numbers. Each sign shall include international fire extinguisher pictogram and directional arrow indicating location of fire extinguisher.
- H. Auxiliary Products:
1. Mounting Brackets: Provide sign manufacturer's standard mounting brackets for installing projected or double-sided signs.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Clean reinforcement surfaces of heavy, flaky rust; loose mill scale; dirt; grease; and other foreign substances before placement.

- B. Accurately place and secure in position so that reinforcement will not be displaced during concrete placement.
- C. Field bending not allowed unless approved by COR or BIA Representative.
- D. Do not weld or tack weld reinforcing bars unless shown on drawings.
  - 1. All welded reinforcing bars shall be ASTM A 706, Grade 60.
- E. Place reinforcement with a clear distance of 1-inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on drawings.
- F. Tolerances:
  - 1. Maintain concrete cover over reinforcement within 1/2-inch of specified cover where specified cover is greater than 2-1/2 inches.
  - 2. Maintain concrete cover over reinforcement within 1/4-inch of specified cover where specified cover is 2-1/2 inches or less.
  - 3. Maintain spacing of reinforcing bars within 1-inch of required spacing.
- G. Plain Dowels:
  - 1. Place dowels per contract drawings.
  - 2. Position dowels parallel to each other and to concrete surface.
  - 3. Maintain dowels accurately in position during concrete placement.

**END OF SECTION**

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**SECTION 10 44 00**  
**FIRE PROTECTION SPECIALTIES**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all fire protection specialties Work.
2. Extent of fire protection specialties Work is shown and specified.
3. Types of fire protection specialties Work required includes:
  - a. Dry chemical extinguishers.
  - b. Carbon dioxide extinguishers.
  - c. Mounting accessories and miscellaneous fasteners.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before fire protection specialties.

C. Related Sections:

1. Section 10 14 00, Signage.

**1.02 REFERENCE STANDARDS**

- A. UL Fire Classification Rating.

**1.03 QUALITY ASSURANCE**

A. Component Supply and Compatibility:

1. Provide fire protection specialties products from one manufacturer.

- B. Regulatory Requirements: Provide fire protection specialties approved and labeled by UL.

**1.04 SUBMITTALS**

A. Action Submittals:

1. RSN 10 44 00, Product Data:
  - a. Manufacturer's technical data, certification of UL rating, and installation instructions for fire protection specialties.

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## **PART 2 PRODUCTS**

### **2.01 FIRE EXTINGUISHERS**

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified.
- B. Multi-Purpose Dry Chemical Fire Extinguishers:
  - 1. Ten-pound capacity, enameled steel container with pressure indicating gauge, for Class A, Class B, Class C fires, UL rating 4A 60 BC.
  - 2. Products and Manufacturers: Provide one of the following:
    - a. Cosmic Model 10E by J.L. Industries.
    - b. Or equal.
- C. Carbon Dioxide Fire Extinguishers:
  - 1. Ten-pound enameled steel container capacity, for Class B and Class C fires UL rating.
  - 2. Products and Manufacturers: Provide one of the following:
    - a. Sentinel Model 10 by J.L. Industries.
    - b. Or equal.

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. Examine substrates and conditions under which fire protection specialties will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to ENGINEER.

### **3.02 INSTALLATION OF FIRE EXTINGUISHERS**

- A. When exact locations of fire protection specialties are not shown on Drawings, locate as directed by ENGINEER.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be:
  - 1. Install fire extinguishers with gross weight greater than 40 pounds with top of fire extinguisher no more than 3.5 feet above finished floor.
  - 2. Install fire extinguishers with gross weight less than 40 pounds with top of fire extinguisher no more than 4.0 feet above finished floor.

3. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.
- C. Identification Devices: Provide signs level and plumb directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate per sign manufacturer's instructions. Signage shall be per Section 10 14 00 – Signage.
- D. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform OWNER in writing of next required inspection and recharging date.

### **3.03 FIRE EXTINGUISHER SCHEDULE**

- A. Type A – Dry chemical, wall mounted.
- B. Type B – Carbon dioxide, wall mounted.

**END OF SECTION**

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**SECTION 13 34 13**  
**VAULT TOILETS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section describes the precast toilet facilities. The toilet facility shall be a “Clovermist Double” style toilet as provided by Boom Concrete, Inc. (or approved equal).

**1.02 MEASUREMENT AND PAYMENT**

- A. Vault Toilet Building:
1. Payment: Lump sum price offered in the schedule.
    - a. Includes construction, onsite placement of a prefabricated precast concrete double vault toilet building, access ramp, bollards, and site grading.

**1.03 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI)
1. ACI 1211.1 Recommended Practices for Selecting Proportions for Normal and Heavyweight Concrete
- B. ASTM International (ASTM)
1. ASTM A 615 Reinforcing Steel
  2. ASTM A 185 Welded Wire Mesh
  3. ASTM C 33 Concrete Aggregates
  4. ASTM C 39 Method of Test for Compressive Strength of Cylindrical Concrete Specimens
  5. ASTM C 143 Method of Test for Slump of Concrete
  6. ASTM C 150 Standard Specification for Portland Cement
  7. ASTM C 192 Method of Making and Curing Test Specimens in the Laboratory
- C. Precast Concrete Institute (PCI)
1. MNL 116 Quality control for Plants and Production of Precast Pre-stressed Concrete Products
- D. United States Forest Service (USFS)
1. PN 9123 1601 In Depth Design and Maintenance Manual for Vault Toilets

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**1.04 Manufacturer:**

- A. Manufacturer shall be Boom Concrete, Inc. or an approved equal.
- B. Manufacturer will provide a written warranty against defective materials and/or workmanship for a period of 20 years from date of delivery.
- C. All non-concrete components such as windows, vents, vault toilet risers, grab bars, toilet paper dispensers, doors, locksets, dead bolts, door sweep, door stops, coat hooks, signs, and vault vent pipe shall carry a 1 year warranty from date of delivery.
  - 1. Vault plastic liner will include a water tightness warranty for a period of 7 years from date of purchase.
  - 2. Defects in paint, caulk, and grout shall carry a 3 year warranty.

**1.05 Design Criteria**

- A. Vault restroom will be manufactured using precast concrete including the roof. Building's structural design will be relevant to the region and properties associated with its final placement.
- B. Vault restrooms shall be designed to meet the following criteria:
  - 1. Snow Load: The vault restroom will withstand a snow load of 25 pounds per square foot.
  - 2. Wind Load: The vault restroom will withstand the effects of 90 mile per hour wind (3-second gust), Exposure C.
  - 3. Seismic Loads: The vault restroom will withstand the effects of seismic loads based on the following:
    - a. Latitude / Longitude: 39.910° / -109.0407°
    - b. Soil Site Class D
    - c. Seismic Importance Factor of 1.0
  - 4. Floor Load: The vault restroom will withstand loads of 400 pounds per square foot.
  - 5. The vault restroom shall meet the requirements of the Americans with Disabilities Act Requirements and Uniform Federal Accessibility Standards as of the date of these specifications.
  - 6. The vault restroom shall have a full 60-inch turning diameter in each interior and entry area.
  - 7. The vault restroom shall incorporate all design aspects of Sweet Smelling Technology as outlined in USFS PN 9123 1601.
  - 8. Tolerances: Tolerances will be within limits as dictated by PCI MNL 116.

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## **1.06 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 13 34 13-1, Certifications and Data:
  - 1. Vault Toilet Certifications and Data:
    - a. Manufacturer’s certification that vault toilet meets quality, design, and service requirements.
    - b. Manufacturer’s warranty against structural, hardware, paint, caulk, and grout defects.
  - 2. Qualifications:
    - a. Installation Company: Name and address.
    - b. Documentation of previous experience installing prefabricated buildings and insurance against defect in installation.
    - c. Manufacturer: Name and address.
    - d. Evidence of manufacturer experience.
    - e. Manufacturer’s NPCA Certified Plant with verifiable references.
  - 3. Installation Plan:
    - a. Manufacturer’s instructions for delivery, storage, and installation of precast vault toilets.

## **PART 2 PRODUCTS**

### **2.01 Materials**

- A. Bedding Material
  - 1. Bedding material to be sand or 3/8” minus crushed or screened aggregate.
- B. Concrete
  - 1. Concrete shall contain proper portions of cement, aggregate, and water to obtain concrete with good workability.
  - 2. Minimum concrete strength shall be 4,500 pounds per square inch at 28 days.
    - a. Cement shall be ASTM C 150 Type II or Type V.
    - b. ASTM C 33 with designated size of coarse aggregate No. 67 (3/4” to No. 4).
    - c. Potable water with minimum water cement ratio.
    - d. Slump shall be 4” +/- 1-inch, follow ASTM C 231.
    - e. Air content shall be 5.5 percent +/- 1.5 percent as per ASTM C231.

- f. Addition of air-entrained admixtures shall conform to ASTM C 260
  - g. Addition of water reducing admixtures shall conform to ASTM C 494, Type A.
  - h. Use of other admixtures is subject to approval.
  - i. Curing compounds shall be colorless complying with ASTM C 309, Type I or I-D.
3. Colored Concrete – Color requirements for precast toilets
- a. Roof Color: Sandstone/Teakwood – Boom Concrete (or equal)
  - b. Wall Color/Texture: Barnwood-Sandstone – Boom Concrete (or equal)
  - c. The toilet building roof, wall panels to floor line, and screen panels shall be precast with integrally colored concrete where appropriate.
  - d. The same type and brand of cement, color, aggregates, and other additives shall be used throughout. In addition, as far as is reasonably practicable, all ingredients shall be from the same lot or manufacturing process. Aggregates shall be from the same source.
  - e. All volumes of concrete shall be uniform in all respects to ensure uniformity of the color of the finished concrete. All ingredients shall be weighed. All color by weight as recommended by the manufacturer of the concrete color. The mixing operations shall be adequate to uniformly disperse the color throughout each batch. A 12” x 12” x 1” color sample shall be available for customer approval.
  - f. Wash and thoroughly clean the mixer and transporting equipment before mixing colored concrete.
  - g. Color additive shall be the color specified on the delivery order. Standard schedule of colors shall be available from manufacturer.

C. Concrete Reinforcement

1. All reinforcing steel shall conform to ASTM A615. All welded wire fabric shall conform to ASTM A185.
2. All reinforcement shall be new, free of dirt, oil, paint, grease, mill scale, loose or rust when placed. Reinforcement shall be stored on blocks or saw horse off the ground in a manner to prevent bending, rusting, and accumulation of dirt or soil.
3. Reinforcement shall be installed as shown on the drawings and if details of reinforcement are not shown shall be in accordance with ACI 318.
4. Steel reinforcement shall be centered in the cross-sectional area of the concrete member unless otherwise specified on the drawings.
5. Welded wire mesh in flat sheet form may be substituted in place of reinforcing steel in the roof slab and the exterior slab. The steel area of the wire mesh must be equal to or greater than the steel bar area. No more than two layers of welded mesh shall be allowed in any concrete section to provide the required steel area.



Mesh openings for two layers of mesh shall be shifted ½ mesh grid size both ways.

6. Adequate placement and support of reinforcing steel and wire mesh in final position shall occur before starting placement of concrete.
7. Reinforcing steel shall be continuous around corners between adjacent walls. Full lengths of reinforcing steel shall be used whenever possible and the number of splices shall be kept to a minimum. On long runs, splices shall be alternated from opposite sides of the component for adjacent steel bars.

D. Concrete Sealers

1. Clear, colorless polysiloxane resin penetrating sealer for weatherproofing concrete which meets performance requirements of Federal Specification SS-W-110b.
2. Weatherproofing sealer for exterior of building shall be transparent, non-yellowing methyl methacrylate acrylic resin sealer, minimum 20% solids, for weatherproofing concrete exteriors. Low luster finish.

E. Caulking, Grout, Adhesive and Sealer

1. In accordance with Federal Specifications TTS-01543A, BASF Sonolastic NP 1 Polyurethane Sealant or equal shall be used with standard colors of white for inside surfaces and color to match the exterior.
2. Epoxy concrete adhesive shall be two components rigid, non-sag gel adhesive for bonding to dry or damp surfaces, moisture insensitive. Gray or other approved color.
3. Portland cement mortar shall consist of one part Portland cement, three parts sand and enough water to make a workable mixture.

F. Paint

1. All paints and materials shall conform to all Federal specifications or be similar “top-of-the-line components”. Paints shall be lead free. Standard paint materials and finish shall be as follows:
2. Metalwork, Steel Doors:
  - a. Factory Primed
    - 1) Metalwork and steel doors shall be primed with a one coat zinc dust metal primer, Federal Specification TT-P-1046A. Primer not required on items delivered shop primed.
    - 2) A minimum of one coat semi-gloss alkyd exterior enamel as per Federal Specification TT-509 Class A shall be applied to all metalwork. The color of enamel shall be dark brown, Federal Standard #595A.
  - b. Factory Powder Coat

- 1) Metalwork and steel doors shall be powder coated by the manufacturer using Sherwin Williams 410 Teakwood brown finish.
- c. The interior walls shall be painted using a two part, high gloss polyamide epoxy enamel, white in color with a minimum of one primer coat and one color coat; or 2 coats of a modified acrylic, water repellent penetrating stain.
- d. Interior floors shall be a one or two part, high gloss polyamide epoxy enamel, tan or grey in color. There shall be a minimum of one primer coat and one color coat.
- e. Exterior concrete surfaces.
  - 1) Exposed Aggregate surfaces shall be sprayed with a clear, water based penetrating sealer with water repellent and graffiti resistant properties.
  - 2) Barnwood surfaces shall be sprayed with 2 coats of water repellent penetrating stain in the same color as the walls followed by one coat of anti-graffiti sealer.
  - 3) Cedar shake textured roof units shall be sprayed with two coats of dark brown water repellent penetrating stain. Upper surface of roof units shall be a dark color to aide positive airflow through the solar heat chamber in roof.
  - 4) Exterior slabs shall be 1 coat of clear sealer.

G. Toilet Riser

1. Toilet Riser for the vault toilet shall be 18" high, white cross linked polyethylene, with heavy duty seat and lid, as manufactured by Romtec, Roseburg, OR (or equal). The color shall be white with safety bars consisting of one 3/4" stainless steel bars centered in the riser.

H. Grab bars

1. Stainless steel, 18 ga. material, satin non-slip finish, 1 1/2" outside diameter tubing, mounted with 1 1/2" wall clearance for handicapped, with concealed screw mounting flanges as manufactured by Tubular Specialties Manufacturing (or equal).

I. Toilet Paper Dispenser

1. Bar-type toilet paper dispenser shall be constructed of stainless steel with satin finish, designed to hold three standard rolls of toilet paper. All corners shall be rounded and the holder shall consist of two mounting brackets (predrilled and slotted) and one lockable bar.

J. Signs

1. Supply one MEN'S and one WOMEN'S toilet signs.
2. Supply appropriate signage to meet ADA-ABAAG standards. The required signs shall be mounted on the exterior wall of the toilet building adjacent to the latch side of the door. Signs shall be attached and trimmed using a color matched Polyurethane Sealant.
3. Signs shall be 6"x 9" made of clear Lexan polycarbonate plastic with standard white recreation symbols or text on a brown background.
4. Message "RESTROOM" shall be in raised Grade 2 Braille across the bottom of the sign.

K. Windows

1. Glazing
  - a. Supply one 20" x 36" window with 1/4" Lexan polycarbonate pebble finished glazing clear/opaque in color per toilet (two total).
2. Steel Frame
  - a. The window frame shall be 16 ga. metal frame suitable for casting or installation in concrete wall. The frame wall thickness shall be plus or minus 1/4". One coat of baked on primer coating shall be factory applied or factory powder-coated using Sherwin Williams #410 Teakwood finish.

L. Steel Doors

1. Steel Door - A 3'-0" x 6'-8" steel flush door shall be installed in each toilet. It shall be 1 3/4" thick, 18 gauge steel panels, 16 gauge internal bracing channels and 14 gauge hinge and lock rail of one piece construction. One coat of baked on primer coating shall be factory applied or factory powder-coated using Sherwin Williams #410 Teakwood finish. Doors shall be Lockseam LS-series by Shanahan's Manufacturing Ltd. (or equal).
2. Steel Door Frame shall be welded type, single rabbet, that is a minimum 16 gauge steel, suitable for installation in precast concrete. Three rubber door silencers shall be installed on the latch side of the door frame. Door frame shall be factory primed with one coat of baked on coating or factory powder-coated using Sherwin Williams #410 Teakwood finish. Frames shall be FW- series by Shanahan's Manufacturing Ltd. (or equal).
3. Spring Door Hinges shall be 1-1/2 pair wrought steel, 4 1/2" x 4 1/2", adjustable tension, anti-friction bearing, non-removable pin, automatic closing, in a satin brass finish. Hinges shall be #1250 by Hager Companies (or equal).
4. Provide a chain door check to control door swing under windy conditions. Chrome plated zinc alloy base with welded galvanized steel chain attached with #8 self-tapping screws. Tear resistant grey EDPM rubber UV protection cover with a 440 pound load strength. Door check # 300D by Hager Companies (or equal).
5. Lockset

- a. Commercial grade, heavy-duty cylindrical lockset for exterior door. UL listed complies with ASNI A156.2, series 4000, grade 1, function F76-1 and meets ADA-ABAAG standards for a toilet lock. Lockset shall be satin brass finish. Lockset shall be 3400 Series Lever by Hager Companies (or equal).
  - b. Lever handles inside and outside with the end of handles return to within ½” to ¾” of door surface.
  - c. Either handle operates latch unless outside handle is locked by inside push-button.
  - d. Push-button shall automatically release when inside lever handle is turned or door is closed.
  - e. Lockset shall have an emergency slot on exterior so door can be unlocked from the outside with a screwdriver. Inside lever shall always be active.
  - f. Deadbolt - Mortised type, operated by key from outside only, keyed to existing or provided key. Deadbolt shall be 3100 series by Hager Companies (or equal).
6. Bumpers
- a. Wall Bumpers shall have a cast metal base, satin brass finish, convex gray rubber bumper with a 2 3/8” diameter and 1” projection, suitable for installation on exterior of steel door. Wall bumpers shall be #236W by Hager Companies (or equal).
7. Door Louvers
- a. Door Louvers shall consist of non-vision, two-piece, exterior door louver for mounting on each side of door. Fiberglass or nylon insect screen with an 18-14 mesh installed in an aluminum frame between louvers. Frames shall have one coat of factory applied baked on primer and sprayed with finish coat to match door. Door louvers shall be Model 700A by Air Louvers Inc. (or equal).
8. Door Sill Seal
- a. Provided at the bottom of door and shall be extruded aluminum channel with one-inch legs on each face of door with vinyl insert on bottom. Door Sill Seal shall be #782S by Hager Companies (or equal).
9. Double Coat Hook
- a. A double coat hook of stainless construction with a satin finish and nail in anchor may be installed. Upper hook shall extend at least 2 1/2” from wall and lower hook extend 1 1/4” from wall. Mounting height shall be a maximum of 48” from floor to center of coat hook. Double coat hook shall be #895 by Tubular Specialties, Inc. (or equal).
- M. Vault Cleanout - The vault cleanout shall be located on the back of the toilet and be 12” Polylok plastic risers (or equal) embedded into the sidewall of the vault at a 60 degree

angle to the center of the vault. Risers shall extend to 4" above grade and be sealed with a plastic lid. Risers and lid are water and air tight and lock together with stainless steel screws.

- N. Vault Vent Pipe shall be polyethylene plastic pipe, 12" DR21, PE 3608 high density, black color, UV stabilized HDPE pipe manufactured by WL Plastics (or equal).
- O. Vault and Liner
  - 1. Standard Vault configuration shall include a precast concrete vault with a minimum wall thickness of 3". The inside of the vault shall be allowed to cure for seven days and then be coated with two coats of Conseal CS-55 applied with a paint roller. The vault/liner shall have a 5-year warranty against leakage.
  - 2. Vault Liner shall consist of a one-piece molded .22" thick LDPE plastic liner by Snyder Industries, Inc (or equal). The LDPE plastic liner shall be warranted against leaks for a period of 7 years.

## **2.02 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Vault Toilet Manufacturers:
    - a. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
    - b. Submit to Engineer name and experience record of manufacturers.

## **PART 3 EXECUTION**

### **3.01 PRECAST CONCRETE VAULT TOILET BUILDING MANUFACTURE**

- A. Building manufacturer shall construct, assemble, and paint at their plant so that it may be transported to the jobsite as a finished module and placed using a crane.
- B. Concrete Forms
  - 1. Steel forms shall be sufficiently rigid to prevent distortion due to pressure of the concrete during placement, vibrating, and curing of concrete.
  - 2. Form ties will not be used in any concrete.
  - 3. Forms will be constructed to allow the interior surface of walls, ceiling, and vault to have a steel form finish. Upper surface of the roof slab will have a steel-trowel finish standard with other optional textures by means of form liner.
  - 4. Form liner patterns shall be continuous pattern match.
- C. Reinforcement

1. All reinforcing steel and wire mesh will be put in place and supported in final position prior to placement of concrete.

D. Concrete

1. Placement - Concrete will be poured in layers not more than 24" deep. Vibrators or tampers will not be used to move concrete.
2. Vibrating:
  - a. The concrete will be consolidated with suitable mechanical vibrators operating within the concrete or attached to the steel forms.
  - b. Vibration will be done at all points to sufficiently accomplish compaction and not prolonged to a point where segregation would occur.

E. Construction and Execution

1. The walls will be a minimum of 4" thick and the floors 5" unless otherwise specified on the drawings.
2. Standard exterior surfaces of all colored concrete components shall have exposed aggregate finish. The exposed aggregate finish will be accomplished by sandblasting, brushing, or other approved methods that will remove 1/8" to 1/4" of cement mortar from surface of concrete. The Manufacturer will have available a 12" x 12" colored sample with the exposed aggregate finish for approval. Other optional exterior finishes will be available.
3. Any exterior exposed aggregate finish will be cleaned, allowed to dry and a concrete sealer will be applied as recommended by the manufacturer.
4. The four sections of the concrete building will be joined at the seam with epoxy concrete adhesive and/or four weld plates, two on top and two on bottom. Excess epoxy will be removed flush with concrete surfaces.
5. The floor slab will be fabricated with a 1" to 2" inch high raised concrete cove around the perimeter except in the door opening.
6. Interior vertical wall surfaces will have all depressions and small rock pockets filled with cement mortar while concrete is still green and within one day of form removal.
7. Patching of holes, chips, exposed reinforcement, and other defects on the exterior of the building will be done with a Portland cement-based patching material with the color, finish, and texture of the patched surface matching the surrounding concrete.
8. Signs will be installed on building as shown on drawings per ADA-ABA guidelines.
9. All hardware will be installed in accordance with manufacturer's instructions after finish paint work is completed.
10. Spring hinges will be adjusted after the building is installed to meet the following criteria:

- a. Maximum force for pushing or pulling open the door shall be five pounds.
  - b. The door shall take at least three seconds to move from an open position of 70 degrees to a point three inches from the latch, measured to the leading edge of the door.
11. Wall bumpers will be installed on outside of steel door as shown on drawings to contact concrete wall near edge of the building.
  12. Glazing will be installed as shown on drawings with glazing strips on the exterior side of the glazing, secured a maximum of ten inches on center with corrosion resistant Phillips metal screws.
  13. Tan or grey concrete enamel on the floor shall extend around the cove at the junction of the wall and floor. Line between the tan or grey floor enamel and white wall enamel shall be straight and parallel to the floor.
  14. Concrete surfaces will be allowed to adequately cure and surfaces will be prepared for application of paints as recommended by the paint manufacturer.
  15. Interior and exterior joints between concrete and steel frames of doors will be caulked and joints will be smoothed with a concave surface tool.

### **3.02 INSTALLATION**

#### **A. Scope of Work:**

1. Work specified under this Section includes, unless otherwise noted, site location, excavation, backfill, and placement of precast concrete vault toilet.

#### **B. Location and Access to the Site:**

1. Contractor shall verify that bridges/culverts in-route to the site are rated for HS-20 loading.
2. Contractor shall provide adequate access and a level pad for the crane and semis to sit side by side under their own power. Working radius shall be 35 feet from center pin on crane.
3. Contractor shall provide all excavation, backfilling, and finish grading for vault toilet building. In addition, Contractor shall provide suitable bedding of sand material for the vault, as approved by COR.

#### **C. Excavation and Elevation**

1. Comply with all applicable OSHA Standards for excavation.
2. The Boom Clovermist Double vault toilets requires an excavated hole that is 15' long by 9' wide and the depth shall be 52.5" below finished grade.
3. Finish floor elevation will be 4 inches above natural grade measured at the front (entrance) of the exterior slab unless otherwise approved by the COR.

#### **D. Bedding and Compaction**

1. Compact the natural ground at the bottom of the vault excavation with a whacker-type mechanical compactor or equivalent approved by the manufacturer.
2. Install sand or aggregate bedding material for leveling course. Compact leveling course so there will be no high spots in the middle of the vault bottom.
3. Set vault in place. Backfill around the structure. Use Zone 1 material for backfill.
4. Fill, adjacent to the building entry, will have excavated material placed in eight inch loose lifts and compacted with a whacker-type mechanical compactor or equivalent.

E. Finish Grading

1. Spread excess excavated material from the vault around structure. Intended final grade is flush with the top of the front slab. Allow for placement of topsoil to reach that grade. Grade back fill away from structure at maximum slope of five (5) percent unless otherwise approved by the COR.
2. Spread stockpiled topsoil as final layer after rough grading is completed.

**END OF SECTION**



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**SECTION 23 37 01**  
**BULLET RESISTANT LOUVERS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Bullet Resistant Louvers:

1. Payment: Include in prices offered for other items of work.

**1.02 REFERENCE STANDARDS**

A. American Society of Mechanical Engineers (ASME)

1. ASME B18.2.1-2010 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

B. ASTM International (ASTM)

1. ASTM A 36/A 36M-08 Carbon Structural Steel
2. ASTM A 90/A 90M-11 Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings
3. ASTM A 123/A 123M-09 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A 307-10 Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
5. ASTM A 563-07a Carbon and Alloy Steel Nuts
6. ASTM A 653/A 653M-11 Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
7. ASTM A 924/A 924M-10a General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

C. American Welding Society (AWS)

1. AWS D1.1/D1.1 M-2010 Structural Welding Code – Steel

D. Federal Specifications (FS)

1. FS FF-S-92B-1975 Screw, Machine, Slotted, Cross Recessed or Hexagon Head

- E. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - 1. SMACNA-006-2006 HVAC Duct Construction Standard - Metal and Flexible, 3<sup>rd</sup> Ed.
- F. Underwriters Laboratory (UL)
  - 1. UL-752 - 05 Bullet-Resisting Equipment

### **1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 23 37 01-1, Approval Data:
  - 1. Product Data: Submit shop drawings for bullet-resistant stationary louvers and screens including: sizes, finish, and type of mounting.
  - 2. Manufacturer's descriptive data, certificate, and test report showing compliance with the specified forced entry standard. The listed free area percentage of the total square feet of the louver shall be for chevron style louvers (inverted angles at 1-inch on center).
  - 3. Schedule: Submit schedule of stationary louvers and screens showing type, size, and location.
- C. RSN 23 37 01-2, Final Data:
  - 1. Service Manuals: Submit service manuals including detailed installation, operation and maintenance instructions.

### **1.04 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years experience.

### **1.05 EXTRA MATERIALS**

- A. Spare maintenance products: Provide one set of spare insect screens to fit the screen frames provided with each stationary louver.

## **PART 2 PRODUCTS**

### **2.01 BULLET-RESISTANT STATIONARY LOUVERS**

- A. Provide factory-fabricated, UL listed and labeled, bullet-resistant stationary louver assemblies which meet or exceed UL-752 standard threat level 1.
- B. Louvers shall be located as shown on drawings and sized for mounting in the tube frames, with frame mounted 4 by 4 mesh bird screens mounted in a common frame

- over the outside of insect screens mounted on the outdoor face of the tube frames, and insect-screens frame-mounted on the indoor face of the tube frames.
- C. Louvers shall be removable from indoors for maintenance. Coordinate with tube framing and concrete drawings.
- D. Louvers shall be as manufactured by American Physical Security Group, LLC (APSG) ([www.americanpsg.com](http://www.americanpsg.com)), Chicago Bullet Proof Systems, Incorporated ([www.chicagobulletproof.com](http://www.chicagobulletproof.com)), Fabrications Systems Incorporated (FDI) (Telephone 641-623-4616), National Bullet Proof Incorporated ([www.nationalbulletproof.com](http://www.nationalbulletproof.com)), or equal, having the following salient characteristics.
1. Quantity and Size:
    - a. Four nominal 12-inch wide by 12-inch high to fit into cast-in-place concrete wall openings furnished.
  2. Weatherproof type having a free area not less than:
    - a. Twenty-five percent of the gross area for the 12- by 12-inch louvers.
  3. Construct of an ASTM listed steel as required to meet the UL threat level requirements.
  4. Blades and frames constructed from minimum 1/4-inch-thick galvanized steel having minimum G60 zinc coating in conformance with ASTM A 90.
  5. Provide louvers with sight-proof, chevron, or inverted V, blades, or approved equal.
  6. The bottom blade shall be continuously welded along frame to prevent leakage of water.
  7. Provide galvanized finish, or an approved manufacturer's standard corrosion resistant finish for bullet-resistant louvers, unless otherwise noted. Minimum galvanized finish shall be as follows:
    - a. Steel sheet: ASTM A 653 and ASTM A 924 having G60 zinc coating in conformance with ASTM A 90.
    - b. Steel plate: ASTM A 123.

## **2.02 SCREENS**

- A. Louver Screens:
1. Bird Screens: Stainless steel wire, 4 by 4 mesh (wires 1/4-inch on centers), 0.063-inch wire diameter, bird screen. Dimension exposed screens to match size of tube frame openings, as shown on drawings.
  2. Insect Screens: Stainless steel wire, 14 by 18 mesh, insect screen. Dimension exposed screens to match size of tube frame openings.
  3. Screen Frames: Galvanized sheet metal not less than 0.25-inch thick, or an approved manufacturer's steel or stainless steel frame.

4. Finish: Provide steel screen frames with G90 zinc coating in conformance with ASTM A 90, or with approved manufacturer's finish to match the louver color. Do not paint stainless steel surfaces.
5. Secure outdoor bird and insect screen frames to the tube frame with corrosion resistant machine screws spaced on not more than 6-inch centers.
6. Secure indoor insect screen frames to the tube frame with corrosion resistant metal casement turn clips anchored with machine screws. Clips shall be spaced on not more than 6-inch centers.

### **2.03 STRUCTURAL STEEL**

- A. Fabricate using structural shapes, plates, rods, and bars.
- B. Minimum ASTM A 36. Steel used shall be as required to meet UL-752.

### **2.04 ARC-WELDING ELECTRODES**

- A. Suitable for the welds and in accordance with the requirements of AWS.

### **2.05 FASTENERS**

- A. Bolts and Nuts:
  1. Bolts: ASTM A 307, grade A.
  2. Nuts: ASTM A 563, grade A.
  3. Length of bolt threads: In accordance with ASME B18.2.1.
  4. Threads: Class 2, free fit, American National coarse-thread series.
- B. Machine Screws: FS FF-S-92B.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify louver locations.
- B. Verify wall systems are ready for installation.

### **3.02 INSTALLATION**

- A. Louvers and Screens:
  1. Install in tube frames where indicated on drawings.
  2. Install in accordance with SMACNA 1966.
  3. Securely fasten to frames with screws or bolts. Provide adequate clearance for maintenance.

4. Apply approved sealant between louvers and tube frame in building wall.
5. Install with louver blades sloped down to the outside.
6. Install screens on both the indoor and outdoor faces of louver tube frames shown on drawings.
7. Repair of galvanized finish, manufacturer's standard paint finish, or damaged surfaces shall be in accordance with Section 09 96 20 – Coatings.

**END OF SECTION**

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**SECTION 26 05 02**  
**BASIC ELECTRICAL MATERIALS AND METHODS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. EWS Complete Electrical System:

1. Payment: Lump sum price offered in the schedule.
  - a. Furnishing and installing all electrical equipment and devices.
  - b. Furnishing certified calibrated test equipment and perform testing.
  - c. Modifying equipment.
  - d. Assembling, adjusting, and installing equipment.
  - e. Painting equipment and materials.
  - f. Brackets, fasteners, bolts, nuts, lock washers, and other accessories required for mounting or installing electrical equipment and materials.
  - g. Drilling holes in steel structures (other than tubular structures) as required for mounting or installing electrical equipment and materials.
  - h. Furnishing, handling, and storing spare parts for electrical equipment.
  - i. Handling and storing spare parts for BIA-furnished electrical equipment.
  - j. Furnishing special tools and appliances for maintenance and adjustment of equipment.
  - k. Making electrical connections.

**1.02 REFERENCE STANDARDS**

A. American Society of Mechanical Engineers (ASME)

1. ASME BPVC-IX (2010) Boiler and Pressure Vessel Code, Section IX –  
Welding and Brazing Qualifications

B. ASTM International (ASTM)

1. ASTM A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and  
Steel Products
2. ASTM A153/A153M-09 Zinc Coatings (Hot-Dip) on Iron and Steel  
Hardware

C. International Electrical Testing Association, Inc. (NETA)

1. NETA ATS-09 Acceptance Testing Specifications

- D. National Fire Protection Association (NFPA)
  - 1. NFPA 70 (2011) National Electrical Code (NEC)

### **1.03 QUALIFICATIONS**

- A. Welder Qualifications: In accordance with ASME BPVC-IX.
- B. Field testing organization and personnel: As specified in NETA ATS, Section 3.

### **1.04 MAINTENANCE**

- A. Provide special tools and accessories required for installation and maintenance of equipment. Studs, bolts, or nuts other than United States Standard provided anywhere in the equipment or installation will be considered as requiring special tools.
- B. Deliver special tools and spare parts for equipment to the COR or BIA Representative. Provide shipments with item list(s).
- C. Special tools and spare parts must be onsite prior to installation of equipment.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS AND EQUIPMENT**

- A. Conform to NFPA 70.
- B. Galvanize mounting brackets, bolts, nuts, and washers for major items of electrical equipment such as batteries, battery chargers, DC converters, AC inverter, enclosed circuit breakers, and wall mounted enclosures in accordance with ASTM A 123 and ASTM A 153.
- C. Provide galvanized steel or non-corrosive metal for mounting bolts, nuts, and washers for minor items of electrical equipment and lighter weight items. Do not use cadmium-plated mounting hardware.
- D. Change designs as required where Contractor-furnished electrical equipment and materials differ in size, type, ratings, or other physical properties from designs in these specifications. Contracting Officer will approve changes at Contractor's expense, unless Contractor can demonstrate that changes are necessary regardless of manufacturer.
- E. Provide special tools and appliances furnished by manufacturer for maintenance and adjustment of manufacturer's electrical equipment.



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## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Do not install electrical equipment until approval data for associated equipment has been approved by BIA or BIA Representative.
- B. Electrical installations, assembly operations, and adjustments: Comply with NFPA 70.
- C. Make electrical installations complete and ready for service.
- D. Install electrical equipment in accordance with directions furnished by manufacturer's instruction books.
- E. Tighten nuts used in electrical equipment assembly with torque wrenches to torque values recommended by equipment manufacturers.
- F. Drill holes in bolted steel structures and provide fastenings required for mounting or installing electrical equipment and materials.
- G. Installation of electrical equipment includes:
  - 1. All electrical equipment shall be level and plum.
  - 2. Drilling holes, furnishing hardware, and assembling components to each other.
  - 3. Furnishing materials for and making all connections correctly in accordance with drawings.
  - 4. Tagging wires and cables at each end.

### **3.02 REPAIR**

- A. Repair damaged painted surfaces of equipment to match original finish.

### **3.03 CONTRACTOR FIELD QUALITY TESTING**

- A. In accordance with the requirements for Inspection of Construction, NFPA 70, and the various equipment Sections.

### **3.04 FIELD QUALITY ASSURANCE**

- A. COR or BIA Representative will inspect full system upon completion of construction. Acceptance of equipment will be made after all equipment has been properly tested and is operational.

**END OF SECTION**

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**SECTION 26 05 19**  
**ELECTRICAL CONDUIT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. Include in price offered in the schedule for EWS Complete Electrical System.

**1.02 REFERENCE STANDARDS**

A. American National Standards Institute (ANSI)

1. ANSI C80.1 (2005) Electric Rigid Steel Conduit (ERSC)
2. ANSI C80.5 (2005) Electrical Rigid Aluminum Conduit (ERAC)
3. ANSI C80.6 (2005) Electrical Intermediate Metal Conduit (EIMC)
4. ANSI/SCTE 77 (2010) Specification for Underground Enclosure Integrity

B. National Electrical Manufacturer's Association (NEMA)

1. NEMA FB 1 (2012) Fittings, Cast Metal Boxes, And Conduit Bodies For Conduit, Electrical Metallic Tubing And Cable
2. NEMA RN 1 (2005) PVC Externally-Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
3. NEMA TC 2 (2003) Electrical Polyvinyl Chloride (PVC) Conduit
4. NEMA TC 3 (2004) PVC Fittings for Use With Rigid PVC Conduit and Tubing.
5. NEMA TC 7 (2005) Smooth-Wall Coilable Polyethylene Electrical Plastic Conduit

C. National Fire Protection Association (NFPA)

1. NFPA 70 (2011) National Electrical Code (NEC)

D. Underwriters Laboratories (UL)

1. UL 360 (2009) Liquid-Tight Flexible Steel Conduit
2. UL 651 (2011) Schedule 40 and 80 Rigid PVC Conduit
3. UL 651A (2011) Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

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### **1.03 SYSTEM DESCRIPTION**

- A. Contractor to determine routing of embedded and exposed conduit when not indicated on drawings.
- B. Determine exact locations of embedded conduit stub-ups based on equipment being furnished.
- C. Sizes as detailed on drawings; when not indicated on drawings size in accordance with NFPA 70.

### **1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 26 05 19-1, Approval Data:
  - 1. Manufacturer’s technical data sheets.

## **PART 2 PRODUCTS**

### **2.01 RIGID METAL CONDUIT (RMC)**

- A. Galvanized coated and in accordance with ANSI C 80.1.
- B. Accessories:
  - 1. Steel materials and hardware: Galvanized.
  - 2. Conform to NEMA FB 1 and Article 2.06.

### **2.02 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)**

- A. Galvanized steel core conduit.
- B. Copper bonding conductor between spiral segments.
- C. Extruded synthetic jacket overall to ensure water tightness.
- D. Grounding-type fittings.
- E. For Outdoor Use:
  - 1. Liquid tight type.
  - 2. Black coated, ultra-violet resistant.
- F. UL listed in accordance with UL 360.

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### **2.03 POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Schedule 40 in accordance with NEMA TC 2.
- B. UL listed in accordance with UL 651.

### **2.04 HIGH-DENSITY POLYETHYLENE (HDPE)**

- A. Type: EPEC-40 (Schedule 40).
- B. Pre-lubricated, extruded, flexible high-density polyethylene resin type.
- C. UL listed in accordance with UL 651A.
- D. Conforms to NEMA TC 7.

### **2.05 UNDERGROUND PULL BOXES**

- A. Pull Boxes Embedded in Dam Crest:
  - 1. Quazite PG style manufactured by Hubbell; or equal, with the following essential characteristics:
    - a. Material: Precast polymer concrete.
    - b. Open bottom construction.
    - c. Cover:
      - 1) Logo: "ELECTRIC" embossed on surface.
      - 2) Tier level rating embossed on surface.
    - d. ANSI/SCTE 77 Application Tier 15 and UL listed.
    - e. Size: 24- by 24-inch.
    - f. Bolts:
      - 1) Penta-head type.
      - 2) Stainless steel.
      - 3) Tamper- and corrosion-resistant screws.
      - 4) Only a penta socket can install or remove.
        - a) Furnish complete with socket.
        - b) Socket dimensions: 2 inches in length.
- B. Quazite Cover Hook manufactured by Hubbell, part No. 82908; or equal, having the following essential characteristics:
  - 1. Electroplated steel.
  - 2. Twenty-seven inches long.

3. 4.38-inch width handle.
4. 0.31-inch diameter hook and shaft.

## **2.06 CONDUIT BODIES AND ACCESSORIES**

- A. Provide fittings required to complete electrical conduit systems. Includes, but not limited to, caps, connectors, couplings (excluding expansion and expansion-deflection couplings), nipples, reducers, elbows, pipe plugs, locknuts, bond-nuts, bushings, seals (excluding wall penetration seals), and any other fittings.
- B. Provide devices required to complete electrical conduit systems and to fasten, clamp, attach, and support each conduit in place.
  1. Includes threaded joint compound; protective sealant; materials for sealing ends of conduits terminating at outdoor boxes, panelboards or cabinets; supports and clamps.
  2. Complete with bolts, washers, and nuts.
- C. Conduit Sealing Bushings:
  1. Non-Toxic.
  2. Non-shrinking.
  3. Fire-retardant type.
  4. Seals against liquid, gas, and vapor seepage.
- D. Conduit Wall Penetration Seals:
  1. Elastomeric material to prevent liquid and gas seepage.
  2. Dust tight.
  3. Fire retardant.
- E. Exposed Outlet Bodies and Boxes: Cast iron, malleable iron, or cast aluminum.
- F. Steel Outlet, Junction, and Pull Boxes: Pressed galvanized steel, minimum of 4 inches, octagonal or square, with galvanized cover or extension ring as required.
- G. Embedded Cast or Malleable Metal Outlet Boxes:
  1. Type FD1 (Single-gang with extension):
    - a. Rectangular, single-gang, deep-wiring device outlet boxes with threaded hub connections for rigid steel conduit.
    - b. Equip with:
      - 1) Four 1-inch threaded hubs.
      - 2) One-inch-deep cast or malleable metal extension ring.
      - 3) One-inch bushed elbows where indicated on drawings.

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- 4) Plugs for any unused openings.
      - 5) Reducers as required.
    - c. Boxes and extension rings: Iron alloy with corrosion-resistant finish.
  - H. Embedded Sheet Steel Pull and Junction Boxes:
    - 1. Thickness: No. 10 United States Standard gauge, minimum.
    - 2. Finish Paint:
      - a. Prime coat: Red vinyl-resin.
      - b. Final coat: Gray vinyl-resin.
  - I. Fabricated Sheet Steel Boxes:
    - 1. Large junction and conduit boxes, excluding outlet boxes, to contain wiring devices or to accommodate lighting fixtures.
    - 2. Sheet steel thickness: No. 14 United States Standard gauge, minimum.
    - 3. Sheet steel finish: Galvanized.
    - 4. Attach covers with bronze, brass, or stainless steel screws or bolts.
    - 5. All boxes shall be weather resistant and watertight type.
      - a. Provide covers with gaskets.
    - 6. Luminaire junction boxes:
      - a. Boxes mounted in ceilings for surface mounted luminaires:
        - 1) Four-inch octagonal hung ceiling boxes.
        - 2) Depth: 3-1/2 inches, minimum.
  - J. Wireways:
    - 1. Fabricate of gauge steel in conformance with applicable codes.
    - 2. Galvanize after fabrication.
    - 3. Covers: Hinged or screw type as indicated on drawings.
    - 4. Secure screw-type covers with rustproof screws.
    - 5. Furnish wireways without knockouts unless otherwise indicated on drawings.
    - 6. Drill and punch onsite as required.
  - K. Sealing Materials:
    - 1. General use:
      - a. Non-toxic.
      - b. Non-shrinking.
      - c. Fire retardant type.
-

- d. Seal ends of conduit against liquid, gas, and vapor seepage.
- L. Adhesive: In accordance with conduit manufacturer's recommendations.
- M. Polyethylene Warning Tape:
  - 1. Width: 6 inches.
  - 2. Color: Red.
  - 3. Copy: Continuously imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".
  - 4. Suitable for direct burial.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. In accordance with Section 26 05 02 – Basic Electrical Methods and Materials.
- B. Layout and Procedures:
  - 1. Determine routing of embedded and exposed conduit prior to installation.
  - 2. Determine exact locations of embedded conduit stub-ups based on equipment being furnished.
  - 3. Ensure that conduit runs and bends are free from kinks, indentations, or flattened surfaces.
  - 4. Stub conduit that terminates at horizontal surfaces 2 inches above finished floor level and terminate with coupling and plug. Replace plug with bushing or Chase-type nipple before installing insulated conductors.
  - 5. For conduit installed vertically that projects through steel tube located on top of wall, a 1-1/2-inch hole for extending conduit through steel tube may be drilled along centerline of tube.
  - 6. No PVC shall be exposed.
- C. Preparation:
  - 1. Remove burrs and sharp corners at ends of metal conduit.
  - 2. Coat male threads of rigid metal conduit joints with suitable graphite or zinc sealing material before making joints.
- D. Cap or plug ends of conduit during periods of no work.
- E. Install conduit with necessary fittings and supports per NFPA 70.
  - 1. Tighten conduit joints securely to ensure electrical continuity and to prevent entrance of moisture or foreign material.



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2. Provide bushings on ends of conduit to protect insulated conductors from abrasion.
  3. Use locknuts and bondnuts to provide tight ground connections between conduit and boxes, panelboards, and cabinets.
- F. Bends:
1. Install smooth, gradual bends to permit pulling insulated conductors without undue stress or damage to conductors or conduit.
  2. Bend conduit cold to prevent damage to protective coating.
- G. Embedded Conduit (in Concrete):
1. Conduit to be PVC type.
  2. Tie to reinforcing bars or otherwise support conduit, conduit fittings, and conduit boxes securely in position while concrete is being placed to prevent sagging.
  3. Conduit not to displace more than 3 percent of the gross area of the cross-section of the slab. (Calculate cross sectional area as 12 inches times slab thickness).
  4. Conduit outside diameter to be no larger than 1/3 of the overall thickness of the slab in which they are embedded.
  5. Conduit to be spaced at least 3 diameters or widths on center.
  6. Conduit to occupy the middle third of the cross sectional depth of the slab in which they are embedded.
  7. Protect ends of conduit to prevent entrance of concrete, sand, or other foreign material.
  8. Terminate ends of conduit that do not terminate at boxes with couplings and pipe plugs or insulating bushings and caps.
  9. Clean concrete from inside of conduit boxes immediately after forms are removed.
  10. Clean threads for attaching devices and covers to boxes.
  11. Swab conduit within 24 hours after removal of forms with clean dry rags until conduit is thoroughly cleaned and dried.
  12. Grease threads of removed plugs and reinstall plugs to prevent entrance of water or foreign material.
  13. Seal conduit boxes with rubber gasketed blank cover.
  14. Conduit stub-ups:
    - a. Minimum length above finished floor: 4 inches, not including coupling.
    - b. Terminate conduit with coupling and plug until ready to connect remaining conduit sections. Replace plug with bushing or Chase-type nipple before installing insulated conductors.
-

- c. Where embedded conduit exits concrete, a least one foot of the embedded conduit shall be RMC.
  - d. Wrap RMC conduit with anti-corrosion tape from the exposed termination coupling to a minimum of 6 inches below finished floor.
- H. Exposed Conduit Runs:
- 1. Straight and parallel with each other and with centerlines of room or structure.
  - 2. Support conduit rigidly from wall or ceiling within 3 feet of each outlet box, junction box, cabinet, or fitting; and at intervals of not more than 5 feet.
  - 3. Installation includes, where required, drilling holes in bottom, side, or top of enclosures or plates of other electrical equipment.
  - 4. Tighten conduit securely.
  - 5. Support conduit rigidly in place.
  - 6. Make connections to outdoor boxes watertight.
- I. Flexible Metal Conduit: Use for connections to electrical equipment that vibrate, or that is necessary to remove for service on a routine basis.
- J. Direct Buried Conduit:
- 1. Install HDPE conduit along the crest of the dam for use with piezometers and weir boxes. An underground pull box shall be located at locations shown on drawings.
  - 2. Install one schedule 40 PVC conduits sized at 2-inch between Control Building and EWS building with fiber optical cable installed. See Section 33 82 23 – Optical Fiber Communications Distribution Cabling for fiber requirements. Terminate conduits at stub-up locations directly inside building walls for both buildings.
  - 3. Joining Conduit:
    - a. The couplings shall have close fit with the conduit and shall maintain alignment of the conduit and prevent separation of the joints and join conduit in accordance with manufacturer’s recommendations.
    - b. Maintain in correct position and alignment during installation and subsequent construction operations.
    - c. Before and during assembly of a joint, keep all parts free of mud, oil, or grease. Keep the conduit interior free from deposits of mud, sand, gravel, or other foreign matter and in good working condition until the contract is complete and accepted.
  - 4. All other direct burial conduit shall be HDPE or PVC.

K. Seals/Sealing:

1. Seal ends of conduits that terminate at boxes, panelboards, or cabinets with sealing material or sealing bushings to prevent air circulation through conduits into boxes, panelboards, or cabinets. Install seals in accordance with manufacturer's instructions.
2. Furnish and install wall penetration seals for conduits entering structures below grade. Install seals in accordance with manufacturer's instructions.

**3.02 SITE UNDERGROUND CONDUIT**

A. Excavation:

1. Keep conduit trenches free of water during installation.
2. Finish trench to lines and grades shown on drawings. Refer to drawing 1743-D-303 for trench details.
3. Grade conduit subgrade to provide uniform support along the bottom of conduit.

B. Schedule work so that at no time will conduit remain in the trench more than 7 days before backfill is placed.

C. Installation:

1. Place sand in bottom of trench to provide a minimum of 2 inches of sand around each conduit.
2. Do not compact sand.
3. Install electrical warning tape 6-inches from top of grade.

D. Backfill:

1. Do not backfill until inspected and approved by COR or COR Representative.
2. Backfill trench with compacted Zone 3 material in accordance with Section 31 24 00 – Fill and Backfill.
3. Place backfill to about the same elevation on both sides of conduit to prevent unequal loading and displacement of conduit.
  - a. Difference in elevation of backfill on sides of conduit, maximum: 6 inches.
4. Compact backfill in accordance with Sections 31 24 00 – Fill and Backfill.

**END OF SECTION**

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**SECTION 26 05 20**  
**CONDUCTORS AND CABLES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in price offered in the schedule EWS Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM B8-11 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. National Electrical Manufacturers Association (NEMA)
1. NEMA WC 57 (2004) Standard for Control, Thermocouple Extension, and Instrumentation Cables
  2. NEMA WC 70 (2009) Power Cables Rated 2000V or Less for the Distribution of Electrical Energy
- C. National Fire Protection Association (NFPA)
1. NFPA 70 (2011) National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL)
1. UL 486B (2003) Wire Connectors

**1.03 DESIGN REQUIREMENTS**

- A. Determine conductor sizes, except where shown or specified, in accordance with NFPA 70. In the event of conflict between design requirements and NFPA 70, the more stringent requirement applies.

**1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 - Submittals.
- B. RSN 26 05 20-1, Approval Data:
1. Manufacturer's technical data sheets.
- C. RSN 26 05 20-2, Field Test Reports:
1. Provide test reports as stated in Article 3.03.

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## **1.05 DEFINITIONS**

- A. Cable: Cable, cables, wire, or wires of one or more insulated conductors.
- B. Power Cable: For power loads including receptacle outlets; motors; alternating- and direct-current distribution circuits; and lighting circuits.
- C. Multi-conductor Control Cable: For control, metering, indication, annunciation, and relaying circuits; and circuits not identified as power circuits.
- D. Instrumentation Cable: For pressure transducer circuits.

## **1.06 CABLE REQUIREMENTS**

- A. Manufactured no more than 24 months prior to Notice to Proceed.
- B. Round, except for 2-conductor cable with parallel conductors.
- C. Conductors: Copper in accordance with ASTM B 8, class B or C.
- D. AWG or kcmil designation.
- E. Coverings or insulation: Suitable for installation in vertical position without injury to covering or deformation of insulation when supported in accordance with NFPA 70.

## **1.07 COLOR CODING AND PHASE IDENTIFICATION**

- A. Direct Current (DC) Conductors:
  - 1. Insulation of individual conductors of multiple-conductor cables shall be in accordance with NEMA WC 70. Color coding shall be as follows:
    - a. Positive – red.
    - b. Negative – black.
    - c. Ground – green.
- B. Control and Instrumentation Cable:
  - 1. Colored insulation or jacket compound. Do not apply color coatings to insulation or jacket surface.
  - 2. In accordance with NEMA WC 57, Table E-2.

## **PART 2 PRODUCTS**

### **2.01 POWER CABLE AND MULTICONDUCTOR CONTROL CABLE**

- A. Only stranded conductors shall be used as power cables and multi-conductor control cables.

- B. Power conductors shall conform to all the applicable requirements of NEMA WC 70 and be annealed copper.
- C. Multi-conductor cable shall conform to NEMA WC 57.
- D. Cables shall be UL listed and labeled on outer surface in accordance with NFPA 70.
- E. 600-volt rated insulation unless specified otherwise.
- F. Type: Single-conductor or multi-conductor, non-shielded type.
- G. Suitable For: Installation in raceways.
- H. Insulation Type: THHN/THWN or XHHW.
- I. Multi-conductor Overall Jacket:
  - 1. Type: PVC (Polyvinyl chloride) or better, flame-retardant.
- J. Provide multi-conductor power cable with integral ground conductor. Size ground conductor in accordance with NEMA WC 70.
- K. Size:
  - 1. Power conductors shall be sized per the overcurrent device unless noted otherwise on drawings.
  - 2. Conductors installed for dedicated equipment inside of the DC control enclosure shall be No. 16 unless specified otherwise.

## **2.02 INSTRUMENTATION CABLE**

- A. Purpose: Connection to pressure transducer, see Section 31 09 12 - Instrumentation.
- B. Type: Twisted pair or triad shield or multiple individual shielded pairs: Aluminum-mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.
  - 1. Each pair or triad sequentially numbered for identification.
- C. Suitable for installation in underground raceways.
- D. Conductor Size: No. 16 AWG.
- E. Insulation: 300 volts, 105 degrees Celsius, minimum.
- F. Jacket: Blue PVC with rip-cord.

## **2.03 ACCESSORIES**

- A. Single Conductor Markers:
  - 1. Type: Self-laminating-vinyl type, machine printable sleeve.

2. Color: White with black text.
  3. Text size: As large as practical but at least 7 point (0.06-inch).
  4. One-inch in length, minimum, and have diameter suitable for installation on the intended conductor.
- B. Multi-conductor Cable Tags:
1. Type: Cross-laminated polyethylene film or Nomex<sup>®</sup>. Be resistant to water, oil, solvent, abrasion, and tearing.
  2. Rectangular shape and have minimum dimensions of 2 by 0.5 inches.
  3. Color: White with black text.
  4. Text size: As large as practical but at least 16 point (0.16-inch).
  5. Attach to cable with standard nylon self-locking tie wraps or cable ties.
- C. Terminal Connectors for Control, Instrumentation, and Telemetry Cable:
1. Heavy-duty, nylon insulated sleeve, pressure-crimp-type with ring tongues.
  2. Tin-plated copper.
  3. Serrated inner barrel.
  4. In accordance with UL 486B and UL listed.
  5. Compatible with conductor size and type of cable for which it is used.
- D. Cord Grip:
1. Bushing fits cable diameter of 0.25 to 0.312 inches.
  2. Straight type connector with 3/8-inch conduit size thread.
  3. Manufactured from non-metallic durable nylon with a compression bushing of high quality neoprene.
  4. Fitting includes a wire mesh.
  5. Include an anti-friction washer made of nylon.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Install in accordance with NFPA 70.
- B. When using cable ties, do not over tighten, to ensure tie does not cut conductor insulation or cable outer jacket. Do not use cable ties to support cables.
- C. Block cable opening in sleeves under equipment or passing through knockouts, with silicone-foam, fire-retardant type material.



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- D. Cable Splicing:
1. Do not splice control, instrumentation, or telemetry cables.
  2. Power cable splices only allowed in approved splice enclosure or pull boxes.
- E. Cable Installed In Conduit:
1. Do not pull cable into conduit until they have been cleaned and are free from obstructions and sharp corners.
  2. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
  3. Install cable using gradual and uniform pulling stresses. Do not exceed allowable pulling tensions and sidewall pressures as recommended by cable manufacturer.
  4. Install cable to prevent cuts or abrasions in insulation or protective covering and kinks in cable.
  5. When a lubricant is needed as an aid to pulling, use only soapstone or other suitable lubricant that is not injurious to cable insulation.
  6. When mechanical cable pulling equipment is used, use a tension meter release mechanism to ensure pulling tension remains below tensile strength of the cable.
  7. Remove and replace any cable damaged during installation.
- F. Cable Installed In Vertical or Inclined Plane:
1. Install in accordance with NFPA 70.
  2. Support with cable grips leaving slack spans between supports.
  3. Clamp cable entering enclosures, junction boxes, or equipment with commercial cable clamps.
- G. Grounding:
1. Provide one grounding conductor, grounded at both ends, in each Multi-conductor control cable.
  2. Ground shielding of instrumentation cable only to source equipment ground bus using pressure crimp type connectors with ring tongues on drain wire.
  3. Land all spare conductors on unused terminal blocks. Ground these conductors to the equipment ground bus.
- H. Wiring Methods:
1. Terminate control and instrumentation cable with heavy-duty, pre-insulated, pressure-crimp type terminal connectors. The connectors shall be tin-plated copper, shall have a serrated inner barrel, shall have 600-volt rated insulation with an insulation support sleeve for vibration resistance, and shall be UL listed. Pressure-crimp, pin type connectors with insulated 600-volt rated barrels may be

used where the use of ring tongue connectors is not practical. The use of ferrule type connectors is not acceptable.

- a. For piezometer wiring install per manufacture's recommendations.
  - b. All piezometer wiring shall terminate inside of the EWS building with an additional 50 feet of coiled conductor.
2. At termination point of multi-conductor cable, form conductors into neat packs and tie conductors with self-locking cable ties.
  3. Do not combine alternating- and direct-current circuits, or current and potential transformer circuits in same multi-conductor cable.
  4. Clamp cable entering equipment with commercial type cable clamps.
  5. Leave sufficient length cable ends to make connections conveniently to equipment, fixtures, and devices.
  6. Retain spare single conductors at each end of a multi-conductor cable in a length equal to longest single conductor of multi-conductor cable.
  7. Terminate spare conductors of multi-conductor cable at terminal blocks. Ground spare conductors by using wire jumpers between terminations and equipment ground bus.
  8. Run both positive and negative leads of a direct-current circuit in same cable.

### **3.02 CABLE AND CONDUCTOR IDENTIFICATION**

#### **A. Power Cable:**

1. Identify power conductors that are AC circuits with colored insulation or colored phase tape in accordance with this Section. An additional conductor marker is not required.

#### **B. Conductor Markers:**

1. Text to be machine or computer generated. Hand written text is not acceptable.
2. Provide individual conductors of multi-conductor control cable, instrumentation cable, and telemetry cable with conductor marker. Print conductor designation.
3. Provide markers for spare conductors of multi-conductor cables. The marker to include cable designation and the word "SPARE".

#### **C. Multi-Conductor Cable Tags:**

1. Tag multi-conductor cables at each end.
2. Text to be machine or computer generated. Hand written text is not acceptable.
3. Mark tags with cable designations.
4. Attach tags to cable with self-locking tie wraps or cable ties.

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### 3.03 CONTRACTOR FIELD QUALITY TESTING

- A. Perform testing after installation, but before connection to equipment.
- B. Test cables in large groups to minimize number of testing sessions.
- C. Furnish all materials, including test instruments beyond those furnished under these specifications that are required for checkout and tests.
- D. Notify COR or BIA Representative, in writing, of date, time, and cables to be tested at least 5 working days before testing. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.
- E. Perform following tests.
  - 1. Check wiring of entire installation including all equipment supplied by Contractor.
  - 2. Include wire-by-wire, terminal-by-terminal (point-to-point) check for following:
    - a. Continuity test: Test continuity of each conductor prior to performing insulation resistance test.
    - b. Insulation resistance tests for power, control, and instrumentation cables:
      - 1) Measure insulation resistance between each conductor and station ground with all other conductors in same cable or conduit grounded.
      - 2) Test voltage: 1,000 volts direct-current, minimum.
      - 3) Minimum acceptable insulation resistance:  $R \text{ in } M\Omega = (\text{rated voltage in kV} + 1) \times 1000/\text{length in feet}$ .
    - c. Proper wire tagging at each end of insulated conductors.
  - 3. When necessary, make wiring changes, adjust settings, make equipment replacements, etc., required for proper functioning of installation to conform to requirements of specifications.
  - 4. Examine and check all protective devices and sequence of operation of all controls for all electrical equipment for proper functioning and settings.
  - 5. Provide drawings at jobsite for use by COR or BIA Representative that show electrical installation at time of examination; and instruction books, test reports, coordination curves, and manufacturer's data for electrical equipment installed.
  - 6. While performing functions of testing and checkout, remove and replace wiring connections that may be required in processing of checkout; and make wiring changes, setting adjustments, equipment replacements, or other revisions which are necessary for proper functioning of installation.

7. Record following test data on test report for each conductor tested:
  - a. Date of test.
  - b. Name or names of Contractor's personnel who performed test.
  - c. Name of BIA inspector or BIA Representative who witnessed test.
  - d. Conductor identification.
  - e. Megohms between conductor and ground.
  - f. Total length of conductor.
  
- F. If any conductor fails continuity or insulation resistance testing, remove and replace cable and conductor.

**END OF SECTION**

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**SECTION 26 05 26**  
**GROUNDING AND BONDING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in lump sum price offered in the schedule for EWS Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM B3-01 (2007) Soft or Annealed Copper Wire
  2. ASTM B8-11 (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronic Engineers (IEEE)
1. IEEE 81 (1983) Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
  2. IEEE 142 (2007) Grounding of Industrial and Commercial Power Systems
  3. IEEE 837 (2002) Qualifying Permanent Connections Used in Substation Grounding
- C. National Fire Protection Association (NFPA)
1. NFPA 70 (2011) National Electrical Code (NEC)
- D. Underwriters Laboratories (UL)
1. UL 467 (2007) Grounding and Bonding Equipment

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 26 05 26-1, Test Reports:
1. Provide test reports as stated in Article 3.02.

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## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

#### **A. Ground Cable:**

1. Annealed bare-copper cable:
  - a. ASTM B 8, class B.
  - b. Solid wires used in forming the copper cable: ASTM B 3.
2. Concentric stranded.
3. Sizes:
  - a. As indicated on drawings.
  - b. When not shown, minimum sizes:
    - 1) Ground risers and electrode conductors: 2 AWG.
    - 2) Equipment grounding conductors: per NFPA 70.

#### **B. Ground Plates:**

1. Copper or copper-alloy.
2. Four-hole type.

### **2.02 ACCESSORIES**

#### **A. Cable Connectors:**

1. Welded, bolted solderless or compression type.
2. Current-carrying capacity: Equal to cable with which they are used.
3. Connectors for ground cables, including fittings, lugs, bolts, nuts, and washers: Copper alloy containing not more than 4 percent zinc.
4. Bolted solderless or compression type connectors: IEEE 837.
5. Ground connectors that will be direct buried or embedded in concrete shall be in accordance with Article 2.03A below.

### **2.03 WELDING PROCESS**

- #### **A. Use Cadweld, thermoweld, or equivalent exothermic process when connecting ground electrode conductor to structural components and reinforcing bar.**

#### **B. Molds and Weld Metal:**

1. Use fresh stock from same manufacturer.
2. Weld metal and starting material: No significant quantities of hazardous ingredients.

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## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with NFPA 70, IEEE 142, UL 467, and this Section.
- B. Connect equipment, metal conduit, metal structures, metal pull boxes, exposed metal surfaces, and other miscellaneous metalwork to grounding system. See drawings for specific equipment connections.
  - 1. Ground equipment and miscellaneous metalwork that is required to be grounded, but is not indicated on drawings to grounding system.
- C. Control Structure Grounding Electrodes:
  - 1. Use steel reinforcing bar system within concrete floor at bottom of sump as grounding electrode.
    - a. Steel reinforcing bars used for electrodes:
      - 1) Diameter, minimum: 1/2-inch.
      - 2) Length, minimum: 20 feet (unbroken or multiple segments combined).
      - 3) Cover, minimum: 2 inches.
  - 2. Ground risers:
    - a. Connect grounding electrodes to ground electrode conductor.
  - 3. Ground plate:
    - a. Embed in concrete wall of structure, 24 inches above metal grating.
    - b. Connect equipment grounding conductors, grounding system risers, photovoltaic panel support structure, roof fencing, and building structural steel to ground plate.
- D. Connections:
  - 1. All equipment grounding connections will be from imbedded ground plates. Contractor shall determine if additional imbedded plates are required to make proper connections.
  - 2. Remove paint, enamel, scale, oil, grease, or other foreign nonconductive material from point of contact on metal surfaces before making ground connections.
  - 3. Repair damaged or removed paint or galvanizing material on metal finishes.
  - 4. Make ground connections that will be direct buried or embedded in concrete:
    - a. Exothermic process.
    - b. In accordance with manufacturer's instructions.

### **3.02 CONTRACTOR FIELD QUALITY TESTING**

#### **A. Test Resistance of Grounding System:**

1. Notify COR or BIA Representative at least 48 hours in advance of time of testing in order that test may be witnessed. Testing shall be mutually agreeable between Contractor and COR or BIA Representative.
2. Perform test within 30 days after completion of structural concrete work.
3. Measured resistance: Less than 5 ohm.
4. Perform continuity and resistance testing on all connected grounding conductors.
5. Use fall of potential method in accordance with section 8.2.1.5 of IEEE 81 for grounding electrode testing.
6. Testing device:
  - a. Earth resistance tester.
    - 1) Heavy-duty, low-resistance type with direct-reading and direct-current ohmmeter.
    - 2) Capable of measuring ground resistance to an accuracy of 0.5 ohms or better.
7. Test performance:
  - a. Initial distance between remote current electrode (C) and grounding system under test (X): At least six times longest diagonal dimension of grounding system.
  - b. Beginning at electrode X, drive potential-reference electrode (P) into ground at a number of test points on a straight line between electrode X and electrode C.
  - c. Distance between test points: Approximately 5 percent of actual distance between electrodes X and C.
  - d. Continuously log apparent resistance readings for each test point and plot curve of resistance versus distance to ensure that the electrode C location is giving acceptable results as indicated in IEEE 81.
  - e. Measure and record test points until reaching electrode C or as directed by COR or BIA Representative. If plot of resistance vs. distance curve indicates remote current electrode is in area of influence of grounding system, increase distance between electrode C and grounding system, and measure and record a new set of test data.
  - f. Submit graph of resistance vs. distance with form listing weather conditions, soil conditions, and humidity levels. Include Contractor personnel performing test and BIA or BIA Representative witness signature in submittal.

**END OF SECTION**



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**SECTION 26 05 33**  
**RACEWAYS AND BOXES FOR INSTRUMENTATION**

**PART 1 GENERAL**

**1.1 SCOPE**

- A. The CONTRACTOR shall furnish and install all electrical conduits; boxes, and accessories required for the installation of low voltage instrumentation services. The term “conduit” shall be considered synonymous with the term “raceway” as defined in Article 100 of the NEC.

**1.2 MEASUREMENT AND PAYMENT**

- A. PVC Raceways and Pull Boxes:
1. Payment: Lump sum price offered in the schedule.

**1.3 REFERENCES**

- A. The latest edition of the following standards and codes, are the minimum requirements for this work.
1. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
  2. NEMA TC 2 Rigid Nonmetallic Conduit (Schedule 40 and Schedule 80)
  3. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing
  4. NFPA No. 70 National Electrical Code (NEC)
  5. UL-651 Standard for Safety Schedule 40 and 80 PVC Conduit
- B. Sizes of conduits, unless specifically shown otherwise, shall be determined from Tables in Chapter 9 of latest National Electrical Code.

**1.4 SUBMITTALS**

- A. The CONTRACTOR shall submit drawings, data, and descriptive information in accordance with the requirements of this Section and Section 01 33 00 – Submittals.

**PART 2 PRODUCTS**

**2.1 RACEWAYS AND FITTINGS**

- A. Nonmetallic Conduit Systems:

1. Rigid Nonmetallic Conduit (RNC): RNC shall be polyvinyl chloride (PVC) Schedule 80 suitable for 90°C. Provide solvent cemented type fittings matched to conduit type and material.
2. Liquidtight Flexible Nonmetallic Conduit (LFNC): LFNC shall comply with UL3.

## **2.2 OUTLET, JUNCTION AND PULL BOXES**

### **A. Acceptable Manufacturers:**

1. Boxes and Cabinets; Bell, Bowers, Raco, Steel City, Appleton, Carlton, Lew Electric, National Electric Products, or approved equal.

### **B. Outlet, Junction and Pull Boxes:**

1. Cast Type Boxes: Cast type boxes shall be ferrous alloy and have gasketed cast covers and inside threaded hubs with adapters as necessary. Cast-metal boxes shall comply with NEMA 3R.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Instrumentation system layouts indicated on drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural and civil drawings.
- B. Consult all other drawings. Verify all scales and report any dimensional discrepancies or other conflicts to Engineer before submitting bid.
- C. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of Engineer, and conform to all structural requirements when cutting or boring structure is necessary and permitted.
- D. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc. required for equipment specified under this section.
- E. Raceways shall be installed and complete prior to pulling any wire into raceway.

### **3.2 RACEWAYS – GENERAL**

- A. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb. (90-kg) tensile strength. Leave at

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- least 12 inches (300 mm) of slack at each end of the pull wire. Tag both ends noting destination.
- B. Use temporary raceway caps to prevent foreign matter from entering conduits.
  - C. Make all bends using an approved bending tool. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated. Cut all conduits square and ream all cuts to remove burrs. Exercise all necessary precautions during the construction period to prevent entry or accumulation of moisture, dust, concrete, and all foreign matter into the raceway system. The contractor shall pull a mandrel through each raceway to ensure the raceway interior is clean and dry prior to pulling conductors or cable.
  - D. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
  - E. Above grade - defined as areas above finished grade for a building exterior and above top surface of any slabs (or other concrete work on grade) for a building interior. Installation of and materials for above-grade raceways shall conform with the following:
    - 1. Install all raceways concealed within finished walls, ceilings, and floors except at surface cabinets, for motor and equipment connections, and in building service equipment rooms unless otherwise indicated. Route all exposed and concealed raceways parallel or perpendicular to building lines with right angle turns and symmetrical bends.
    - 2. Provide for waterproofing of all raceways, outlets, fittings, etc. which penetrate exterior walls or the roof to preserve the weatherproof integrity of the building. Provide pockets for waterflashing and counterflashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc. which penetrate roof. Wherever conduits penetrate concrete walls to outdoors, the Contractor shall provide a watertight seal as manufactured by O.Z. Gedney Company, Type CSMC; Thunderline Corporation, Link Seal, or equal.
    - 3. Conduit Supports and Fasteners:
      - a. Supports: Provide supports for horizontal steel conduits and EMT not more 2 feet from boxes and conduit bodies, and not more than 8 feet (2.5 m) apart with one support near each elbow or bend, including runs above suspended ceilings.
      - b. Individual: Install spring steel fasteners with hanger rods on conduits 1-1/2 inch (40 mm) or smaller. Install individual pipe hangers for conduits larger than 1-1/2 inch (40 mm).
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- c. Trapezes: Install multiple (trapeze) pipe hangers where two or more horizontal conduits run parallel and at the same elevation. Secure each conduit to the horizontal hanger member by a U-bolt, one-hole strap or other specially designed and approved fastener. Install 3/16-inch (5 mm) diameter or larger steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit.
  - d. Roof Top Conduit Support: Fasten pipe to stands specifically manufactured for support of pipes installed on roofs. Stands shall support pipe a minimum of 6 inches above the roof and be resistant to damage from environmental conditions and other causes such as birds. Stands shall be Caddy Pyramid 50 series or equivalent. Support stands requiring fastening through the roof membrane are prohibited.
  - e. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. Power-driven fasteners may be used to attach pipe straps and hanger rods to concrete where approved by Engineer. Install raceway on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.
4. Fittings: Use approved type couplings and connectors in all conduit runs, and make all joints tight. Provide insulated bushings or rain-tight connections with insulated throats for all terminations in pipe sizes 1-1/4" (32 mm) and larger. Provide waterproof fittings for all runs in wet locations, such as exposed to weather, buried in slabs, etc. Provide raceway expansion joints, in compliance with NEC and approved by the State, with necessary bonding conductor at building expansion joints, between structures, and where required to compensate for raceway or building thermal expansion and contraction.
- F. Below Grade: Defined as area below finished grade for a building exterior and below bottom floor slab for a building interior. Installation of and materials for below-grade raceways shall conform with the following:
- 1. Elbows for conduit installed below grade or floor slabs shall be rigid steel conduit with factory PVC coating or two coats of corrosion resistant paint or tape wrap.
  - 2. Make all penetrations up through concrete with plastic-coated RSC to 48" above grade.
  - 3. Below-grade raceways shall turn up and extend 48 inches minimum above floor or equipment foundation.
  - 4. Install conduits below slab-on-grade concrete 12 inch minimum below bottom of concrete slab unless shown otherwise on the drawings.

5. Install exterior underground conduits 30 inch minimum below finished grade unless shown otherwise on the drawings.
6. Non-encased Raceways: Unless specifically noted on drawings for concrete encasement, provide either of the following raceway systems for installation below slabs on grade or in earth or gravel.
  - a. Rigid, heavy-wall, Schedule 80, polyvinyl chloride PVC plastic conduit, suitable for direct burial. All offsets and 90-degree ell's shall be rigid plastic-coated conduit. Provide continuous ground wire for all non-metallic conduits.
  - b. Rigid steel conduit that is not completely encased in concrete but is in contact with ground or on a vapor barrier shall be wrapped with Scotchrap 51 half-lapped, or shall have an additional outside factory coating of polyvinyl chloride with a minimum coat thickness of 30 mils (0.762 mm). Other PVC or Phenolic-resin-epoxy coating material, which is equally flexible and chemically resistant, may be used providing approval by the Engineer is obtained prior to installation. Provide pre-jacketed couplings to provide a substantially watertight jacketing system.
  - c. All underground conduits and ducts 2 inches (50 mm) and larger shall be proven clear by pulling through a ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt or similar material. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. Clean empty raceways similarly. Clear or replace any raceway which rejects ball mandrel.
  - d. Provide seal-off fittings where conduits enter or leave hazardous wiring area or areas of widely different temperature and/or humidity.
7. Non-Metallic Raceway Installations:
  - a. Joints shall be made using the material recommended by the raceway manufacturer. Components shall be cleaned prior to assembly.
  - b. Raceway cutoffs shall be square and shall not deform conduit. Ream rough surfaces.
  - c. Provide male box adapters to terminate raceways.
  - d. Where separable terminations are required, provide PVC threaded adapters with locknuts or bushings. Provide "O" rings for watertight installations.
  - e. Bends shall be made by methods that do not deform or damage the conduit.
  - f. Provide expansion fittings where required in compliance with NEC and approved by the State.

- g. Raceway supports shall be installed to allow the non-metallic conduit to slide through the supports.
- h. Non-metallic raceway is not permitted within the building.

### **3.3 RACEWAYS – COMMUNICATION AND DATA**

- A. Raceway for telephone, communication, data, instrumentation, and controls.
  - 1. Conduit runs less than 100 feet from point-to-point shall not contain more than two 90° standard factory bends, or three 90°, 24 inch radius bends.
  - 2. Conduit runs exceeding 100 feet from point-to-point or exceeding two 90° bends shall contain accessible pull boxes.

**END OF SECTION**

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**SECTION 26 27 40**  
**WIRING DEVICES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in price offered in the schedule for EWS Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. National Electrical Manufacturers Association (NEMA)
1. NEMA WD 1-1999 (2010) General Requirements for Wiring Devices
  2. NEMA WD 6-2002 (2008) Wiring Devices - Dimensional Specifications
  3. NEMA ICS 5-2000 (2010) Control Circuit and Pilot Devices
  4. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. National Fire Protection Association (NFPA)
1. NFPA 70 (2011) National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL)
1. UL 248-5 (2000) Low-Voltage Fuses – Part 5: Class G Fuses

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 26 27 40-1, Approval Data:
1. Manufacturer's technical data sheets.
- C. RSN 26 27 40-2, Test Reports:
1. Provide test reports as explained in Article 3.03.

**PART 2 PRODUCTS**

**2.01 DIRECT CURRENT (DC) CONTROL ENCLOSURE**

- A. Enclosure Type: Type 3R in accordance with NEMA 250 with hinged single-door.
- B. Constructed of sheet metal no lighter than 14 Manufacturer's Standard Gage (MSG).

- 
- C. Enclosure shall be wall mounted per drawings.
  - D. Sized to accommodate electrical equipment definite on drawings and the following:
    - 1. Power distribution blocks.
    - 2. Molded case circuit breakers.
    - 3. Lighting and general contact relays.
    - 4. DC/DC Converter.
    - 5. Terminal Blocks.
    - 6. Fuses.
    - 7. Future space:
      - a. 6 inches by 12 inches space for future Remote Terminal Unit (RTU).
  - E. Seams: Continuously welded and ground smooth.
  - F. Rolled lip on three sides of door and on all sides of enclosure opening.
  - G. Door:
    - 1. Clamps:
      - a. Stainless steel spring loaded.
      - b. Located on three sides of door.
    - 2. Hinge:
      - a. Stainless steel.
      - b. Continuous.
    - 3. Lockable door.
    - 4. Gasket: oil-resistant with oil-resistant adhesive and held in place with steel retaining strips
    - 5. Refer to drawings for push-button and indicating lights to be mounted on DC control enclosure door.
  - H. Finish:
    - 1. Manufacturer's standard white on inside.
    - 2. Manufacturer's standard gray on outside.



J. Accessories:

1. Din Rail:
  - a. Material: Steel.
  - b. Type: 35mm x 10mm.

**2.02 24-VOLT TO 12-VOLT DC CONVERTER**

A. Heavy Duty Industrial Grade Converter as manufactured by Power Stream, [www.powerstream.com](http://www.powerstream.com), part No. PVTC120-12-2424; or equal having the following essential characteristics:

1. Input voltage range to include 24 VDC.
2. Output: 24 VDC, 120 watts continuous maximum.
3. Line regulation:  $< \pm 0.5$  percent.
4. Load regulation:  $< \pm 0.5$  percent.
5. Efficiency:  $> 80$  percent.
6. Operating range: -25 degrees Celsius to 40 degrees Celsius.
7. Warranty: 3-year, minimum.

**2.03 POWER DISTRIBUTION BLOCKS**

- A. Material: Copper.
- B. Voltage: 24 VDC minimum.
- C. Current: 200 Ampere.
- D. Main Terminal: 4AWG – 500kcmil, 2 connections per pole.
- E. Branch Terminal: 14AWG – 2AWG, 6 connections per pole.

**2.04 MOLDED CASE CIRCUIT BREAKERS**

- A. Voltage: 24 VDC minimum.
- B. Current: As shown on drawings.
  1. Final rating to be verified by load equipment.
- C. Fault Current: 10 kA.
- D. Mount: DIN Rail.
- E. Type: 2-Pole.

---

## 2.05 BATTERY VOLTAGE RELAY DRIVER

- A. Relay Driver as manufactured by Morningstar, <http://www.morningstarcorp.com>, catalog No. RD-1; or equal, have the following essential characteristics:
1. Operating voltage: 24 VDC.
  2. Relay driver outputs: 4 independent channels.
  3. Programmable via RS-232 port.
  4. Controllable via MODBUS.
  5. Mounts on 35mm DIN rail.
  6. LED indicators for displaying power, status of each channel, and faults.
  7. Electrical protections:
    - a. Reverse polarity: relay driver power.
    - b. Reverse polarity: channel input voltage.
    - c. Short circuit and overload for all channels.
    - d. Surge protection: 1500W per channel.
  8. Capable of monitoring voltages between 12V-48VDC.
  9. Programming capability: on and off threshold voltages up to 25VDC.
  10. Programmable delay for operating channel on and off.
  11. Operating Temperature range: -40 degrees Celsius to 45 degrees Celsius.
  12. Warranty: 5 years minimum.

## 2.06 GENERAL CONTACT RELAY

- A. Coil Voltage: 24 VDC.
- B. Contact Voltage: 24 VDC.
- C. Contact Current: 40 Ampere.
- D. Contact Type: Three (3) Normally Open (NO) and one (1) Normally Closed (NC) minimum.
- E. Single-Pole, Single-Throw.

## 2.07 TERMINAL BLOCKS

- A. Type EB-25 as manufactured by General Electric, <http://www.gedigitalenergy.com>; 1600 Series Heavy Duty Terminal Blocks as manufactured by Marathon Special Products, <http://www.marathonsp.com>; Buchanan One Piece Terminal Blocks, catalog Nos. B104, B106, and B112, as manufactured by Ideal Industries, Incorporated, <http://www.idealindustries.com>; or equal, having the following essential characteristics:

1. Molded one piece design with 4, 6, or 12 termination points.
2. Rating: 600 volts, 25 amperes, minimum.
3. Terminals: Binding-head or washer-head screws with serrated or grooved contact surfaces suitable for use with ring-type terminal connectors.
4. Full-size marking strips.
5. Provide a minimum of 2 spare terminals per terminal block.
6. A terminal block shall be provided at all Remote Terminal Unit (RTU) input/output locations as shown on drawings.

## **2.08 FUSES**

- A. Type: Ceramic, time-delay, cartridge. Type G in accordance with UL 248-5.
- B. Rating: 250 VDC, 2.5 Amperes.
- C. UL listed.

## **2.09 PUSH BUTTONS**

- A. Bulletin 800T Push Buttons as manufactured by Allen-Bradley, <http://www.ab.com>; Harmony 9001SK Push Buttons as manufactured by Square-D, <http://www.schneider-electric.com>; CR104P NEMA Pilot Devices as manufactured by General Electric, <http://www.geindustrial.com>; or equal, having the following essential characteristics:
  1. Type: Heavy-duty, watertight/oil-tight with 30.5 mm mounting hole. Momentary contact.
  2. Contact rating: 600 VDC.
  3. START, OPEN VALVE, CLOSE VALVE pushbuttons: Momentary contact with black, flush button.
  4. STOP pushbutton: Momentary contact with red, extended head button.
- B. Nameplate: Equipment manufacturer's standard or custom engraved nameplate suitable for mounting directly over device. Engraving as shown on drawings.
- C. Conform to NEMA ICS 5.

## **2.10 INDICATING LIGHTS**

- A. Type: Heavy-duty, watertight/oil-tight, push-to-test with 30.5 mm mounting hole.
- B. Full voltage for operation on 24 VDC.
- C. Color: Red for 'open' and green for 'closed'. Lamp:
  1. High visibility, LED type, 24 VDC.

2. Minimum of 5 LEDs in a cluster. Lamps with one LED are not acceptable.

D. Nameplate: Equipment manufacturer's standard or custom engraved nameplate suitable for mounting directly over device. Engraving as shown on drawings.

### **2.11 LIGHT SWITCH**

A. Type: Single-pole, self-grounding, industrial grade.

B. Voltage: 12 VDC.

C. Current: 3 Amperes.

D. Impact resistant plastic device body and white handle.

E. Terminals: Screw type for line wiring and grounding.

F. Conform to NEMA WD 1 and be UL listed.

### **2.12 COVER PLATES**

A. Standard Switch:

1. Type: 302 stainless steel.

2. Material Thickness: 0.032 inches.

3. Single gang.

B. Weatherproof Receptacle Cover:

1. Cover shall be metal, 'in-use' type.

2. Extra Deep, self-closing cover.

### **2.13 FINISHES**

A. Manufacturer's standard finishes except as follows:

1. Light Switches and all Receptacles: White.

2. Standard Cover Plates: Satin.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

A. Install all electrical equipment and wiring in accordance with NFPA 70.

B. Wiring and Wiring Connections:

1. Make connections at device terminals or terminal blocks.

2. Maximum of 2 wires per termination.
3. Form wiring into compact groups bound together and firmly supported. Run wiring groups straight, horizontally, or vertically with short-radius, right-angle bends.
4. Support and secure wire bundles with cable tie mounting bases. Secure cable tie mounting base with two No. 8 screws. Mounting cable tie bases with only adhesive will not be allowed.
5. Group wires at terminal blocks to minimize number of external cables.
6. Install ring tongue pressure-crimp-type connectors for terminations at electrical devices.
7. Install pin pressure-crimp-type connectors for terminations where the use of ring tongue is not practical such as terminations at selector switches, pushbuttons, indicating lamps, or auxiliary relays.

C. Terminal Blocks:

1. Arrange terminal blocks to allow external cabling to be supported.
2. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 12 inches separation minimum. Access to front of terminal blocks shall be unobstructed.
3. Machine lettered terminal numbers shall be on terminal block marking strips. Do not use hand lettering.
4. Terminals: Binding-head or washer-head screws with serrated or grooved contact surfaces.
5. Analog Inputs shall be of disconnect switch type terminal blocks.

D. Wire Markers:

1. Install wire markers on conductor ends.
2. Print conductor designation as shown on drawings.

- 
- F. Nameplates:
    - 1. Attach nameplate with machine screws. Use of adhesives for attaching nameplates is not acceptable.
    - 2. See drawings for nameplates.
  - G. Mounted Components:
    - 1. Install in accordance with manufacturer's instructions and recommendations.
    - 2. Install per drawings with secure and suitable fasteners and connectors.
    - 3. Install all devices located in the electrical equipment area at a minimum height of 30 inches and a maximum height of 72 inches.
  - H. Refer to Section 35 23 15 – Hydraulically-Operated Sluice Gate for incorporating power inlet box.
  - I. Install devices as indicated on drawings and per manufacturer's requirements.
  - J. Install switches with OFF position down.
  - K. Install receptacles with grounding pole on top.
  - L. Install fork pressure-crimp-type connectors for terminations. Do not place bare stranded conductors directly under screws. Do not use push-in terminals for wiring connections.
  - M. Contractor shall terminate all input/output points to the terminal block inside the DC Control Enclosure for each device as stated on drawings.

### **3.02 BATTERY VOLTAGE RELAY DRIVER SETTINGS**

- A. Program the driver to the following settings.
  - 1. Channel 1 (low voltage):
    - a. Turn off channel at 1111.4 VDC.
    - b. Turn on channel at 1111.9 VDC.
    - c. Minimum 30-second delay before turning channel on/off.
  - 2. Channel 2 (low-low voltage):
    - a. Turn off channel at 10.8 VDC.
    - b. Turn on channel at 1111.5 VDC.
    - c. Minimum 30-second delay before turning channel on/off.

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### **3.03 CONTRACTOR FIELD QUALITY TESTING**

- A. Notify COR or BIA Representative, at least 72 hours in advance of time of testing in order that test may be witnessed. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.
- B. Continuity and Operation of Control Wiring:
  - 1. Verified by actual electrical operation of the component control devices.
  - 2. DC control circuits:
    - a. Checked by operation of devices, including control switches, indicating lights, DC circuit breakers, and test switches.
    - b. If the control circuits include static relay components, simulate the operation of static relay contacts at the relay terminals or the relay test switch, with the static relays isolated from the DC circuits via test switches or by lifting wires from relay terminals.
  - 3. Remote devices such as power circuit breakers: Simulated at the external cable termination blocks in the duplex control switchboards. The simulation equipment shall accurately simulate power circuit breaker trip and close coil currents, as well as auxiliary contact operation.
  - 4. Demonstrate battery voltage relay settings by applying the proper voltages for operations.
- C. Testing Report:
  - 1. Record date and time of testing as well as signatures from Contractor personnel performing testing, and COR or BIA Representative.
  - 2. State all operations tested; additionally, state any equipment found to need modifications to pass testing.
  - 3. Record time delay for all battery voltage relay driver operations.

**END OF SECTION**

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**SECTION 26 28 10**  
**ENCLOSED CIRCUIT BREAKERS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Include in price offered in the schedule for EWS Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. National Electrical Manufacturers Association (NEMA)
1. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
  2. NEMA AB 1 (2002) Molded Case Circuit Breakers and Molded Case Switches
- B. National Fire Protection Association (NFPA)
1. NFPA 70 (2011) National Electrical Code (NEC)
  2. NFPA 70E (2012) Standard for Electrical Safety in the Workplace

**1.03 DESIGN REQUIREMENTS**

- A. Circuit Breaker Sizes: As indicated on drawings unless load equipment requires an alternate size. All breaker sizes that differ from drawings must be submitted for approval prior to installation. Alternate breaker sizes shall be submitted with load equipment technical data sheets and calculations demonstrating the required change in breaker size.

**1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 - Submittals.
- B. RSN 26 28 10-1, Approval Data:
1. Manufacturer's technical data sheets.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Handle in accordance with manufacturer's recommendations.
- B. Store in clean, dry, secure space. Protect from spills or other moisture by using appropriate coverings.

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## **PART 2 PRODUCTS**

### **2.01 DC CIRCUIT BREAKERS**

- A. Type: Thermal-magnetic.
- B. Voltage: 250 VDC.
- C. Amps/Poles:
  - 1. DC Control Main Breaker: 150 ampere, 2-Pole.
- D. Automatic: Inverse-time trip characteristics on overload and instantaneous trip on short circuit with an interrupting rating of 10kA symmetrical RMS amperes, minimum.
- E. Arc quenchers.
- F. Quick-make and quick-break toggle mechanisms.
- G. Operating Handle:
  - 1. Trip-free.
  - 2. Single operating handle. Handle ties on multiple-pole circuit breakers are not acceptable.
  - 3. Meet NFPA 70E Lock-out/Tag Out requirements.
    - a. Pad lockable in “OFF” position.
- H. Enclosure:
  - 1. Rated Amps:
    - a. CB1: 250, maximum.
  - 2. Door: Hinged, pad-lockable.
  - 3. Mounting: Wall-mounted.
  - 4. Type NEMA 3R in accordance with NEMA 250.
  - 5. UL listed.
- I. Conform to NEMA AB 1 and be UL listed.

### **2.02 FINISHES**

- A. Enclosure: Manufacturer’s standard.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install per manufacturer's instructions, NFPA 70, and as indicated on drawings.
- B. Mounting height: 30 inches minimum, 72 inches maximum.

### **3.02 CONTRACTOR QUALITY CONTROL TESTING**

- A. Notify COR or BIA Representative at least 72 hours in advance of time of testing in order that test may be witnessed. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.
- B. Verify proper operations of all enclosed circuit breakers.

**END OF SECTION**

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**SECTION 26 33 00**  
**BATTERY EQUIPMENT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Cost:

1. Include in price offered in the schedule for Complete Electrical System.

**1.02 REFERENCES**

A. National Electrical Manufacturer's Association (NEMA)

1. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

B. National Fire Protection Association (NFPA)

1. NFPA 70 (2011) National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL)

1. UL 50 (2007) Enclosures for Electrical Equipment, Non-Environmental Considerations

**1.03 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 26 33 00-1, Approval Data:

1. Manufacturer's technical data sheets.

C. Manufacturer's Battery System Calculations:

1. The Battery System shall be sized/rated to maintain power for all electrical equipment for a minimum of 72 hours.

**1.04 DELIVERY, STORAGE, AND HANDLING**

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

**1.05 PROJECT CONDITIONS**

A. Altitude: 7080 feet above sea level.

B. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

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## **1.06 DESIGN REQUIREMENTS**

- A. Batteries shall store electrical energy supplied from photovoltaic system as described in Section 48 14 00 – Solar and Electrical Equipment.
- B. From full charge, batteries must meet a system run-time of 72 hours minimum without recharge under full system load. See drawings for load equipment.

## **PART 2 PRODUCTS**

### **2.01 BATTERY ENCLOSURE**

- A. Construction: Steel or aluminum.
- B. Enclosure: Type 3R in accordance with NEMA 250.
- C. Doors: Hinged double doors, lockable.
- D. Finish: Manufacturer's standard powder coat.
- E. Spill containment tray.
- F. Ventilation: Passive.
- G. Size: Able to accommodate all batteries required, plus 20 percent spare.

### **2.02 BATTERY**

- A. Type: Sealed, maintenance free, lead acid battery.
  - 1. Absorption glass mat (AGM), valve regulated, and specifically made for photovoltaic applications.
- B. Terminal Voltage: 24 VDC nominal.
- C. Temperature Range: -40 degrees Celsius to 72 degrees Celsius.
- D. The Battery System shall be sized/rated to maintain power for all electrical equipment for a minimum of 72 hours.
- E. Self-Discharge: Less than 1 percent per month at 25 degrees Celsius.
- F. Use of flooded cell batteries is not permitted.
- G. Conforms to UL 50.

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## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install batteries in battery enclosure per manufacturer's recommendations and NFPA 70.
- B. Provide all battery cables, grounding, and associated equipment required for a complete independent battery supply system to DC Control Enclosure, see Section 26 27 40 – Wiring Devices for DC Control Enclosure requirements.
- C. Install conduit in accordance with Section 26 05 19 – Electrical Conduit.
- D. Install cable in accordance with Section 26 05 20 – Conductors and Cables.
- E. Install grounding and bonding connections in accordance with Section 26 05 26 – Grounding and Bonding.
- F. Installed equipment must be suitable for installation in project conditions.
- G. Install battery enclosure at location specified on drawings and secure with suitable fasteners in accordance with manufacturer's instructions.
- H. Install enclosure so as to not impede any room or enclosure access.
- I. Wiring and Wiring Connections:
  - 1. Make connections at device terminals or terminal blocks.
  - 2. Maximum of two wires per termination
  - 3. Form wiring into compact groups bound together and firmly supported. Run wiring groups straight, horizontally, or vertically with short-radius, right-angle bends.
  - 4. Support and secure wire bundles with cable tie mounting bases. Secure cable tie mounting base with two No. 8 screws. Mounting cable tie bases with only adhesive will not be allowed.
  - 5. Group wires at terminal blocks to minimize number of external cables.
  - 6. Install ring tongue pressure-crimp-type connectors for terminations at electrical devices.
- J. Nameplates: Attach nameplate with machine screws. Use of adhesives for attaching nameplates is not acceptable.
  - 1. Battery enclosure nameplate to state: "BATTERY ENCLOSURE".

### **3.02 CONTRACTOR FIELD QUALITY TESTING**

- A. Notify COR or BIA Representative at least 3 days in advance of time of testing. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.

- B. To demonstrate the system is fully functional, allow the system to run for 72 hours or greater without use of solar modules from a fully charged battery system.
- C. COR or BIA Representative will furnish a discrepancy list to Contractor 20 days after satisfactory completion of on-site test.
- D. Contractor shall resolve discrepancies.
- E. COR or BIA Representative will provide final acceptance.

**END OF SECTION**



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**SECTION 26 51 10**  
**INTERIOR LUMINAIRES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
  - 1. Include in price offered in the schedule for Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. National Fire Protection Association (NFPA)
  - 1. NFPA 70 (2011) National Electrical Code (NEC)

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 26 51 10-1, Approval Data:
  - 1. Manufacturer's technical data sheets.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Luminaires: Underwriters Laboratories (UL) listed.
- B. Furnish all necessary mounting hardware.

**2.02 TYPE A LUMINAIRE**

- A. LED 160 LED162CP Series as manufactured by Thin-Lite, [www.thinlite.com](http://www.thinlite.com), Catalog No. LED 162CP; or equal, having the following essential characteristics:
  - 1. Surface Mount.
  - 2. 1920 Lumen Output minimum.
  - 3. LED: 48 LED count minimum.
  - 4. Operating Voltage: 8 – 30 VDC.
  - 5. Clear acrylic lens.
  - 6. LED life: 100,000 hours minimum.
  - 7. Warranty: 3-year minimum.

8. Reverse polarity protection.
9. Over voltage protection.
10. Suitable for outdoor use.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install luminaires and accessories as indicated on drawings and in accordance with manufacturer's instructions and NFPA 70.
- B. Luminaires requiring special modifications shall be modified and wired by manufacturer.
- C. Aim and adjust luminaires so that one luminaire shall be placed on each wall, and two placed on opposite walls below grates.
- D. Install fittings and accessories required for complete installation.
- E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Make connections to branch circuits. Use insulated conductors with insulation suitable for temperature conditions within luminaire.
- G. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- H. Remove dirt and debris from enclosures.
- I. Clean photometric control surfaces as recommended by manufacturer.
- J. Clean finishes and touch up damage.

**END OF SECTION**

**SECTION 31 02 10**  
**WATER FOR DUST ABATEMENT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Water for Dust Abatement:
1. Payment: Lump sum price offered in the schedule.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

**3.01 APPLYING WATER FOR DUST ABATEMENT**

- A. Provide water in accordance with Section 01 51 00 – Temporary Facilities.
- B. Provide means and equipment to convey water to point of use and applying water.
- C. Use pressure spray or distributor bar to apply water evenly.
- D. Apply water for dust abatement as directed by the COR or BIA Representative.

**END OF SECTION**

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**SECTION 31 03 10**  
**DIVERSION AND CARE OF FLOW DURING CONSTRUCTION**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Diversion and Care of Water During Construction:

1. Payment: Lump sum price offered in the schedule.
  - a. Includes:
    - 1) Constructing and maintaining cofferdams, channels, flumes, drains, sumps, piping, and other temporary diversion and protective works.
    - 2) Removing or leveling such works, where required.
    - 3) Providing and operating reservoir unwatering pumps during construction. Note: Pumps and piping shall be in place prior to construction.
    - 4) Disposing of materials.
    - 5) Diverting water.
    - 6) Making required closures.
    - 7) Excavation of Sediments.
    - 8) Other work required by this Section.
  - b. Monthly progress payments will be based on approved cost allocations to the major work divisions and the percentage of each major division of work performed.

**1.02 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 03 10-1, Water Control Plan:

1. Describe proposed method for diversion and care of water during construction and measures to be taken to meet permit requirements and water quality standards.

C. RSN 31 03 10-2, Cofferdam and Diversion Plan:

1. Cofferdam fill material test data. Cofferdam fill material must meet requirements of Zone 1A material.
2. Sequence of construction and removal.
3. Methods of diverting water stored by cofferdam.

### **1.03 SITE CONDITIONS**

- A. The cofferdam will be sufficiently sized to store the 100-year flood volume and provide adequate protection against the peak flows.
1. The cofferdam shall have a minimum crest at El. 7072 feet.
  2. The cofferdam shall have a minimum height of 8 feet.
  3. The COR and the BIA Representative assume no responsibility for deductions, interpretations, or conclusions made by the Contractor based on hydrologic information made available by the COR or the BIA Representative.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Prior to excavation and commencement of the outlet works replacement, the cofferdam shall be constructed to a height of no less than 8 feet above the contact between the upstream cofferdam toe and the existing ground to temporarily store inflows and direct reservoir inflows away from the outlet works to a collection sump for pumping and diversion. Cofferdam construction shall be in accordance with Section 31 24 00 – Fill and Backfill.

### **3.02 DIVERSION**

- A. Construct and maintain temporary diversion and protective works necessary for diversion and care of the water during construction, including, but not limited to, cofferdams, channels, flumes, drains, piping, and sumps.

### **3.03 CLEANUP AND RESERVOIR REGULATION**

- A. Remove or level temporary diversion and protective works in a manner approved by the COR or BIA Representative.
1. Removed materials remain property of the Contractor.

2. Dispose of removed material in accordance with Section 01 74 00 – Cleaning and Waste Management.
  3. Remove pumps and piping required for reservoir unwatering. Regrade and seed pipe corridors if required by the COR or BIA Representative.
- B. Temporary diversion and protective works constructed upstream from the dam and not a part of the permanent dam embankment.
1. Remove or level and grade to extent required to prevent obstruction of flow to spillway or outlet works.
  2. After installation and testing of gates and other metalwork and equipment in the outlet works structure, the COR or BIA Representative will operate the gates and regulate the flow through the outlet works, and reserves the right to commence storage in the reservoir.
  3. Repair damage to foundations, structures, or other part of the work caused by floods, water, or failure of diversion or protective works.

**END OF SECTION**

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**SECTION 31 03 33**  
**DEWATERING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Removal of Water from Excavation:
1. Payment: Lump sum price offered in the schedule.
    - a. Except as otherwise provided in Section 31 23 23: Excavation, the lump sum price includes costs of furnishing labor, equipment, and materials for maintaining excavations and work areas free from water.
    - b. Includes costs of furnishing labor, equipment, and materials for maintaining work related to the removal of water as required by this section.
  2. Payment Allocation:
    - a. Allocation of the lump-sum price is subject to approval of the CO.

**1.02 DEFINITION**

- A. Dewatering: Removal and control of groundwater from pores or other open spaces in soil or rock formations to allow construction activities to proceed as intended, and includes relief of groundwater pressure.
- B. Unwatering: Control and removal of ponded, seeping, or flowing surface water or emerging subsurface water from excavated surfaces and from precipitation within and adjacent to excavations and construction zones using channels, ditches, gravel drains, gravel blankets, pipe, sumps, and discharge lines. Includes control and discharge of effluent waters.

**1.03 SYSTEM DESCRIPTION**

- A. Design, install, operate, maintain, and monitor water removal and control facilities.
- B. Design and layout facilities to collect discharge water from water removal systems and convey water to discharge points approved by the COR or BIA Representative.
- C. Locate water removal facilities to maximize water removal and minimize construction interference.
- D. Select pump types and design discharge systems and settling ponds, if required. Discharge systems shall be capable of cleaning water to meet permit requirements.
- E. Provide required equipment and monitor as required by permit.

#### **1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 03 33-1, Removal of Water Plan:
  - 1. Showing proposed method for removal of all water from foundations and other excavations.

#### **1.05 REGULATORY REQUIREMENTS**

- A. Obtain required Federal, Navajo Nation, and local permits for water discharge and other activities associated with removal and control of water.
- B. Refer to Section 01 57 20 – Environmental Protection.

#### **1.06 PROJECT CONDITIONS**

- A. The Contractor should anticipate ground water levels to be at or near the ground surface for excavation at the filter trench and outlet works.
- B. Conditions which may influence the unwatering include:
  - 1. Frequency and rate of precipitation at the site.
  - 2. Subsurface conditions including natural layering, thickness, permeability, and storativity of materials, and groundwater levels.
  - 3. Efficiency and number of pumps, collectors, and discharge systems.
  - 4. Inflow of water into excavation from existing toe drain, seepage through the existing embankment, foundation, or outlet works.
  - 5. Reservoir level behind the dam or temporary cofferdam.
- C. Water content and water levels and pressures in subsurface materials vary with location, depth, and material.
- D. Refer to the Design Summary Report for information on geologic and subsurface conditions.

#### **PART 2 PRODUCTS**

Not Used

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## **PART 3 EXECUTION**

### **3.01 TEMPORARY FACILITIES**

- A. Design, furnish, install, construct, operate, monitor, maintain, and remove temporary facilities required to remove and control water 3 feet below the subgrade elevation. Provide or construct pumps, pipelines, cofferdams, sumps, ditches, channels, and other facilities required for unwatering.
- B. Supplement or modify facilities when monitoring or other conditions reveal inadequate performance of facilities. Obtain approval of additions or modifications from the COR.
- C. Remove temporary facilities when no longer required.

### **3.02 WATER REMOVAL AND CONTROL**

- A. Remove water and maintain foundations, work areas, and borrow area free from water so that construction operations are performed in dry conditions.
- B. Plans may be placed in to operation upon approval, but nothing in this Section shall relieve the Contractor from full responsibility for the adequacy of the water removal and control.
- C. Control water so that stable excavations are maintained and damage to work is prevented.
- D. Unwatering:
  - 1. Remove surface water from work areas.
  - 2. Control and collect flowing surface water, precipitation runoff, and seepage to prevent accumulation of water which could interfere with construction operations or damage work.
  - 3. Locate ditches, channels, sumps, and settling ponds at locations approved by the COR or BIA Representative.
  - 4. Refill ditches or channels excavated below final lines and grades indicated on drawings to established lines and grades as specified for refill of overexcavation.

### **3.03 REPAIR**

- A. Repair damage to work caused by inadequate performance of facilities, mechanical or electrical failure of equipment, or inadequate monitoring or maintenance of facilities. Obtain approval of repair or replacement work from the COR or BIA Representative.

### **3.04 DISPOSAL**

- A. Dispose of removed water in accordance with Section 01 57 20 - Environmental Protection.

**END OF SECTION**

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**SECTION 31 09 12**  
**INSTRUMENTATION**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Inspection Wells:

1. Payment: Lump sum price offered in the schedule.
  - a. Includes:
    - 1) Precast reinforced concrete manhole sections.
    - 2) Cast in place concrete base slab.
    - 3) Weir plate.
    - 4) Sonic water level sensor.
    - 5) Cast/precast concrete cover.
    - 6) Access hatch.
    - 7) Ladders.
    - 8) Grating and angle supports.
    - 9) Grab bar.
    - 10) Air vent.
    - 11) Staff gauges.
    - 12) PVC raceways.
    - 13) Stilling Well and cap.

B. Abandoning Existing Piezometers:

1. Payment: Lump sum price offered in the schedule.

C. Piezometers:

1. Payment: Lump sum price offered in the schedule.

D. Crest Survey Monuments:

1. Measurement: Number of survey monuments installed.
2. Payment: Survey monument per unit offered in the schedule.

E. Staff Gauges:

1. Payment: Lump sum price offered in the schedule.
  - a. Includes staff gauges on the intake structure and the embankment.

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## 1.02 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
1. AASHTO M 252-09 Corrugated Polyethylene Drainage Pipe
  2. AASHTO M 294-10 Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter
  3. AASHTO SSHB-02 Standard Specifications for Highway Bridges, Seventeenth Edition
- B. ASTM International (ASTM)
1. ASTM C 33/C 33M-11a Concrete Aggregates
  2. ASTM C 150/C 150M-09 Portland Cement
  3. ASTM C 1602/C 1602M-06 Mixing Water Used in the Production of Hydraulic Cement Concrete
  4. ASTM C 478-11 Precast Reinforced Concrete Manhole Sections
  5. ASTM C 923-08 Resilient Connections Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
  6. ASTM C 990-09 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible joint Sealants
  7. ASTM D 1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
  8. ASTM D 2466-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
  9. ASTM D 3350-10a Polyethylene Plastic Pipe and Fittings Materials
  10. ASTM F 477-10 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
  11. ASTM F 480-06b Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
  12. ASTM F 714-10 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- C. National Electrical Manufacturer's Association (NEMA)
1. NEMA TC 2-2003 Electrical Polyvinyl Chloride (PVC) Conduit
  2. NEMA TC 3-2004 PVC Fittings for Use with Rigid PVC Conduit and Tubing
  3. NEMA WC 57-2004 Thermocouple Extension and Instrumentation Cables

- D. National Fire Protection Association (NFPA)
  - 1. NFPA 70-2011 National Electrical Code (NEC)

### **1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 - Submittals.
- B. RSN 31 09 12-1, Survey Reports:
  - 1. Location (northing, easting, station, offset, and elevation) of piezometer standpipes, inspection wells, crest survey monuments, and weir plates.
  - 2. Piezometer installation reports including materials used, depth and elevation of riser pipe, grout, silt traps, screened intervals, filters, and seals.
- C. RSN 31 09 12-2, Abandoning Existing Piezometers Plan:
  - 1. Include methods, plans, and sequence with excavation for abandoning existing piezometers.
- D. RSN 31 09 12-3, Instrumentation Plan:
  - 1. Procedures for installation, performance testing, and initial instrument reading for each type of instrument;
  - 2. Layout drawings showing locations of instruments, routing of cables, instrument installation details and complete wiring diagrams;
  - 3. Manufacturers literature including catalog cut sheets, installation directions, operations and maintenance manuals and pamphlets, and warranty information for all instruments;
  - 4. Details of final design, installation, and performance testing procedures; and
  - 5. Drilling procedures for piezometers.

### **1.04 PROJECT CONDITIONS**

- A. The existing piezometers to be abandoned under this Section are located within the dam embankment and at the downstream toe.
- B. Existing piezometers to be abandoned are shown on the design drawings. Available borelogs from piezometer installation are contained in the Design Summary Report.

### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Inspection Well Sections:
  - 1. Store and handle in accordance with manufacturer's recommendations.
  - 2. Protect sections from damage.

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## **PART 2      PRODUCTS**

### **2.01    INSPECTION WELLS**

- A.    Precast Reinforced Concrete Manhole Sections:
1.    Riser sections, ASTM C 478 as manufactured by Monarch Products Company, Incorporated, 385 Sipe Road, York Haven, PA 17370, Telephone 717-938-8303 or equal having the following characteristics:
    - a.    Lifting devices:
      - 1)    Eyebolts, hooks, other devices cast into risers to facilitate lifting and positioning, and to provide balanced lift.
      - 2)    Designed for adequate strength with a factor of safety to carry anticipated loads during handling and installing of riser sections.
    - b.    Make openings for pipe inlets and outlets at locations shown on drawings.
    - c.    Built in manhole rungs.
  2.    Joint sealants: ASTM C 990.
- B.    Connections to Inlet and Outlet Pipe: Resilient connector in accordance with ASTM C 923.
- C.    Base Slab:
1.    Cast-in-place reinforced concrete slab.
  2.    Dimensions and reinforcement shown on drawings.
  3.    In accordance with Section 03 30 00 – Cast-In-Place Concrete.
- D.    Weir Divider Wall: In accordance with Section 03 30 00 – Cast-In-Place Concrete.
- E.    Stainless Steel Weir Plate:
1.    As provided in Section 05 50 00 – Metal Fabrications.
  2.    Dimensions are as shown on drawing.
- F.    Staff Gauge:
1.    Style C manufactured by Stevens Water Monitoring Systems, Incorporated, 5465 SW Western Avenue, Suite F, Beaverton, OR 97005, Telephone 503-445-8000; or equal, with the following essential characteristics:
    - a.    Porcelain enameled 18 gage iron or steel.
    - b.    Minimum 2-1/2 inches wide.
    - c.    Markings and holes shown on drawings.
      - 1)    Black numbers on white background.
      - 2)    Marked at every tenth of a foot and every foot.



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- 3) Holes: Grommet installed to prevent cable damage.
- G. Cast or Precast Concrete Cover:
1. Cast or precast reinforced concrete cover.
  2. Dimensions are shown on drawings. Reinforcement shall be No. 4 reinforcing bars at 6 inch spacing each way on each face.
  3. Recessed lifting tabs as shown on drawing.
  4. Formed block out for toe drain inspection well 36- by 36-inch access hatch.
- H. Access Ladder: In accordance with Section 05 50 00 – Metal Fabrications.
- I. Safety Grab Bar: In accordance with Section 05 50 00 – Metal Fabrications.
- J. Goose Neck Air Vent: In accordance with Section 05 50 00 – Metal Fabrications.
- K. Toe Drain Inspection Well Access Hatch:
1. "Single Leaf Surface Mount Access Door – Type SM-4" single leaf access door manufactured by The Bilco Company, P.O. Box 1203TR, New Haven, CT 06505, Telephone 203-934-6363 or equal, having the following essential characteristics:
    - a. Thirty-six-inch by 36-inch extruded aluminum frame opening.
    - b. 1/8-inch Aluminum diamond plate cover.
    - c. Torsion/cam operating mechanism.
    - d. Stainless steel slam lock.
    - e. Removable square locking key wrench.
    - f. Automatic hold open arm.
    - g. Continuous neoprene cushioned door seal.
    - h. Concealed stainless steel hinges.
    - i. Optional exterior padlock hasp.
    - j. Lift assist:
      - 1) Gas strut lifting mechanism.
      - 2) Controlled cover operation opening and closing through arc of movement.
    - k. Designed for minimum 100 psf live load.
- L. Joint Sealants: RU-106 – RUBR-NEK LTM, manufactured by Henry Company – Sealant Division, 909 North Sepulveda Boulevard, El Segundo, CA 90245, www.henry.com, Telephone 310-955-9200 or equal with the following essential characteristics:
1. Vulcanized butyl rubber sealant.
  2. Specific gravity at 77 degrees Fahrenheit 1.2 to 1.35.

3. Conforms to ASTM C 990.

## **2.02 PVC STILLING WELL AND CAP**

### **A. Solid PVC Pipe:**

1. One 6-inch nominal diameter 4 feet in length or longer to accommodate ultrasonic water level sensor and manufacturers installation requirements.
  - a. Six-inch diameter plug sealed into the base of the pipe
  - b. 4-1/2-inch diameter holes at 90 degrees from each other 2 inches from base of stilling well.
  - c. 1-1/2-inch diameter hole 2 inches from the top.
2. One 6-inch nominal diameter pipe caps with cable gland in center.
3. ASTM D 2466, Schedule 40, PVC slip-on type.
4. Stilling well mounting brackets.
  - a. As shown on drawings.
  - b. Two each stainless steel strap 1/16-inch by 1-1/2-inch long enough to secure stilling well to concrete manhole.
  - c. 3/8-inch by 3-inch stainless steel anchor bolts and nuts, No. 16 UNC bolts.
  - d. Stainless steel, ASTM A 276, type 304.

## **2.03 BOLTS, NUTS, AND WASHER**

- A. 3/8-inch, No. 16 UNC bolts.
- B. Other installations.
- C. Stainless steel, ASTM A 276, type 304.

## **2.04 STANDPIPES - PIEZOMETERS**

### **A. Standpipe:**

1. Attach to pipe coupling on the top of porous tube.
2. As manufactured by Colorado Engineering and Instrumentation, Incorporated, 12860 West Cedar Drive, Lakewood, CO 80228, Telephone 303-989-5159, or equal, having the following essential characteristics:
  - a. Schedule 80, PVC pipe in accordance with ASTM D 1785.
  - b. Section lengths: 10 feet.
  - c. Inside diameter: 2-inch.
  - d. Square-threaded flush joints, 6 threads per inch in accordance with ASTM F 480.

e. Furnished with an o-ring seal.

B. PVC Solvent Weld Cement:

1. Most suitable grade for fastening PVC fittings and PVC pipe together.
2. Fast setting or 5-minute cements not permitted.

C. Pipe Hangers:

1. ASTM A 276, type 304 stainless steel, suitable for hanging 2-inch diameter standpipe off the relief well wall by means of 1/4-inch thread rod (1/4-20 NC).
2. The hangers shall totally encase the 2-inch stand pipe at its mounding point.
3. Install two hangers per well.

**2.05 POROUS-TUBE PIEZOMETER**

A. A porous-tube piezometer consists of a porous tube, schedule 80 PVC pipe coupling, and standpipe, and shall be assembled using two-part epoxy.

B. Porous Tube: Casagrande type standpipe piezometer, as manufactured by RST Instruments LTD., P.O. Box 8110-814, Blaine, WA, 98231-8110, Telephone 604-540-1100; or equal, having the following essential characteristics:

1. External filtering element:
  - a. Material: 2-inch PVC.
  - b. Outside diameter, maximum: 1.32 inches.
  - c. Length: 24 inches.
  - d. Outside slot size: 0.01-inch.
2. Internal filtering element:
  - a. Porosity: 70 micron.
  - b. Permeability:  $3 \times 10^{-4}$  meters per second.
3. Able to accept 1-, 3/4-, and 1/2-inch diameter stand pipes.
4. Piezometer adapted to fit 2-inch PVC pipe coupling which attaches to the piezometer stand pipe.

C. PVC Solvent Weld Cement:

1. Most suitable grade for fastening PVC fittings and PVC pipe together.
2. Fast setting or 5-minute cements not permitted.

**2.06 PIEZOMETER FILTER SAND**

A. Graded sand for backfill in piezometer influence zone.

1. Washed sand.

2. Gradation:
  - a. Passing No. 4 screen: 100 percent.
  - b. Ninety-five percent of total gradation falling between U.S. Standard sieve sizes No. 8 and 50.
  - c. Passing No. 200 screen, maximum: 2 percent.

## **2.07 PIEZOMETER GROUT AND BENTONITE BACKFILL**

- A. Bentonite: Manufactured by American Colloid Company, Water/Mineral Division, One North Arlington, 1500 West Shure Drive, Arlington Heights, IL 60004, Telephone 847-392-4600; or equal, having the following essential characteristics:
  1. Montmorillonite clay purity, minimum: 90 percent.
  2. Moisture content as packaged, maximum: 10 percent.
  3. Dry particles passing No. 200 screen, minimum: 70 percent.
  4. Dry bulk density, minimum: 55 pounds per cubic foot.
  5. Specific gravity, minimum: 2.5.
  6. PH with 5 percent suspension: 9 to 10.5.
- B. Bentonite Pellets: Manufactured by American Colloid Company, Water/Mineral Division, One North Arlington, 1500 West Shure Drive, Arlington Heights, IL 60004, Telephone 847-392-4600; or equal, having the following essential characteristics:
  1. Montmorillonite clay purity, minimum: 90 percent.
  2. Moisture content as packaged, maximum: 10 percent.
  3. Size: 1/2-inch diameter.
  4. Dry-bulk density, minimum: 75 pound per cubic foot (lb/ft<sup>3</sup>).
- C. Bentonite Seals:
  1. One cubic foot of grout:
    - a. Bentonite: 14.3 pounds.
    - b. Water: 6.7 gallons.
- D. Cement Bentonite Grout Mix:
  1. Water: 7-10 gallons
    - a. ASTM C 1602, including optional requirement of Table 2.
  2. Portland Cement: 94 lbs
    - a. ASTM C 150, Type V.
    - b. Meet equivalent alkalis requirements of ASTM C 150 – Table 2.
    - c. Meet false-set requirements of ASTM C 150 – Table 4.

3. Bentonite powder: 4 lbs

## **2.08 OUTFALL SCREEN**

### **A. Stainless Steel Wire Cloth:**

1. Stainless steel, Type 304 or 316.
2. Mesh openings per linear inch: 2 by 2.
3. Wire diameter, minimum: .080 inches.

## **2.09 GROUT MATERIALS FOR ABANDONING PIEZOMETERS**

### **A. Portland Cement:**

1. ASTM C 150, Type V.
2. Meet equivalent alkalis requirements of ASTM C 150 – Table 2.
3. Meet false-set requirements of ASTM C 150 – Table 4.

### **B. Water:**

1. ASTM C 1602, including optional requirement of Table 2.

### **C. Water/Cement Ratio: 1:1.**

## **2.10 CONCRETE PLUG ANCHORS**

### **A. Stainless steel suitable for compression type installation in concrete.**

## **2.11 ULTRASONIC WATER LEVEL SENSOR**

### **A. Ultrasonic water level sensor: Model 3010 Ultrasonic Flow Transmitter, manufactured by Teledyne ISCO, 4700 Superior Street, Lincoln, NE 68504, Telephone 402-464-0231, or equal, having the following essential characteristics:**

1. Type: Ultrasonic
2. Operating temperature and compensated temperature range: -22 to 140 degrees Fahrenheit
3. Distance range: 2 to 12 feet
4. Measurement accuracy: maximum error of  $\pm 0.02$  feet for a head change of  $< 1.0$  feet
5. Manufacturers recommended cabling for power and communication, furnished in lengths that do not require splicing.

## **2.12 PVC PIEZOMETER PIPE CAPS**

### **A. ASTM D 2466, Schedule 40, PVC slip-on type.**

1. Nominal diameter: As indicated on drawing.

### **2.13 RESERVOIR STAFF GAUGE**

- A. Style E manufactured by Stevens Water Monitoring Systems, Incorporated, 5465 SW Western Avenue, Suite F, Beaverton, OR 97005, Telephone 503-445-8000; or equal, with the following essential characteristics:
  1. Porcelain enameled 18 gage iron or steel.
  2. Minimum 2-1/2 inches wide.
  3. Markings and holes shown on drawings.
    - a. Black numbers on white background.
    - b. Marked at every tenth of a foot and every foot.
    - c. Holes: Grommet installed to prevent cable damage.
  4. Display water surface elevation in feet (NGVD 29).

## **PART 3 EXECUTION**

### **3.01 INSPECTION WELL INSTALLATION**

- A. After cast-in-place slab with splitter wall has cured for at least 7 days, secure inspection well riser section in mortar to base slab and sealed with approved sealant to provide a watertight joint.
- B. Cut toe drain pipe inlets and outlets into first riser section of the toe drain inspection well.
- C. Install riser sections and extend riser sections and cover until inspection extends 18 inches above ground surface. All joints to be sealed with joint sealants.
- D. Install stub pipe entrances in accordance with manufacturer's instructions.
- E. Install ladders and access hatch covers in accordance with Section 05 50 00 - Metal Fabrications.
- F. Install weir plates, staff gages, stilling wells, grating, and grab bar as shown on drawings.
- G. Tolerance:
  1. Deviation for vertical for installed well: 1/2-inch in 10 feet.

### **3.02 CONDUIT AND CABLE INSTALLATION**

- A. Install conduit in accordance with Section 26 05 19 – Electrical Conduit.
- B. Install cable in accordance with Section 26 05 20 – Conductors and Cables.

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### 3.03 PIEZOMETER INSTALLATION

#### A. Drilling for Piezometers:

1. Drill holes, subject to the technique and media restrictions stated here, in the locations and to the bottom elevations shown on drawings. Due to construction considerations concerning the protection of the embankment, and the requirement to maintain a clean, open drill hole prior to, and during, the installation of the instrumentation, the drilling requirements of this paragraph expressly restrict the type of drilling equipment and drilling procedures that may be used with no exception.
2. Sample requirements:
  - a. Collect representative samples of subsurface materials by performing Standard Penetration Tests (SPT) at a minimum of every 5 feet of depth, or at other intervals as may be directed, for the purpose of maintaining an accurate drill log for the entire depth of each hole. The samples are also for the purpose of identifying materials at influence zones. Collect, log, and place representative samples in containers for inspection. Drill logs should be maintained.
3. Drilling circulation media:
  - a. Drill fluids, including air, may only be used to remove drill cuttings in boreholes advanced at the downstream toe and in areas downstream of the embankment. Any drill fluid other than air or clean water shall require prior approval by the COR or BIA Representative. The drilling fluid shall be a commercially available product which is made for the drilling industry and approved for use by Navajo Nation regulations governing the water well drilling industry. The drilling fluid will not contain any additive that would penetrate into permeable formations or otherwise restrict free water flow into the drill hole.
  - b. During all drilling operations, the water levels within the drill hole will be monitored. All water levels will be measured hourly during hole drilling and reported on drill log reports. If any water losses are measured within the drill hole, all drilling operations will stop until the reason for the loss is determined and approval is given to begin drilling operations again.
4. Upon completion of each installation hole to the total designed or directed depth, flush all fluids from the drill hole with clean water. Flushing will be from the bottom of the hole up with a continuous flow for 2 minutes or as required. This water will be removed by air circulation to remove the injected water prior to instrument installation and backfilling as required.
5. Embankment drilling:
  - a. To eliminate the potential of creating a hydraulically induced fracture in the embankment, by excessive circulation media, injection pressure, mud blocks, or restricted drill hole annulus for circulation media and cuttings return, open hole drilling with any form of pressurized fluid or compressed

- air circulation media is prohibited. The following subparagraphs define the drilling equipment types and procedures approved for use in drilling through embankment materials.
- b. Hollow stem augers drilling equipment and procedures. Hollow stem auger equipment used for drilling through embankments will be equipped with an internal center stem and plug bit. Furnish the augers with an internal diameter large enough to fit the required hole size where the internal diameter of the hollow stem auger will be 4 inches. If hollow stem augers are being used, then no temporary casing will be required for the drill holes being used for the instrument installations. The augers will be removed during installation as described below. The following drilling requirements will be strictly enforced through all embankment and foundation or formation material.
6. Auger removal:
    - a. All drill holes for instrument installation will remain open within the hollow stem auger until the backfill has reached an elevation one foot below the bottom of the last auger section. At this point, removal of one section of auger shall be completed followed by the continuation of backfill placement in compliance with this requirement.
  7. Drill-hole completion and clean out:
    - a. Following drilling to the required depth, clean all material from within the temporary drill casing, if it is required and approved by the COR or BIA Representative, by continuous circulation with clean water until the discharge is clean and free of cuttings, followed by circulation of compressed air to remove drilling media residue and water residue.
    - b. Following the temporary casing clean out, verify the total depth of cased hole by lowering a measuring probe to the hole bottom. This measurement will be made from a benchmark location established by surveying near the drill hole collar on the ground surface. The measurements or soundings of the drill hole made will be made using tapes that are marked in decimal feet, not in fractional feet. Accurate surface locations for instrument placement cannot be determined if accurate depth measurements are not made.
    - c. Prior to the installation of any instrumentation or backfill into the drill hole, if temporary casing has been installed, attach casing pulling equipment to the temporary drill casing and verify the equipment's capability to remove the entire casing string by pulling a maximum of 6 inches above hole bottom. Instrumentation installation and/or backfilling shall not commence until the casing pulling capabilities have been verified.
    - d. Instrument installation and backfilling shall commence and continue to completion without interruption as soon as possible following drill hole completion and clean out:



- 1) Take precautions, as necessary, during all backfill placement operations to prevent bridging of the backfill material, and to ensure compliance with backfill depth requirements by measurement probe checks and placement volume calculations.
- 2) Be prepared to dislodge all bridged material by vibration of the temporary drill casing, clear-water jetting, or other approved method.
- 3) If clear water has to be introduced into the cased hole during the backfilling operation, the following requirement will apply before continuing backfill through a seal zone scheduled for the placement of bentonite pellets:
  - a) Free-water accumulation within the drill hole that is in excess of 5 feet in depth will be removed by bailing prior to the placement of bentonite pellets backfill material.

### **3.04 GROUTING OF ABANDONED PIEZOMETERS**

- A. Locations of existing piezometers are shown on drawings.
- B. Grout the piezometer wells in accordance with the following:
  1. Excavate to expose top of PVC piezometer.
  2. Completely grout PVC standpipe.
  3. Excavate and remove protective casing after grouting.
  4. Cut off grouted PVC standpipe 2 feet below final ground surface.

### **3.05 DISPOSAL**

- A. Dispose of removed materials in accordance with Section 01 74 00 – Cleaning and Waste Management.

**END OF SECTION**

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**SECTION 31 11 00**  
**CLEARING AND GRUBBING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Clearing and Grubbing:
1. Measurement: Area cleared measured on sloping surface.
  2. Payment: Acre price offered in the schedule.
    - a. Includes cost of disposing of cleared material.
- B. Cutting and Removing Trees:
1. Measurement: Number of trees cut and removed as directed by the COR or BIA Representative.
  2. Payment: Lump sum price offered in the schedule for clearing and grubbing at the embankment and within the reservoir area, separate lump sum price for clearing and grubbing in the borrow area.
    - a. Includes cutting and removing trees, tree stumps, and root balls at the downstream toe of the dam.
    - b. Includes disposing of removed materials.
    - c. Includes providing, placing, and compacting backfill in rootball holes.
    - d. Other required clearing and grubbing contained in this section.

**1.02 DEFINITIONS**

- A. Vegetation: Trees, shrubs, brush, stumps, exposed roots, down timber, branches, grass, and weeds.

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 11 00-1, Herbicide (if used)

**1.04 PROJECT CONDITIONS**

- A. Trees requiring cutting and removing range in diameter from approximately 9 inches minimum to approximately 105 inches maximum Diameter at Breast Height (DBH). DBH is tree diameter measured at 4-1/2 feet above ground surface.

- B. Local habitat supports nesting of migratory birds. Tree removal shall not occur between March 15<sup>th</sup> and August 15<sup>th</sup> without conducting a migratory bird nesting survey prior to the work. Trees with migratory birds' nests shall not be removed between March 15<sup>th</sup> and August 15<sup>th</sup>.
- C. The Contractor is required to obtain the Navajo Nation Forestry Woodcutting Permit from the Navajo Nation.

## **PART 2 PRODUCTS**

### **2.01 BACKFILL**

- A. Material for backfill of rootball holes outside of dam embankment.
  - 1. Cohesionless soil containing some clay and silt.
  - 2. Particles, maximum size: 3 inches.
  - 3. Free of peat and other organic materials, debris, and trash.
- B. Material for backfill of rootball holes within dam embankment: In accordance with Section 31 24 00 – Fill and Backfill.

## **PART 3 EXECUTION**

### **3.01 CLEARING**

- A. Clear rights-of-way to be occupied by permanent construction and rights-of-way required for access to the work, and surfaces of Contractor use areas, borrow areas, staging areas, stockpile sites, and waste areas.
- B. Clear adjacent to cut or fill sections to a minimum distance of 3 feet outside of slope lines.
- C. Remove vegetation, rubbish, and objectionable material as determined by COR or BIA Representative. This may include non-native invasive woody riparian plants (i.e., salt cedar [*Tamarix* spp.] and/or Russian olive [*Elaeagnus angustifolia*]) which will require specific treatment and/or removal methods, as specified below.
- D. Preserve and protect vegetation designated for preservation within clearing limits and vegetation outside clearing limits.
- E. Identify and protect existing bench marks and survey monuments from damage or displacement.

### **3.02 GRUBBING**

- A. Grub ground surfaces of excavations to be used for embankment or structures.

- B. Remove stumps, roots, and vegetative matter.
  - 1. Remove roots to a lateral extent of 8 feet, and to a depth of 5 feet, or until root diameter is less than 1/2 inches, whichever is encountered first.
- C. Perform grubbing in advance of grading operations.

### 3.03 CUTTING AND REMOVAL

- A. Cut and remove trees in area indicated on drawings and as directed by the COR or BIA Representative. Tree removal may not take place between March 15<sup>th</sup> and August 15<sup>th</sup>.
- B. Remove tree stumps and root balls of cut and removed trees.
  - 1. Excavate earth and remove stumps.
    - a. Remove roots 1/2-inch or greater in diameter.
  - 2. Around each stump, scalp sod and strip topsoil to a depth of 6 inches; retain and stockpile topsoil for reuse as needed to restore original grade.
- C. Removal of salt cedar. The ultimate goal should be complete mechanical removal in order to minimize the use of chemical herbicides on sprouts from residual roots.
  - 1. Salt cedar potentially serves as nesting habitat for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), which is protected under the Endangered Species Act. To avoid harm to this endangered species, information should be obtained from the U.S. Fish and Wildlife Service prior to commencing any removal activities for stands  $\geq 0.25$  acres in size.
  - 2. Complete removal of root ball by mechanical pulling is the most effective way to assure that re-growth will not occur. Any other methods for removal must be approved by the COR or BIA Representative.
  - 3. Removal should take place in during winter or early spring, as greatest success for mechanical removal is when soil moisture is highest.
- D. Removal of Russian olive.
  - 1. Russian olive potentially serves as nesting habitat for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) which is protected under the Endangered Species Act. To avoid harm to this endangered species, information should be obtained from the U.S. Fish and Wildlife Service prior to commencing any removal activities for stands  $\geq 0.25$  acres in size.
  - 2. For removal of saplings (<3.5 inch DBH): dig up with shovel, hoe, or weed removal tool. For removal of larger trees (>3.5 inch DBH): extract with an excavator or backhoe.

### 3.04 BACKFILLING

- A. Backfill further than 25 feet from Dam Embankment:

1. Backfill requirements for backfilling rootball holes:
    - a. Obtain from borrow areas.
    - b. Particle maximum size: 3-inches.
    - c. Free of peat and other organic materials, debris, and trash.
  2. Place and compact material in accordance with Section 31 24 00 – Fill and Backfill.
- B. Backfill Within 25 feet of Dam Embankment:
1. Backfill Zone 1 material in accordance Section 31 24 00 – Fill and Backfill.
  2. Backfill requirements for backfilling rootball holes: Backfill materials and procedures shall meet the requirements of Section 31 24 00 – Fill and Backfill.

### **3.05 DISPOSAL OF CLEARED MATERIAL**

- A. Stack stumps, in maximum 6-ft lengths in a form and location as approved by the COR or BIA Representative.
- B. Stack trees, in maximum 6 feet lengths, in a form and location as approved by the COR or BIA Representative.
- C. Dispose of cut and removed trees, tree stumps, root balls and other materials in accordance with Section 01 74 00 – Cleaning and Waste Management, or as approved by the COR or BIA Representative for trees and stumps larger than 3 inches in diameter.
- D. In order to properly control the reestablishment of salt cedar species, plants should be piled and burned following removal.
- E. Russian olive root and stem remnants should be removed or piled and then destroyed by using fire, shredding, or mulching.

### **3.06 MAINTENANCE OF CLEARED AREAS**

- A. The Contractor shall be responsible for maintaining cleared work areas in a condition free from additional vegetation growth for the duration of the project. Use of herbicides to discourage plant growth shall not be allowed unless approved by the COR or BIA Representative via a formal project submittal. The Contractor shall be compensated for clearing each work area only once. If weed and brush growth require additional clearing, this shall be performed solely at the Contractors expense.

### **3.07 LONG-TERM MAINTENANCE OF INVASIVE SPECIES**

- A. Re-sprouting of Russian olive should be anticipated – controlling through proper reseeding with native vegetation and targeted treatment with an approved chemical application will help to minimize regrowth.

- B. Russian olive can be controlled via application of herbicides which may include but not be limited to products containing glyphosphate, imazapyr, or a combination of the two. Although, damage to surrounding native vegetation as well as impacts to wildlife as a result of misapplications and/or drift can be an unintended side-effect of application. Should chemical controls be employed, risk minimization measures should be incorporated into the maintenance and monitoring plan.
- C. Russian olive can also be controlled by prescribed (short-term) goat grazing by mature, trained animals. This method may act as a suitable biological management strategy, hindering the reestablishment of seedlings.
- D. A general maintenance and monitoring plan should be established for management of areas impacted by invasive plant species.
- E. In most cases an integrated approach involving mechanical, chemical, and biological controls is most useful in dealing with invasive plant species. This type of integrated approach coupled with an adaptive management strategy is most effective, including adjustments to methods based on effectiveness of implemented removal practices.

**END OF SECTION**

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**SECTION 31 14 10**  
**STRIPPING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Stripping:
1. Measurement: Volume stripped to lateral dimensions as specified or directed by COR or BIA Representative and to depth as specified or directed.
  2. Payment: Cubic yard price offered in the schedule.

**1.02 DEFINITIONS**

- A. Top soil: Topsoil stripped from the top 12 inches of the existing ground surface
- B. Muck: Muck shall be soft and saturated materials stripped from the existing ground surface within the reservoir area. Stripping below the upper 12 inches may be required as directed by the COR or BIA Representative.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

**3.01 STRIPPING**

- A. Strip topsoil from the following:
1. Areas to be excavated.
  2. Areas to be under embankments.
  3. Borrow areas.
  4. Stockpile areas for embankment, filter, and fill materials.
  5. Contractor use areas.
- B. Remove topsoil to a depth of 12 inches and to additional depths where directed by the COR or BIA Representative.
- C. Stripping includes removal of existing riprap on the upstream embankment slope.
- D. Removal of native vegetation shall be minimized to the extent practicable.

- E. Muck shall be evenly spread and disposed of in the on-site disposal area, as directed by the Engineer.

### **3.02 USE OF TOPSOIL**

- A. Do not use topsoil removed by stripping for backfill or constructing embankments, except as required below.
- B. Transport and place topsoil to form the upper 12 inches of areas that are to be seeded.
- C. Spread remaining topsoil over borrow areas, disposal areas, and disturbed construction areas as directed by COR or BIA Representative.

### **3.03 STOCKPILE**

- A. Transport and stockpile topsoil as necessary prior to final hauling and placing.
- B. Do not compact topsoil in stockpile.
- C. Protect stockpile from contamination and erosion.
- D. Separate agricultural topsoil at the direction of the COR or BIA Representative.

**END OF SECTION**

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## SECTION 31 23 23

### EXCAVATION

#### PART 1 GENERAL

##### 1.01 MEASUREMENT AND PAYMENT

- A. Excavation of Existing Embankment and Spillway Excavation:
1. Measurement: Volume measured in excavation to neat lines shown on drawings unless otherwise approved or directed by the COR or BIA Representative.
  2. Payment: Cubic yard price offered in the schedule.
    - a. Does not include volume of materials removed in stripping.
    - b. Includes excavating embankment fill, alluvium, and sandstone bedrock.
    - c. Includes excavating reservoir sediment and alluvium and for the intake structure; control structure, outlet works, conduits, stilling basin, and excavating alluvium and sandstone for the spillway.
    - d. Includes cost of hauling, stockpiling, and disposing materials.
    - e. No payment will be made for overexcavation and replacement or refill of overexcavation beyond approved excavation lines.
  3. Include in prices offered in the Schedule for Zone 1 and Zone 1A.
- B. Excavation for Roadways:
1. Payment: Lump sum price offered in the schedule.

##### 1.02 DEFINITIONS

- A. Additional Excavation: Excavation beyond specified lines as directed by the COR or BIA Representative to remove unsuitable foundation material.
- B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines. Includes removal of foundation damaged by the Contractor.

##### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 23 23-1, Excavation Plan:
1. Describe equipment, schedule, sequence, and methods for each excavation area. Describe rock excavation method(s). Describe sediment excavation and any

temporary shoring, dewatering, or unwatering methods for excavating the new intake structure.

2. Include materials distribution chart with anticipated production rates.
3. Include haul traffic plans.

#### **1.04 PROJECT CONDITIONS**

- A. Refer to the Design Summary Report for information on subsurface conditions.
- B. Obtain Zone 1 and Zone 1A materials required to reconstruct embankment from borrow area shown on drawings.
- C. Obtain earthfill for access roadway construction from borrow area shown on drawings.
- D. COR or BIA Representative will designate locations within borrow area from which materials shall be removed.
- E. Establish and maintain haul road to access borrow area.
- F. Excavation of material from borrow area shall begin in the southeast corner and proceed to the north minimizing the disturbance to trees.
- G. Excavation of existing riprap, embankment, alluvial foundation materials and sandstone bedrock will be accomplished by common methods with heavy duty construction equipment. Blasting is not permitted. Mechanical excavating using mounted rock hammers or rippers may be required.
- H. Excavation lines shown on drawings are subject to changes determined necessary by the COR or BIA Representative to adapt foundation excavation to conditions exposed by the excavation.
- I. Groundwater will likely be encountered in the dam foundation, at the filter trench installed at the downstream toe, and intake structure foundation excavations. Soils exposed in the base of the excavations may contain excessive moisture which could result in difficulties when placing initial embankment material lifts or structure backfill. It is anticipated that unwatering shall be required to allow work to progress. Remove and control water in accordance with Section 31 03 33 – Dewatering.
- J. Piezometer wells exist in the area to be excavated. These monitoring wells shall be removed and disposed of according to Section 31 09 12 - Instrumentation.
- K. Existing riprap on the dam shall be reused if determined suitable by the COR or BIA Representative. Riprap that is unsuitable for reuse shall be wasted off site in accordance with 01 74 00 – Cleaning and Waste Management.

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**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Clear, grub, and strip excavation surfaces in accordance with Section 31 11 00 – Clearing and Grubbing and Section 31 14 10 – Stripping.

**3.02 EXCAVATION**

- A. Excavate additional materials required to complete Zone 1 and Zone 1A, road fills or grading from borrow area shown on the drawings. During excavation of borrow area, selectively excavate materials unsuitable for use as Zone 1 and Zone 1A.
1. Refer to the Design Summary Report for information on subsurface conditions.
  2. Place unsuitable materials in separate stockpile within borrow area at location directed by COR or BIA Representative.
- B. Do not operate outside of borrow area boundaries shown on the drawings.
- C. Excavate sufficient material from borrow area to complete required work.
- D. Excavation for modified dam shall extend to the limits of modified dam footprint.
- E. Existing riprap that is determined to be suitable by the COR or BIA Representative shall be removed, sorted, and stockpiled for reuse.
- F. Excavate foundations at the spillway, intake structure, control structure, stilling basins, and outlet channel.
- G. Do not excavate beyond depths shown on drawings unless directed by COR or BIA Representative.
- H. Remove existing shallow piezometer wells located on the downstream side of the dam as shown on the design drawings.
1. Where piezometer wells extended below required excavation surface, excavate to bottom and re-compact in accordance with Section 31 24 00 – Fill and Backfill. Dispose of piezometer well materials in accordance with Section 01 74 00 – Cleaning and Waste Management.
- I. Excavation slopes should conform to the specified lines shown on the drawings and meet the recommended slopes tabulated below.

Material Description	Excavation Slope
Reservoir Sediment	2.5H:1V or flatter
Embankment Stripping Surface	2H:1V
Existing Embankment and Alluvium within embankment footprint	2H:1V
Borrow Materials	2H:1V
Alluvium	2H:1V or flatter
Sandstone Bedrock	0.5H:1V or flatter

J. Sloped excavations shall conform to applicable OSHA regulations, and the Contractor shall assume responsibility for an excavation that is safe for workers. The Contractor shall designate a representative to monitor excavations and evaluate appropriate soil classifications and excavation slopes. Excavation slopes may be flattened by the Contractor based on the soil classifications observed as approved by the COR or BIA Representative.

1. Do not excavate beyond horizontal limits or depths shown on drawings unless directed by COR or BIA Representative.

K. Remove and control water in accordance with Section 31 03 33 – Dewatering. Wet conditions may exist at the base of required excavations for the modified dam and intake structure, it is anticipated that dewatering shall be required to allow work to progress.

L. Handle suitable excavated materials to minimize waste.

### **3.03 ROADWAY EXCAVATION**

A. Excavate for road to lines, grades shown on the drawings and dimensions approved by COR or BIA Representative.

B. Provide adequate drainage.

### **3.04 ADDITIONAL EXCAVATION**

A. Perform additional excavation beyond neat lines as directed by the COR or BIA Representative.

### **3.05 OVEREXCAVATION**

A. Replace excavation beyond established grades with additional material from borrow and compact in accordance with Section 31 24 00 – Fill and Backfill.

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### **3.06 PROTECTION**

- A. Provide temporary work, such as water removal and control systems and shoring, to maintain excavations during construction operations.
  - 1. Temporary shoring and unwatering methods may be required for the intake structure, control structure, stilling basins, outlet channel, and filter trench excavations.
  - 2. The intake structure excavation should have a minimum base dimension as shown on the drawings.
- B. Protect final surfaces from freezing.
  - 1. Remove frost and frozen materials.
  - 2. Replace frozen materials with suitable materials at Contractor's expense.

### **3.07 STOCKPILING MATERIALS**

- A. As excavation progresses, the COR or BIA Representative will sample and test materials for suitability as topsoil or Compacted Zone 1 or Zone 1A materials.
  - 1. Place materials determined by COR or BIA Representative to be suitable for topsoil or Compacted Zone 1 or Zone 1A materials in separate stockpiles at approved locations.
  - 2. Overly wet materials shall be wasted, processed to meet the standards specified for moisture content in Section 31 24 00 – Fill and Backfill, or hauled to the borrow area for reclamation purposes.
  - 3. Stockpiled materials excavated from structure foundations should be placed no closer than 10 feet from the top of the excavation slope.

### **3.08 FOUNDATION PREPARATION FOR INSPECTION**

- A. Rock Surfaces:
  - 1. Clean foundation surfaces for inspection by COR or BIA Representative after excavation has been completed to specified lines, grades, and dimensions shown on the drawings.
  - 2. All excavated rock surfaces shall be cleaned by air jet, water jet, a combination of both, brooming and hand removal as directed by the COR or BIA Representative to achieve the desired results.
  - 3. Only the minimum amount of air or water pressure required to achieve the desired results as directed by the COR or BIA Representative is allowed.
  - 4. Desired foundation surface will be clean and sound.
  - 5. Clean foundation surfaces to remove all slaked materials, loose or sloughed material, sediments, other loose materials, and other areas as directed by the COR

or BIA Representative. Minimize the slaking potential by maintaining the natural moisture content of the foundation to the extent possible.

6. Remove unconsolidated or highly weathered or fractured portions of formation, as directed by the COR or BIA Representative.
- B. Excavated Embankment and Alluvium Surfaces: Once lines and grades have been reached, remove loose debris or oversized material for inspection by COR or BIA Representative prior to placement of new fill materials.

### **3.09 FOUNDATION INSPECTIONS**

- A. Inspection and geologic mapping will be performed by the COR or BIA Representative to obtain a geologic record of the foundation surfaces and cut slopes.
- B. Provide safe access for COR and BIA Representative and personnel during inspection.
- C. Notify COR or BIA Representative at least 10 working days prior to reaching final excavation elevation for each exposed portion of the embankment foundation. Allow 3 days for the COR or BIA Representative to complete its inspection.
- D. Do not operate equipment in area being inspected until inspection and survey are complete.

### **3.10 FOUNDATION SURFACE PREPARATION**

- A. Maintain all foundation surfaces in a clean condition and free of standing water. Final foundation clean up shall include the removal of all unsuitable material as directed by the COR or BIA Representative.
- B. Excavated embankment fill and alluvium surfaces to receive embankment fill placement.
  1. Excavated embankment fill and alluvium surfaces shall be scarified to a minimum depth of 8 inches, moistened and compacted before placing the initial Zone 1, Zone 1A or Zone 2 material. Any cracks or voids should be excavated and/or backfilled as directed by the COR or BIA Representative.
  2. Equipment traffic on the final approved surface shall be minimal. If equipment traffic damages or ruts an approved surface the COR or BIA Representative will direct overexcavation to firm in-place soils or to a depth of 2 feet, whichever is less. Disturbed soils will be identified by the COR and/or BIA Representative once the excavation is complete. Over excavations shall be backfilled with compacted Zone 1 material.
  3. Place Zone 1, Zone 1A, or Zone 2 onto the surface within one day of foundation preparation.
  4. Excavated alluvium surfaces to serve as a structure foundation: Excavated alluvium surfaces shall be firm and stable. Any cracks, voids, or soft materials shall be excavated and/or backfilled as directed by the COR or BIA Representative.



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### **3.11 BORROW AREA MAINTENANCE**

- A. When necessary, as determined by COR or BIA Representative, drain borrow area by means of open ditches to prevent accumulation of standing water.

### **3.12 RESTORATION OF BORROW AREA**

- A. Replace unsuitable materials not used for Zone 1 or Zone 1A, road fills, or grading in borrow area.
- B. Grade borrow area to even and uniform surfaces in accordance with Section 01 12 40 – Construction of the Work.
- C. Place topsoil and restore borrow area by seeding in accordance with Section 32 91 19 – Revegetation.
- D. Provide drainage swale or berm within borrow area to reduce drainage into spillway from adjacent land at direction of COR or BIA Representative.

### **3.13 DISPOSAL OF EXCAVATED MATERIALS**

- A. Waste material from required excavation which is not suitable or required for backfill, embankment, grading, and topsoil.
- B. Waste excavated materials in borrow area or as directed by the COR or BIA Representative.
- C. Do not place waste material in wetlands, within 12 feet of drainage channels, within the spillway channel, or within 20 feet of Red Lake.
- D. Do not waste material by dumping from top of slope.
- E. Grade waste banks to reasonably even and uniform surfaces that blend with natural terrain.
  - 1. Minimum slope: 2 percent.
  - 2. Maximum slope: 5H:1V.
- F. Leave surface in a condition that will facilitate natural revegetation. Place topsoil in accordance with Section 32 91 19 – Revegetation.

**END OF SECTION**

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**SECTION 31 23 24**  
**EXPLORATORY TRENCH EXCAVATION**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Exploratory Trench Excavation:
1. Measurement: Volume of material removed during trench excavation.
  2. Payment: Cubic yard price offered in the schedule for embankment excavations.

**1.02 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 23 24-1, Exploratory Trench Excavation Plan:
1. Equipment methods.
- C. RSN 31 23 24-2, Located Structures Information:
1. Type, location, and size of located structures.

**1.03 PROJECT CONDITIONS**

- A. It is reported that the dam has outlets works other than those that are currently visible. The alignment, depth, and condition of the abandoned outlet works is assumed based on historical data and results of a geophysical investigation performed in 2015, which is included as an appendix to the Design Summary Report. The approximate location of the abandoned structures is shown on the Drawings and should be verified by exploratory trenching at the upstream and downstream embankment slopes. The Contractor will be directed by the COR or BIA Representative as to the depth and size of exploratory trench excavation to be performed using the results of the geophysical investigation to verify the location of the abandoned structures.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

**3.01 EXCAVATION**

- A. Excavate exploratory trench in accordance with agreed on plan and as directed by COR or BIA Representative.

**3.02 DISCOVERY**

- A. Contractor shall document the type, location, and size of any structures that are discovered.
- B. If structures are encountered the Contractor shall remove the structures in accordance with the Section 02 41 07 – Removal and Disposal of Structures.
- C. Excavations shall be backfilled in accordance with Section 31 24 00 – Fill and Backfill.

**END OF SECTION**

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**SECTION 31 24 00**  
**FILL AND BACKFILL**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Compacting Earth Materials
1. Cost:
    - a. Include in prices offered in the schedule for items of work where earth materials are required to be compacted.
      - 1) Includes furnishing water and moistening materials.
- B. Embankment:
1. Measurement:
    - a. Measurement for various zones of embankment will be made for in place completed embankment materials meeting specified requirements within neat lines shown on the Drawings and on surveyed volumes approved by the COR or BIA Representative.
    - b. No allowance will be given for shrinkage.
    - c. Volume of structures will be deducted from pay quantities.
  2. Payment: Cubic yard price offered in the schedule.
- C. Primary Access Road Construction:
1. Measurement: Roadway volume measurement will be made for in place completed access road within neat lines shown on the drawings and as directed by the COR or BIA Representative:
    - a. No allowance will be given for shrinkage.
    - b. Volume of structures will be deducted from pay quantities
  2. Payment: Cubic yard price offered in the schedule.
- D. Payment Procedure:
1. For various items of embankment shall include the following costs:
    - a. Preparing foundations for inspection.
    - b. Preparing foundations prior to placing embankment materials.
    - c. Scarifying, moistening, and compacting foundations.
    - d. Preparing bonding surfaces.

- e. Furnishing material from commercial sources or construction processing plants.
- f. Moistening or drying as required, mixing, placing, and compacting embankment materials.
- g. Loading and transportation of materials from borrow to stockpiles.
- h. Loading and transportation of materials from stockpiles and borrow.

## 1.02 REFERENCE STANDARDS

### A. ASTM International (ASTM)

- |     |                      |  |
|-----|----------------------|--|
| 1.  | ASTM C 33 /C 33M-11  | Concrete Aggregates  |
| 2.  | ASTM D 422-63(2007)  | Particle-Size Analysis of Soils  |
| 3.  | ASTM D 653-09        | Terminology Relating to Soil, Rock, and Contained Fluids   |
| 4.  | ASTM D 698-07        | Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> )) |
| 5.  | ASTM D 1140-00(2006) | Amount of Material in Soils Finer than the No. 200 (75- $\mu$ m) Sieve   |
| 6.  | ASTM D 1556-07       | Density and Unit Weight of Soil in Place by the Sand-Cone Method   |
| 7.  | ASTM D 2216-10       | Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass  |
| 8.  | ASTM D 2487-11       | Classification of Soils for Engineering Purposes (Unified Soil Classification System)  |
| 9.  | ASTM D 2488-09a      | Description and Identification of Soils (Visual-Manual Procedure)  |
| 10. | ASTM D 4318-10       | Liquid Limit, Plastic Limit, and Plasticity Index of Soils   |
| 11. | ASTM D 4718-87(2007) | Correction of Unit Weight and Water Content for Soils Containing Oversize Particles  |
| 12. | ASTM D 4914-08       | Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit   |
| 13. | ASTM D 4959-07       | Determination of Water (Moisture) Content of Soil by Direct Heating  |
| 14. | ASTM D 5030-04       | Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit  |
| 15. | ASTM D 5080-08       | Rapid Determination of Percent Compaction  |

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16. ASTM D 6938-10 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depths)
  17. ASTM D 7382-08 Determination of Maximum Dry Unit Weight and Water Content range for Effective Compaction of Granular Soils Using a Vibrating Hammer.

B. Bureau of Reclamation (USBR)

1. USBR EM - Earth Manual, Part 2, Third Edition (1990)
2. Procedure No. and Title:
  - a. USBR 3900-89 Standard Definitions of Terms and Symbols Relating to Soil Mechanics
  - b. USBR 5000-86 Determining Unified Soil Classification (Laboratory Method)
  - c. USBR 5005-86 Determining Unified Soil Classification (Visual Method)
  - d. USBR 5300-89 Determining Moisture Content of Soil and Rock by the Oven Method
  - e. USBR 5315-89 Determining Moisture Content by the Microwave Method
  - f. USBR 5325-89 Performing Gradation Analysis of Gravel Size Fraction of Soils
  - g. USBR 5330-89 Performing Gradation Analysis of Fines and Sand Size Fraction of Soils, Including Hydrometer Analysis
  - h. USBR 5335-89 Performing Gradation Analysis of Soils Without Hydrometer
  - i. USBR 5350-89 Determining the Liquid Limit of Soils by the One-Point Method
  - j. USBR 5355-89 Determining the Liquid Limit of Soils by the Three-Point Method
  - k. USBR 5360-89 Determining the Plastic Limit and Plasticity Index of Soils
  - l. USBR 5500-89 Performing Laboratory Compaction of Soils--5.5-lbm Rammer and 18-inch Drop
  - m. USBR 5525-89 Determining the Minimum Index Unit Weight of Cohesionless Soils
  - n. USBR 5530-89 Determining the Maximum Index Unit Weight of Cohesionless Soils

- o. USBR 7205-89 Determining Unit Weight of Soils In-Place by the Sand-Cone Method
  - p. USBR 7220-89 Determining Unit Weight of Soils In-Place by the Sand Replacement Method in a Test Pit
  - q. USBR 7221-89 Determining Unit Weight of Soils In-Place by the Water Replacement Method in a Test Pit
  - r. USBR 7230-89 Determining Unit Weight and Moisture Content of Soil In-Place - Nuclear Moisture-Density Gauge
  - s. USBR 7240-89 Performing Rapid Method of Construction Control
  - t. USBR 7255-89 Determining the Percent Compaction of Earthwork for Construction Control
3. Guidelines for Earthwork Construction Control Testing of Gravelly Soils, Earth Sciences and Research Laboratory, Technical Service Center, Bureau of Reclamation, Denver, Colorado, September 2008.

### 1.03 DEFINITIONS

- A. Use definitions from USBR 3900 or ASTM D 653.
- B. Control Fraction: The portion of a soil sample consisting of particles smaller than a designated sieve size. The fraction is used to compare in-place unit weight with standard laboratory unit weight. The control sieve size depends on the laboratory test used for determination of laboratory maximum or minimum density.
- C. Oversize Particles: Particles larger than the maximum allowed in the laboratory test for determining the laboratory maximum and minimum density.
- D. C-value: The ratio expressed as a percentage of (1) in-place unit weight at fill moisture content to (2) the wet unit weight of a laboratory-compacted specimen prepared at fill moisture content as determined by the rapid method of construction control in accordance with ASTM D 5080 (USBR 7240). The C-Value is a comparison of compactive effort of field compaction equipment to standard laboratory compactive effort.
- E. D-value: The ratio expressed as a percentage of (1) in-place wet unit weight at fill moisture content to (2) laboratory maximum wet unit weight as determined from a compaction curve constructed at fill moisture content as determined by the rapid method of construction control ASTM D 5080 (USBR 7240). The D-value is the equivalent of percent compaction in accordance with ASTM D 698 (USBR 5500).
- F. Percent Compaction: The ratio, expressed as a percentage, of; (1) dry unit weight of a soil, to (2) maximum dry unit weight obtained in a laboratory compaction test (ASTM D 698).
- G. Special Compaction: Compaction close to structures or in spaces not accessible by rollers.



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#### **1.04 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 24 00-1, Embankment Construction Plan:
  - 1. Describe equipment, schedule, sequence, and methods for placing and compacting fill, filter, and drain materials. Include information on the procedures and methods used to construct the filter trench and prevent contamination, including equipment and shoring.
  - 2. Include materials distribution chart with anticipated production rates.
  - 3. Include haul route plans.
  - 4. Include proposed distribution of materials in stockpile areas.
- C. RSN 31 24 00-2, Road Plan:
  - 1. Show location of and quantities of proposed cut and fill and provide documentation for imported materials properties.
- D. RSN 31 24 00-3, Certification and Laboratory Test Results:
  - 1. Certification and laboratory test results demonstrating filter material meets concrete hardness and durability requirements of ASTM C 33 and specified gradation.
  - 2. Certification and laboratory test results demonstrating Zone 3 material meets concrete aggregate hardness, durability, and gradation requirements of ASTM C 33.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Handle, load, haul, stockpile, and place materials to minimize segregation, contamination, and breakdown.
- B. Prevent contamination with soil or vegetative material.
- C. When stockpiling material on site, whether temporary or permanent stockpile, clear and strip stockpile areas prior to stockpiling.

#### **1.06 PROJECT CONDITIONS**

- A. Preventing contamination of embankment zones is very important to ensure that these zones perform as designed.
- B. All practical means shall be taken by the Contractor to ensure that the sand filter material and the gravel drain material do not become contaminated with fines.
  - 1. Controlling surface runoff, careful attention to haul patterns and crossing areas, maintaining dry excavations, protection during shutdown periods, and keeping

zones higher than the surrounding earthfill are examples of sound measures to help minimize contamination.

- C. At equipment crossings, protect sand filter material and gravel drain material from contamination in a manner approved by COR or BIA Representative.
- D. Before resuming placement of sand filter material and gravel drain material at equipment crossings or after shutdown, remove all materials used to protect the embankment materials. If the materials are contaminated or otherwise harmed, restore them to satisfactory state at Contractor's expense.
- E. Earthfill material used for temporary protection may be reused for performing other embankment work at the Contractor's option if the material is suitable for such use.
- F. Do not place and compact soil under following conditions.
  - 1. Ambient air temperature below freezing.
  - 2. Rain that creates puddles in clayey or silty materials.
  - 3. Heat or wind or both that dries material below special moisture conditions.
  - 4. Ice or snow pockets are visible in soil being placed or in underlying materials.

## **PART 2 PRODUCTS**

### **2.01 CLASSIFICATION**

- A. When required, classify earth materials using the Unified Soil Classification System (USCS) according to ASTM D 2487 (or USBR 5000) or ASTM D 2488 (or USBR 5005).
  - 1. Gradation tests for classification: ASTM D 422 or ASTM D 1140 (USBR 5325, 5330, or 5335).
  - 2. Atterberg limits testing for classification: ASTM D 4318 (USBR 5350, 5355, or 5360).

### **2.02 SOIL TYPES**

- A. Clean Fill:
  - 1. Any soil except soils with classifications Peat (PT), Organic Silts and Organic Clays (OL and OH), or Elastic Silt (MH).
  - 2. Free of roots, stumps, limbs, vegetation, organic matter, and ice.
  - 3. Does not contain construction debris, scrap materials, refuse, man-made wastes, or chemical or hydro-carbon contamination.
- B. Do not use frozen soils.

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## **2.03 DESIGNATION OF SOILS FOR COMPACTION**

- A. Requirements for lift thickness, method of compaction, and method of determining degree of compaction depends on whether soil is considered to be silty or clayey, cohesionless, or granular with containing some silt and clay.
- B. Silty or Clayey Soils:
  - 1. Contain appreciable amounts of fines (generally more than 15 percent plastic fines or 30 percent non-plastic fines).
  - 2. Classified as GM, GC, SM, SC, CL, ML, CH, or any dual symbol or borderline soil beginning with one of these symbols.
- C. Cohesionless Soils:
  - 1. Contain few fines (generally less than 5 percent fines).
  - 2. Classified as GW, SW, GP, SP, or any borderline soil beginning with any of these symbols.
- D. Granular Soils with some Silty or Clayey fines:
  - 1. Granular soils with more than 5 percent fines and up to 30 percent non-plastic or 15 percent plastic fines
  - 2. Classified as SM, SC, GC, or GM.
  - 3. Controlled by the ASTM D 7382.

## **2.04 MAXIMUM PARTICLE SIZE**

- A. Maximum particle size limitations described in appropriate sections.

## **2.05 COMPACTED ROADWAY EMBANKMENT**

- A. Obtain from required excavations or from borrow area.
- B. Maximum Particle Size: 3 inches in maximum dimension.
- C. Unsuitable Materials:
  - 1. Material containing brush, roots, sod, or other organic materials.
  - 2. Clay soils, dry clay, clay clods, and volcanic cinder material.

## **2.06 ZONE 1 MATERIAL**

- A. Sources:
  - 1. Use suitable materials excavated from existing embankment and foundation. Obtain additional materials required to complete Zone 1 from borrow area in accordance with Section 31 23 23 - Excavation.

2. Zone 1 materials may also be used above pipe springline for backfill in areas away from the embankment.
- B. Zone 1 material shall meet the following requirements.
1. Select mixture of clay, silt, sand, and gravel.
  2. Thoroughly mixed and reasonably well-graded mixture.
  3. Maximum particle size: 3 inches.
  4. Percent passing No. 200 Sieve: greater than 20 percent.
  5. Minimum Plasticity Index: 10.
  6. Maximum Liquid Limit: 45.
  7. Free of peat and other organic materials, debris, and trash.
  8. No frozen materials.
- C. Process excavated and borrow materials to meet specified requirements.

#### **2.07 ZONE 1A MATERIAL**

- A. Zone 1A Material is to be placed as embankment fill where outlet works are being replaced, as shown on the drawings.
- B. Sources:
1. Use suitable materials excavated from existing embankment and foundation. Obtain additional materials required to complete Zone 1A from borrow area in accordance with Section 31 23 23 - Excavation.
- C. Zone 1A material shall meet the following requirements.
1. Select mixture of clay, silt, sand, and gravel.
  2. Thoroughly mixed and reasonably well-graded mixture.
  3. Maximum particle size: 3 inches.
  4. Percent passing No. 200 Sieve: greater than 50 percent.
  5. Minimum Plasticity Index: 15.
  6. Maximum Liquid Limit: 45.
  7. Free of peat and other organic materials, debris, and trash.
  8. No frozen materials.
- D. Process excavated and borrow materials to meet specified requirements.

#### **2.08 ZONE 2 MATERIAL**

- A. Provide from commercial source.

- B. Well-graded mixture conforming to ASTM C 33, fine aggregate, except meet gradation requirements specified in Table 31 24 00A - Zone 2 Material Gradation. Material shall meet specified gradation requirements after placement and compaction.

Table 31 24 00A - Zone 2 Material Gradation

U.S. Standard Sieve Size	Percent Passing by Weight
3/8-inch	100
No. 4	90 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	5 – 30
No. 100	0 – 10
No. 200	0 – 5*

\*Non-plastic fines.

**2.09 ZONE 3 MATERIAL**

- A. Provide from commercial source.
- B. Hardness and Durability: ASTM C 33.
- C. Well-graded mixture of sand and gravel conforming to ASTM C 33, gradation No. 57.
- D. Gradations are shown in Table 31 24 00B - Gradation Requirements for Gravel Drain Material.
- E. Material shall meet gradation requirements of Table 31 24 00B - Zone 3 Material Gradation Requirements after placement and compaction.

Table 31 24 00B - Zone 3 Material

U.S. Standard Sieve Size	Percent Passing by Weight
	No. 57
1.5 inches	100
1-inch	95 – 100
1/2-inch	25 – 60
No. 4	0 – 10
No. 8	0 – 5

**2.10 PIPE BEDDING MATERIALS**

- A. Provide from commercial source.
- B. Hardness and Durability: ASTM C 33.
- C. Well-graded mixture of sand and gravel conforming to ASTM C 33, gradation No. 67.
- D. Gradations are shown in Table 31 24 00C - Gradation Requirements for Pipe Bedding Material.
- E. Material shall meet gradation requirements of Table 31 24 00C –Pipe Bedding Material Gradation Requirements after placement and compaction.

Table 31 24 00C – Pipe Bedding Material

U.S. Standard Sieve Size	Percent Passing by Weight
	No. 67
1-inch	100
3/4-inch	90-100
3/8-inch	20-55
No. 4	0 – 10
No. 8	0 – 5

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## **PART 3 EXECUTION**

### **3.01 SURFACE PREPARATION**

- A. Clear, grub, and strip.
- B. Control water in all excavations before placing materials.
- C. Allow concrete in structures to attain full strength before performing adjacent compaction.
- D. Allow concrete in structures to attain its full design strength, as determined by COR or BIA Representative, before placing any fill material against structures.
- E. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing layer of material to be compacted, at least 6 inches for roadway fill foundations.
- F. Do not place soil on frozen surface.

### **3.02 SOIL MOISTURE CONTENT**

- A. Moisten or aerate material, as necessary, to provide moisture content that will readily facilitate obtaining specified compaction. Add water to soil only in increments that will permit moisture content to be uniform and homogenous throughout each layer after mixing.
- B. Silty and Clayey Soils and Granular Soils containing some Silt and Clay:
  - 1. Moisture content during compaction:
    - a. Soils controlled by impact compaction
      - 1) Not greater than 3 percentage points wet or not less than 1 percentage point dry of optimum moisture content.
    - b. Soils controlled by the vibrating hammer.
      - 1) Within the water content range for effective compaction as determined by ASTM D 7382.
  - 2. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.
    - a. If clayey borrow soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in the clods.
    - b. Use of disks, harrows, or rakes may be required to blend moisture in the borrow area.
  - 3. Moisture content will be determined as follows:
    - a. Moisture content is determined on the control fraction material.

- b. Variation from Optimum Moisture Content:
  - 1) Difference between optimum moisture and compaction moisture can be measured in accordance with ASTM D 5080 (or USBR 7240).
- c. Moisture Content Comparison:
  - 1) Optimum moisture content determined by ASTM D 698 (or USBR 5500).
  - 2) Water content range for effective compaction as determined by ASTM D 7382.
  - 3) Compared to field compaction moisture content with moisture contents determined in accordance with:
    - a) ASTM D 2216 (or USBR 5300), or
    - b) ASTM D 6938 (USBR 7230). The moisture from the nuclear gage will require corrections for gage error for the specific soils tested and the moisture content of the total material may require adjustment for the control fraction (see USBR 7230, Method C; ASTM D 4718), or
    - c) ASTM D 4959, provided the results have been correlated to ASTM D 2216 (USBR 5300) for specific soil tested.
- C. Cohesionless Soils:
  - 1. Add water during compaction, as necessary to achieve required density, since these soils are free-draining.
- D. Adjacent to the existing outlet works fill shall have a moisture content of not greater than 3 percent wet or 1 percent dry of optimum moisture content.

### **3.03 PLACEMENT**

- A. Do not place material until foundation has been inspected and approved by the COR or BIA Representative.
- B. Place roadway fill to reconstruct roadways to existing lines and grades at the locations shown on drawings.
- C. Place soils to be compacted in horizontal layers.
- D. If necessary, blend materials so that compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations, or other imperfections.
- E. Maintain elevation of embankment on each side of structures within 1 foot of each other.
- F. No longitudinal bearing surfaces steeper than 1H:1V.



- G. Transverse bonding surfaces in any embankment zone above original ground surface shall be as shown on the design drawings.
- H. Each layer of each material shall be constructed continuously and approximately horizontal for the width and length of the layer, except that fill in parts of excavation may be left lower to facilitate water removal. When no longer required for water removal, fill any such low areas with the appropriate materials in horizontal lifts, as specified for that material.
- I. All placement and compaction operations adjacent to geosynthetics shall be carefully conducted so that no damage to geosynthetics occurs.
- J. Where exposed, protect all compacted sand filter and gravel drain materials from erosion, excessive saturation, and general contamination.
- K. Provide temporary construction as necessary to protect exposed sand filter and gravel drain materials from surface drainage.
- L. Place by methods that prevent contamination and segregation. The upper surface of Zone 2 and Zone 3 material shall be maintained at a minimum elevation of 1 foot above the upper surface of adjacent fill materials
- M. Rework materials not meeting specified gradation, moisture content, and density requirements until approved results are obtained.
- N. Reworking may include removal, rehandling, reconditioning, recompacting, or combinations of these procedures.
- O. No additional compensation is due to the Contractor for reworking materials.
- P. Any zones of segregation will be replaced or otherwise mitigated to the COR or BIA Representatives approval.

### **3.04 COMPACTION**

- A. Compact material with following methods and techniques appropriate to type of soil.
- B. At start of work, determine compactive effort, with the equipment to be used, to achieve the minimum relative density.
- C. A test section of Zone 3 material shall be completed to obtain performance requirements for adequate compaction.
- D. Special Compaction:
  - 1. Use mechanical tampers, hand-held equipment, or other approved methods.
  - 2. Meet density requirements for respective earthfill material.
  - 3. Compaction close to structures or in confined spaces.

4. Required within 3 feet of structures, inspection wells, piezometer installations and pipes.
5. Perform special compaction in fill areas surrounding toe drain pipe in pipe trenches and in areas not applicable to large equipment operation, as approved by the COR or BIA Representative within 2 feet of pipes.
6. Adjacent to the outlet works Zone 1A material shall be compacted to a thickness of 6-inches by a minimum of 6 passes of rubber tired equipment having a minimum wheel loading of 25,000 pounds and tire pressure of 80 to 100 pounds per square inch.

E. Silty or Clayey Material:

1. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, other suitable compaction equipment, or equipment travel.
  - a. Uniformly distribute equipment passes.
  - b. Compact in horizontal layers to compacted thickness of 6 inches or less.
  - c. Scarify lifts as required for lift bonding.
2. Special compaction: Compact with hand held impact tampers, or small tamping equipment
  - a. Uniformly distribute effort.
  - b. Compact in horizontal layers to compacted thickness of 4 inches.
3. Density:
  - a. Percent Compaction:
    - 1) Minimum 98 percent, or
    - 2) C- Value and D- Value minimum: 98 percent.
    - 3) As determined on portion of soil passing the No. 4 sieve.

F. Cohesionless Free-draining Material:

1. In areas accessible to heavy equipment, compact with a minimum of four passes (with a pass defined as at least one complete coverage of the track) over the entire surface with the track of a crawler-type tractor weighting at least 20 tons, or by controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded hauling equipment.
2. In areas inaccessible to heavy equipment, compact by manually controlled pneumatic or vibrating tampers having a minimum static weight of 1500 pounds.
3. In narrow slot trenches, compact in the trench using a high energy vibrating compactor wheel or vibratory plate that can be hydraulically mounted to a skid steer or other equipment.
4. Compact in horizontal layers in maximum compacted lift thicknesses of:

- 
- a. Vibrating smooth drum rollers, surface plate vibrator, or similar equipment: 12 inches in loose depth as approved by COR or BIA Representative.
  - 5. Special compaction: Compact with hand held impact tampers, vibrating plate tampers, or small tamping equipment.
    - a. Uniformly distribute effort.
    - b. Compact in horizontal layers to compacted thickness of 6 inches loose depth.
  - G. Granular Soils Containing Some Silt and Clay:
    - 1. Compact in accordance with either procedure above in a lift thickness which can achieve density requirement.
    - 2. Density:
      - a. Percent Compaction, minimum: 98 percent.
      - b. D-value minimum: 98 percent.
  - H. Adjustment:
    - 1. Silty and clayey soils containing more than 20 percent oversize particles: Required D-value or Percent Compaction may be adjusted in accordance with appropriate curve on Figure 3 in USBR Guidelines for Earthwork Construction Control Testing of Gravelly Soils.
  - I. Demonstration:
    - 1. Lift thicknesses may vary depending on equipment and methods. Before changing requirements in this Section, demonstrate that required density will be obtained.

### **3.05 MEASURE OF COMPACTION**

- A. Methods for determining the unit weight of soils in-place.
  - 1. ASTM D 1556 (or USBR 7205), or
  - 2. ASTM D 4914 (or USBR 7220), or
  - 3. ASTM D 5030 (or USBR 7221), or
  - 4. ASTM D 6938 (or USBR 7230).
- B. Degree of soil compaction will be determined by one of the following.
  - 1. Silty or Clayey Soils: Percent Compaction will be determined by one of the following:
    - a. Rapid Method: ASTM D 5080 (or USBR 7240).
    - b. Laboratory Compaction Test: Comparison of in-place dry unit weight minus No. 4 sieve size control fraction to laboratory maximum dry density as determined by ASTM D 698, Procedure A (or USBR 5500).

- c. Silty and clayey soils containing more than 5 percent oversize particles:
  - 1) In-place unit weight of minus No. 4 size control fraction determined by screening gravel, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D 4718 (USBR 7205).
- 2. Granular soils containing some silt and clay: Compaction will be measured by determination of percent compaction as specified.
  - a. In place dry unit weight of minus 2-inch control fraction compared to the maximum dry unit weight determined by ASTM D 7382.
    - 1) Percent Compaction of soils containing more than 5 percent oversize particles:
      - a) In-place dry density unit weight of the control fraction determined by oversized particles, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D 4718 (or USBR 7205).

### **3.06 FIELD QUALITY CONTROL**

#### **A. Testing:**

- 1. Contractor shall perform tests as required to verify that type of soil used, placement of soil, and compaction of soil conform to contract requirements.
- 2. Contractor shall notify the COR and BIA Representative 24 hours before compaction work begins and 24 hours before significant change in compaction operations (major change in equipment or procedure used).
- 3. Notify the COR and BIA Representative immediately of equipment change due to breakdown, or re-deployment.
- 4. The COR or BIA Representative will perform independent Quality Assurance testing. The Contractor shall make reasonable accommodations for this testing.

#### **B. Testing Frequency:**

- 1. Frequency of testing is at discretion of the COR or BIA Representative.
- 2. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.
- 3. After a successful work operation pattern is established, testing frequency is normally performed at these minimum guidelines.
  - a. At least one test for each shift for each compaction operation, with a minimum testing frequency of one test every 2,000 yd<sup>3</sup>.
  - b. Compacted Zone 1A fill: Every 500 yd<sup>3</sup>.

- c. Additional tests may be performed at sites considered questionable by an independent Inspector; such as suspected incomplete compaction, surfaces that may have become excessively wet or dry since compaction, compacted surfaces torn up by subsequent equipment travel, or other similar circumstances.

C. Tests:

- 1. Standards listed in Table 31 24 00C - Standard Used for Testing, will be used by the Contractor for testing compacted soil for conformance with specification requirements. Substitution or modification of standards shall be done only with concurrence of all parties.

Table 31 24 00C - Standard Used For Testing

PROCEDURE	STANDARD NO.
Soil Classification	ASTM D 2487 (or USBR 5000) ASTM D 2488 (or USBR 5005)
Gradation Analysis	ASTM D 422 (or USBR 5325, 5330, 5335)
Atterberg Limits	ASTM D 4318 (or USBR 5350, 5355, 5360)
Moisture Content	ASTM D 2216 (or USBR 5300) ASTM D 6938 (or USBR 7230)
In-Place Density: Sand Cone Test Pits Sleeve Nuclear	ASTM D 1556 (or USBR 7205) ASTM D 4914 (or USBR 7220) ASTM D 5030 (or USBR 7221) ASTM D 6938
Rapid Construction Control	ASTM D 5080 (or USBR 7240)
Laboratory Maximum Density of Granular soils containing Silty or Clayey Fines	ASTM D 7382
Laboratory Maximum Density	ASTM D 698, Procedure A (USBR 5500)

D. Contractor Support for Quality Assurance testing:

- 1. Provide timely access to areas for density testing and excavate and level an area in compacted material to provide a surface for testing.
  - a. Fills compacted by sheepfoot rollers are normally tested one or two lifts below surface.

2. When density is being measured by a sand-cone device (ASTM D 1556, USBR 7205), cease construction activity in immediate vicinity of testing.
3. Dig test pits as requested to examine compacted soil. Backfill test pits to original requirements.
4. Provide warning lights, flags, or other safety devices as needed by testing personnel.
5. Provide adequate lighting for performing test if required because of darkness.

### **3.07 COMPACTION EQUIPMENT**

- A. Self-propelled tamping roller or sheepsfoot roller compactor, single or dual drum.
- B. Smooth rollers will not be allowed.
- C. Small rollers may be required for special compaction next to structures and in tight, restricted, or steep areas not accessible by larger rollers.
- D. Rubber tired equipment having a minimum wheel loading of 25,000 pounds and tire pressure of 80 to 100 pounds per square inch shall be used to compact Zone 1A material adjacent to the outlet works.
- E. Small walk-behind rollers or tampers shall be required for special compaction of Zone 2 and Zone 3 material around toe drains.
- F. Equipment for special compaction shall be approved by the COR or BIA Representative.
- G. The specified compaction equipment shall be used perpendicular to the conduit encasement.

### **3.08 PREPARATION OF FOUNDATION**

- A. Control water in all excavations before placing materials in accordance with Section 31 03 33 – Dewatering.
- B. Prevent materials from contaminating Zone 2.
- C. Do not allow sloughing of any materials from excavated surfaces onto the Zone 2 or Zone 3 material to minimize contamination.
- D. Compact surface of soil foundation prior to placement of initial lift of Zone 2 and Zone 3 material.

### **3.09 PLACING**

- A. Place material to the lines, grades, and dimensions shown on the drawings.

- B. Place Zone 1 and Zone 1A material in continuous, approximately horizontal layers not to exceed 6 inches in thickness after compaction with self-propelled equipment, and 4 inches after compaction where special compaction is used.
- C. Place Zone 2 material in continuous, approximately horizontal layers not to exceed 12 inches in thickness prior to compaction.
- D. Place Zone 3 in continuous, approximately horizontal layers.
- E. Thoroughly wet the Zone 2 material immediately before compaction as needed to meet required densities.
- F. Minimize persons working on Zone 2 and Zone 3 material to prevent segregation, contamination, over compaction, or breakdown of materials.
- G. Place any layer or zone such that the top surface elevation of that layer/zone is not higher than adjacent layer/zone and no lower than 12 inches below elevation of adjacent embankment.
- H. Rework and/or remove previously placed materials that have become soft or loose, which contain erosion channels or cracks, or are excessively dry or wet prior to placing additional material.
- I. Adjacent to the outlet works fill shall be ramped up to the concrete encasement on a slope of 6 horizontal to 1 vertical.

### **3.10 PROTECTION**

- A. Protect material from erosion, contamination, excessive saturation, and surface drainage.

**END OF SECTION**

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**SECTION 31 32 32**  
**GEOTEXTILES**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Geotextile Type A:

1. Measurement: Surface area covered by geotextile with no allowance for seam overlap, repairs, or waste.
  - a. Includes 16 oz/yd<sup>2</sup> geotextile placed between Zone 1 and Zone 3 materials and between gravel surfacing and Zone 1 material.
2. Payment: Square yard price offered in schedule.

B. Geotextile Type B:

1. Measurement: Surface area covered by geotextile with no allowance for seam overlap, repairs, or waste.
  - a. Includes 32 oz/yd<sup>2</sup> geotextile placed in anchor trench and along upstream embankment slope between riprap and Zone 1 material.
2. Payment: Square yard price offered in schedule.

C. Geonet:

1. Measurement: Surface area placed, except no allowance will be made for repairs or waste.
2. Payment: Square yard price offered in the schedule.

**1.02 REFERENCES**

A. ASTM International (ASTM)

- |    |                 |  |
|----|-----------------|--|
| 1. | ASTM C 33-11    | Concrete Aggregates  |
| 2. | ASTM D 1505-10  | Density of Plastics by the Density-Gradient Technique  |
| 3. | ASTM D 1603-06  | Standard Test for Carbon Black in Olefin Plastics  |
| 4. | ASTM D 1693-08  | Environmental Stress-Cracking of Ethylene Plastics   |
| 5. | ASTM D 4355-07  | Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus |
| 6. | ASTM D 4491-99a | Water Permeability of Geotextiles by Permittivity  |
| 7. | ASTM D 4533-04  | Trapezoid Tearing Strength of Geotextiles  |
| 8. | ASTM D 4632-08  | Grab Breaking Load and Elongation of Geotextiles   |

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- |     |                |   |
|-----|----------------|---|
| 9.  | ASTM D 4751-04 | Determining Apparent Opening Size of a Geotextile   |
| 10. | ASTM D 4833-07 | Index Puncture Resistance of Geomembranes and Related Products                              |
| 11. | ASTM D 5199-11 | Measuring Nominal Thickness of Geotextiles and Geomembranes.                                |
| 12. | ASTM D 5261-10 | Measuring Mass per Unit Area of Geotextiles   |
| 13. | ASTM D 6241-04 | Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe |
| 14. | ASTM E 41-92   | Terminology Relating to Conditioning.   |

### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 32 32-1, Certifications and Data:
1. Geotextile Certifications and Data:
    - a. Manufacturer’s certification that geotextile meets specified chemical, physical, and manufacturing requirements.
  2. Geonet Certifications and Data
    - a. Manufacturer’s certification that geonet meets specified chemical, physical, and manufacturing requirements.
  3. Qualifications:
    - a. Installation company:
      - 1) Name and address.
      - 2) Documentation of previous experience with specified geotextile and geonet installations.
        - a) Names of facility owner(s).
        - b) Person to contact at facilities who can discuss projects listed.
        - c) Project manager, designer, manufacturer, fabricator (if any).
        - d) Locations, thicknesses, and area in square feet of geotextile and geonet installed.
        - e) Types of seaming and patching equipment used.
        - f) Dates of installation.

- b. Onsite personnel experience:
  - 1) Resumes, including dates and duration of employment and pertinent experience.
- c. Manufacturer:
  - 1) Name and address of manufacturer.
  - 2) Evidence of manufacturer experience
    - a) Name, location, owner, and purpose of completed facility.
    - b) Name and telephone number of contact at facility who can discuss project.
    - c) Type and thicknesses of each material, total square footage of installation, installation date, project manager, designer, fabricator (if any), and installer.
  - 3) Descriptive documentation of manufacturer's quality control program.
- 4. Installation Plan:
  - a. Manufacturer's instructions for delivery, storage, and handling of geotextile and geonet materials.
  - b. Details of installations:
    - 1) Work schedule.
    - 2) Location, size, orientation, and identification of panels.
    - 3) Sequencing of panel installation.
    - 4) Equipment and procedures for handling and installing panels.
    - 5) Equipment and procedures for installing around penetrations.
    - 6) Equipment and procedures for field testing adequacy installation.
    - 7) Details of equipment, products, and procedures for cleaning, protecting, and performing repairs.
    - 8) Number of crews and crew size.
    - 9) Contractors Quality Control (QC) Plan
    - 10) Method to place materials on existing slope, include details for minimizing damage to underlying layers.
- 5. Protection methods for geotextile:
  - a. Methods to protect exposed geotextile, when covering is not possible within 14 days.
- 6. Method of placement of geotextile:
  - a. For first lift on top of geotextile, for all installations.

7. For sewn seams, if used:
  - a. Certification stating that polymeric threads to be used for sewing have chemical resistance properties equal to or exceeding those of geotextile.
  - b. Include data showing that sewn seams have tensile strength of not less than specified percent of parent geotextile material.
8. Sample:
  - a. Geotextile: Roll width by 3 feet.
  - b. Geonet: Minimum 2- by 2-foot geonet panel and clip and key to be furnished

#### **1.04 QUALIFICATIONS**

- A. Onsite Installation Supervisor:
  1. Installed or supervised installation of a minimum of 100,000 square feet of specified geonet.
- B. Manufacturer:
  1. Completed facilities totaling at least 500,000 square feet of specified geonet.
- C. Manufacturers Technical Representative:
  1. Qualified to provide technical guidance on materials and procedures for installation approved by manufacturer and worked on three similar project.
- D. Installer:
  1. At least three separate and satisfactory installations totaling at least 50,000 square feet of the specified geonet.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to site in Manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.
- B. The materials shall be delivered, unloaded and installed in a manner to prevent damage.
- C. The materials shall be stored in accordance with Manufacturer's instructions. The materials shall be protected from damage and out of direct sunlight.
- D. Wrap geotextile rolls in relatively impermeable and opaque protective covers.
- E. Mark or tag geotextile rolls with manufacturer's name, product identification, lot number, roll number, and roll dimensions.
- F. Mark with special handling requirements such as "This Side Up or "This Side Against Soil to be Retained."

- G. Protect geotextile from ultraviolet light exposure, temperatures greater than 140 degrees Fahrenheit (60 degrees Celsius), precipitation or other inundation, mud, dirt, dust, puncture, cutting, or other damaging or deleterious conditions.
- H. Elevate and cover material stored outside with waterproof membrane.

**PART 2 PRODUCTS**

**2.01 GEOTEXTILES**

- A. Needle-punched, nonwoven geotextile comprised of long-chain polymeric filaments composed of at least 85 percent, by weight, polyolefins or polyesters.
- B. Orient filaments into stable network which retains its structure during handling, placement, and long-term service.
- C. Stabilizers or inhibitors added to filament base material: Resist deterioration due to ultraviolet or heat exposure.
- D. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away.
- E. Conform to roll values listed in Table 31 32 32A – Geotextile Physical Properties.
  - 1. Values listed are minimum average roll values (MARV’s), unless otherwise noted.
  - 2. Test results for weaker principal direction shall meet or exceed minimum values listed in the table.
  - 3. Mass per unit area is a nominal value and is provided for information purposes only.
- F. Direct Exposure to Sunlight: Withstand 14 days with no measurable deterioration.

Table 31 32 32A - Geotextile Physical Properties

Property	Test Method	Required Values	
		Type A	Type B
Mass Per Unit Area	ASTM D 5261	16 oz/yd <sup>2</sup>	32 oz/yd <sup>2</sup>
Grab Tensile Strength	ASTM D 4632	380 lbs	500 lbs
Elongation at Break	ASTM D 4632	50 percent	50 percent
Trapezoidal Tear	ASTM D 4533	140 lbs	215 lbs
Puncture Strength (Pin)	ASTM D 4833	230 lbs	350 lbs

Table 31 32 32A - Geotextile Physical Properties

Property	Test Method	Required Values	
		Type A	Type B
Permittivity	ASTM D 4491	0.5 sec <sup>-1</sup>	---
Apparent Opening Size (Minimum U.S. Sieve Size)	ASTM D 4751	0.21 mm (No. 100)	0.21 mm (No. 100)
UV Resistance – tensile strength retained at 500 hours, minimum	ASTM D 4355	70 percent	70 percent

**2.02 GEOTEXTILE PINS**

- A. Pins: 3/16-inch diameter, 18 inches long steel pins, pointed at one end, and fitted with 1-1/2-inch diameter washer at other end.

**2.03 GEONET**

- A. Geonet shall be a composite material which provides filter protection and drainage, and shall be one of the following or approved equal.
  - 1. MineDrain Geocomposite, manufactured by GSE Environmental, 19103 Gundle Road, Houston, TX 77073. [www.gseworld.com](http://www.gseworld.com). Geocomposite, manufactured by Colorado Lining International, 1062 Singing Hills Rd., Parker, CO 80138. [www.coloradolining.com](http://www.coloradolining.com). The geocomposite shall have the following characteristics:
    - a. Transmissivity:
      - 1) A minimum of 0.45 gallons per minute per foot per 540,000 square feet of geotextile, in accordance with ASTM D 4716.
    - b. Permittivity:
      - 1) A minimum of 1.0 gallon per minute per foot per 540,000 square feet of geotextile, in accordance with ASTM D 4491.
    - c. Puncture Strength:
      - 1) A minimum of 90 pounds, in accordance with ASTM D 4833.
    - d. Mass per unit area:
      - 1) A minimum of 6 ounces per square yard of geocomposite, in accordance with ASTM D 5261.

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## **PART 3 EXECUTION**

### **3.01 EQUIPMENT**

- A. Do not drive equipment on geosynthetic products (geocomposite, geotextile, or any other geosynthetic material onsite), unless approved by COR or BIA Representative.

### **3.02 EXAMINATION**

- A. Verify site conditions are as indicated on the drawings. Notify the COR and BIA Representative if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

### **3.03 SUBGRADE PREPARATION**

- A. Prepare surface upon which geotextile is to be placed to a firm surface, reasonably even and smooth, and free of offsets, abrupt indentations, and protruding materials greater than 1-1/2 inches.
- B. Obtain COR or BIA Representative approval of subgrade before installing geotextile.

### **3.04 GEOTEXTILE INSTALLATION**

- A. Place geotextile in the manner and at locations shown on drawings.
- B. Lay geotextile smoothly, free of tension, stress, folds, wrinkles, or creases so far as is practical and except where required in these specifications.
- C. Shingle overlaps on slopes with upstream roll placed over downstream roll.
- D. Pin, staple, or weight to hold geotextile in position.
- E. Anchor terminal ends of geotextile with key trenches or aprons at crest and toe of slopes.
- F. In the presence of wind, weight geotextiles with sandbags or equivalent until cover material is placed.
- G. Do not entrap stones, soil, excessive dust, or moisture in geotextile that could damage geotextile or hamper subsequent seaming.
- H. Do not drive or operate equipment directly on geotextile.
- I. Cover geotextile within 14 days after geotextile placement.
  - 1. If covering geotextile with specified material is not possible within 14 days, protect exposed geotextile with suitable cover approved by the COR or BIA Representative.
  - 2. Replace geotextile not protected.

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### **3.05 SEAMING**

- A. Join adjacent sheets of geotextile by overlapping, sewing, or thermal welding.
- B. Overlapped seams:
  - 1. Overlap minimum: 12 inches.
  - 2. Upstream/upslope roll placed over the downstream/downslope roll.
  - 3. Weight or pin on 3-foot centers to secure the overlap during placement of cover material.
- C. Sewn Seams:
  - 1. Interlocking or sewn twice.
  - 2. Thread:
    - a. Contrasting color.
    - b. Chemical resistance: Equal to geotextile.
  - 3. Sew geotextiles continuously. Spot sewing is not allowed.
  - 4. Sewn seam strength: Not less than 70 percent of parent material strength.
- D. Thermal welding: In accordance with manufacturer's recommendations.

### **3.06 GEONET INSTALLATION**

- A. Install geonet system in accordance with this Section, as shown on drawings, and in accordance with approved installation plan, whichever is most restrictive.
- B. Manufacturer's technical representative(s) shall be onsite during geonet system installation.
  - 1. Manufacturer's technical representative(s) shall exercise technical control of installation, observe the work, instruct and/or make recommendations to the installers as required, and report unsatisfactory conditions to the COR and Representative.
- C. Properly protect and maintain any completed installations during periods of installation inactivity in accordance with approved installation plan.
- D. Foundation Preparation:
  - 1. Prepare surface upon which Geonet is to be placed to a firm, dry surface, reasonably even and smooth, and free of offsets, abrupt indentations, and protruding materials greater than 1.5 inches.
  - 2. Obtain COR or BIA Representative approval before foundation installation of the geonet.



- 
- E. Panel Placement, Connection, and Anchorage:
1. Position upper sections first and expand panel sections down the slope.
  2. Lay geonet smoothly, free of tension, stress, folds, wrinkles, or creases so far as is practical and except where required in these specifications.
  3. Pin, staple, or weight to hold geonet in position. In the presence of wind, weight geonet with sandbags or equivalent until cover material is placed
  4. Expand uniformly to the required dimensions and correct alignment.
  5. Interleaf or overlap edges of adjacent sections according to the manufactures recommendation. Ensure upper surfaces of adjoining panel sections are flush at joint and adjoining cells are fully aligned.
  6. Do not modify panels in field without manufacturer's technical representative and COR or BIA Representatives approval.
    - a. Obtain approval of modification method from manufacturer's technical representative and COR or BIA Representative.

### **3.07 INSTALLATION OF COVER MATERIAL**

- A. Place cover material so as not to damage geotextile or geonet.
1. Place directly on geotextile or geonet with drop height not exceeding 1-foot.
  2. Place cover material in a manner to minimize movement of the geonet and assure that no tensile stress is induced.
  3. Place cover material from the bottom of the slope proceeding upwards.
- B. Before placing cover material, demonstrate to COR or BIA Representative that placing technique will not damage geotextile. If the demonstration does not show that cover material can be installed without damaging geotextile, modify cover material placing technique (such as reducing drop height, installing additional layer of sacrificial geotextile, or installing additional gravel cushion).
- C. Cover material includes riprap, Zone1, or Zone1A materials.

### **3.08 REPAIRS**

- A. At placement, geotextile and/or geonet will be rejected if it has defects, rips, holes, flaws, deterioration, contamination, or damage.
- B. Replace or repair geotextile and/or geonet damaged during installation or placement of cover in the following manner:
1. Remove cover from damaged area.
  2. Remove any soil or other material which may have penetrated torn geotextile.

3. Repair damaged geotextile by placing additional layer of geotextile to cover damaged area and either sew the patch to undamaged geotextile according to sewing requirements stated above or overlap undamaged geotextile by at least 3 feet on all sides.

### **3.09 FIELD QUALITY CONTROL**

- A. After installation, examine entire surface to ensure that potentially harmful foreign objects (such as needles) are not present.
- B. Remove foreign objects or replace material.

**END OF SECTION**

**SECTION 31 32 37**  
**GEOCELL**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Geocell installation is considered an alternative to revegetation as a means of providing protection of the downstream slope. Contractor is required to submit a bid for furnishing and installing geocell according to the requirements of this specification. For purposes of this bid, the Contractor shall assume the entire downstream slope shall be covered with 10,000 square yards of geocell filled with approximately 750 cubic yards of geocell gravel. Contractor's bids should be submitted separately from bid schedule, as bids for geocell will not be considered within the overall proposal.
- B. Geocell:
1. Measurement: Surface area placed, except no allowance will be made for repairs or waste.
  2. Payment: Square yard price offered in the schedule.
- C. Geocell Gravel:
1. Measurement: Volume placed, except no allowance will be made for repairs or waste.
  2. Payment: Cubic yard price offered in the schedule.

**1.02 REFERENCE STANDARDS**

- A. American Society of Testing and Materials (ASTM)
1. ASTM C 33-11 Concrete Aggregates
  2. ASTM D 1505-10 Density of Plastics by the Density-Gradient Technique
  3. ASTM D 1603-06 Standard Test for Carbon Black in Olefin Plastics
  4. ASTM D 1693-08 Environmental Stress-Cracking of Ethylene Plastics
  5. ASTM D 5199-11 Measuring Nominal Thickness of Geotextiles and Geomembranes.
  6. ASTM E 41-92(2010) Terminology Relating to Conditioning.

**1.03 SUBMITTALS**

- A. The submittals outlined in this section will be required if BIA elects to use geocell as downstream slope protection.

- B. Submit the following in accordance with Section 01 33 00 – Submittals.
- C. RSN 31 32 37-1, Certification:
1. Manufacturer's certification that geocell meets requirements of these specifications:
    - a. Include:
      - 1) Carbon black percentage.
      - 2) Environmental Stress Crack Resistance.
      - 3) Minimum seal strength.
      - 4) Copies of quality control certificates issued by resin supplier.
    2. Samples:
      - a. Minimum 2- by 2-foot geocell panel.
      - b. Clip and key to be furnished.
    3. Qualifications:
      - a. Installation company:
        - 1) Name and address.
        - 2) Documentation of previous experience with specified geocell.
          - a) Names of facility owner(s).
          - b) Person to contact at facilities who can discuss projects listed.
          - c) Project manager, designer, manufacturer, fabricator (if any).
          - d) Locations, thicknesses, and area in square feet of geocell installed.
          - e) Types of seaming and patching equipment used.
          - f) Dates of installation.
      - b. Onsite personnel experience:
        - 1) Resumes, including dates and duration of employment and pertinent experience.
      - c. Manufacturer:
        - 1) Name and address of geocell manufacturer.
        - 2) Evidence of manufacturer experience
          - a) Name, location, owner, and purpose of completed facility.
          - b) Name and telephone number of contact at facility who can discuss project.

- c) Geocell type and thicknesses, total square footage of installation, installation date, project manager, designer, fabricator (if any), and installer.
  - 3) Descriptive documentation of manufacturer's quality control program.
- 4. Installation Plan:
  - a. Manufacturer's instructions for delivery, storage, and handling of geocell materials.
  - b. Details of geocell installation:
    - 1) Work schedule.
    - 2) Location, size, orientation, and identification of panels.
    - 3) Sequencing of panel installation.
    - 4) Equipment and procedures for handling and installing panels.
    - 5) Equipment and procedures for installing geocell around penetrations.
    - 6) Equipment and procedures for field testing adequacy installation.
    - 7) Details of equipment, products, and procedures for cleaning, protecting, and repairing geocell.
    - 8) Number of crews and crew size.
    - 9) Contractors Quality Control (QC) Plan
    - 10) Method to place geocell on existing slope, include details for minimizing damage to underlying layers.

#### **1.04 QUALIFICATIONS**

- A. Onsite Installation Supervisor:
  - 1. Installed or supervised installation of a minimum of 100,000 square feet of specified geocell.
- B. Manufacturer:
  - 1. Completed facilities totaling at least 500,000 square feet of specified geocell.
- C. Manufacturers Technical Representative:
  - 1. Qualified to provide technical guidance on materials and procedures for installation approved by manufacturer and worked on three similar project.
- D. Installer:
  - 1. At least three separate and satisfactory installations totaling at least 50,000 square feet of the specified geocell.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in Manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.
- B. The materials shall be stored in accordance with Manufacturer's instructions. The materials shall be protected from damage and out of direct sunlight.
- C. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

## PART 2 PRODUCTS

### 2.01 GEOCELL

- A. Geocell shall be one of the following or equal.
  - 1. Presto Geoweb GW30V4 (4-inch), manufactured by Presto Geosystems, P.O. Box 2399, Appleton, WI 54912 2399. [www.prestogeo.com](http://www.prestogeo.com). Geo EnviroGrid EGA30 (4inch), manufactured by Geo Products, 8615 Golden Spike Lane, Houston, TX 77086. [www.geoproducts.org](http://www.geoproducts.org). StrataWeb 30 (4-inch) manufactured by Strata Global GeoSolutions, 380 Dahlonega Road, Suite 200, Cumming, GA 30040 [www.geogrid.com](http://www.geogrid.com), with the following essential characteristics:
    - a. Base Materials:
      - 1) Polyethylene Stabilized with Carbon Black:
        - a) Density shall be 58.4 to 60.2-pound/ft<sup>3</sup> in accordance with ASTM D 1505.
        - b) Environmental Stress Crack Resistance (ESCR) shall be 5,000 hours in accordance with ASTM D 1693.
        - c) Ultra-Violet light stabilization:
          - i. Carbon Black content shall be 1.5 to 2 percent by weight, through addition of a carrier with certified carbon black content.
        - d) Carbon black shall be homogeneously distributed throughout material.
        - e) The manufacturer must have an in-place quality control to prevent irregularities in strip material.
      - b. Geocell section width: 8.5 feet.
      - c. Cell Properties:
        - 1) Individual cells shall be uniform in shape and size when expanded.
        - 2) Individual cell dimensions (nominal) shall be plus or minus 10 percent.

- 3) Length shall be 11.3 inches.
- 4) Width shall be 12.6 inches.
- 5) Nominal area shall be 71.3 square inch (in<sup>2</sup>) plus or minus 1 percent.
- 6) Nominal cell depth shall be 4 inches.
- d. Strip Properties and Assembly:
  - 1) Perforated Textured Strip/Cell.
  - 2) Strip sheet thickness shall be 50 mils, minus 5 percent, plus 10 percent in accordance with ASTM D 5199. Determine thickness flat, before surface disruption.
  - 3) Polyethylene strips shall be textured surface with a multitude of rhomboidal (diamond shape) indentations.
  - 4) Textured sheet thickness shall be 60 mils, plus or minus 6 mils.
  - 5) Indentation surface density shall be 140 to 200 per in<sup>2</sup>.
  - 6) Perforated with horizontal rows of 0.4-inch-diameter holes.
  - 7) Perforations within each row shall be 0.75 inches on-center.
  - 8) Horizontal rows shall be staggered and separated 0.50 inches relative to hole centers.
  - 9) Edge of strip to nearest edge of perforation shall be a minimum of 0.3 inches.
  - 10) Centerline of spot weld to nearest edge of perforation shall be a minimum of 0.7 inches.
  - 11) A slot with a dimension of 3/8-inch x 1-3/8-inch is standard in the center of the non-perforated areas and at the center of each weld.

## **2.02 FABRICATION OF ASSEMBLY:**

### **A. Assembly of Cell Sections:**

1. Fabricate using strips of sheet polyethylene each with a length of 142 inches and a width equal to cell depth.
2. Connect strips using full depth ultrasonic spot-welds aligned perpendicular to longitudinal axis of strip.
3. Ultrasonic weld melt-pool width shall be 1.0-inch maximum.
4. Weld spacing for geocell sections shall be 17.5 inches plus or minus 0.10-inch.

### **B. Cell Seam Strength Tests:**

1. Short-Term Seam Peel-Strength Test, as approved by manufacturer:
  - a. Cell seam strength shall be uniform over full depth of cell.

- b. Minimum seam peel strength shall be 320 lbf for 4-inch depth.
- 2. Long-Term Seam Peel-Strength Test, as approved by manufacturer:
  - a. Conditions: Minimum of 7 days in a temperature-controlled environment that undergoes change on a 1-hour cycle from room temperature to 130 degrees Fahrenheit (54 degrees Celsius).
  - b. Room temperature shall be in accordance with ASTM E 41.
  - c. Test samples shall consist of two, 4-inch (100-mm) wide strips welded together.
  - d. Test sample consisting of 2 carbon black stabilized strips shall support a 160-pound (72.5-kg) load for test period.

### **2.03 CONNECTIONS**

- A. Clip: ATRA Clip or equal, manufactured by Presto Geosystems, P.O. Box 2399, Appleton, WI 54912 2399, [www.prestogeo.com](http://www.prestogeo.com), or equal with the following essential characteristics:
  - 1. Molded, high-strength polyethylene device available in standard (0.5-inch) and metric (10-12-mm) versions.
  - 2. Installed as endcap on No. 4 rebar for anchoring the geocell.
- B. Key: ATRA Key or equal, manufactured by Presto Geosystems, P.O. Box 2399, Appleton, WI 54912 2399, [www.prestogeo.com](http://www.prestogeo.com), or equal with the following essential characteristics:
  - 1. Polyethylene, formulation similar to geocell panels.
  - 2. Provide a high strength connection of geocell panels at panel interleaf and end to end.

### **2.04 CELL INFILL MATERIALS**

- A. Gravel: ASTM C 33, Size No 67.

## **PART 3 EXECUTION**

### **3.01 EQUIPMENT**

- A. Do not drive equipment on Geocell, unless approved by COR or BIA Representative.

### **3.02 EXAMINATION**

- A. Verify site conditions are as indicated on the drawings. Notify the COR or BIA Representative if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.



### 3.03 INSTALLATION

- A. Install geocell system in accordance with this Section, as shown on drawings, and in accordance with approved installation plan, whichever is most restrictive.
- B. Manufacturer's technical representative(s) shall be onsite during geocell system installation.
  - 1. Manufacturer's technical representative(s) shall exercise technical control of installation, observe the work, instruct and/or make recommendations to the installers as required, and report unsatisfactory conditions to the COR or BIA Representative.
- C. Properly protect and maintain any completed installations during periods of installation inactivity in accordance with approved installation plan.
- D. Foundation Preparation:
  - 1. Prepare surface upon which Geocell is to be placed to a firm surface, reasonably even and smooth, and free of offsets, abrupt indentations, and protruding materials greater than 1.5 inches.
  - 2. Obtain COR or BIA Representative approval before foundation installation of the geocell.
- E. Panel Placement, Connection, and Anchorage:
  - 1. Position collapsed panel sections at the crest of the slope as approved.
  - 2. Expand the panel sections down the slope.
  - 3. Expand uniformly to the required dimensions and that outer cells of each section are correctly aligned.
  - 4. Interleaf or overlap edges of adjacent sections. Ensure upper surfaces of adjoining panel sections are flush at joint and adjoining cells are fully aligned at the cell wall slot.
  - 5. Connect the panel sections with keys at each interleaf and end to end connection.
    - a. Insert the key through the cell wall slot before inserting through the adjacent cell.
    - b. Lock the panels together.
  - 6. Keys and clips shall be installed per manufacturer's recommendation.
  - 7. Anchor with 24-inch anchors in cells 1, 4, and 7 and every third row down the slope or in accordance with manufacture's recommendations.
  - 8. Do not modify panels in field without manufacturer's technical representative and COR or BIA Representative approval.
    - a. Obtain approval of modification method from manufacturer's technical representative and COR or BIA Representative.

- F. Aggregate Infill Placement:
1. Place specified infill in expanded cells with suitable material handling equipment, such as a backhoe, front-end loader, conveyor, or crane-mounted skip.
  2. Limit drop height to a maximum of 1-foot to avoid damage or displacement of the underlying layer and cell walls.
  3. Fill cells from the crest of the slope to toe or in accordance with COR or BIA Representatives direction.
  4. Infill material shall be free-flowing and not frozen when placed.
  5. Evenly spread infill and ensure the infill is flush with the top of the cell walls.

### **3.04 REPAIRS**

- A. At placement, geocell will be rejected if it has defects, rips, holes, flaws, deterioration, contamination, or damage.
- B. Replace or repair geocell damaged during installation or placement of cover as recommended by the manufacturer's technical representative and approved by the COR or BIA Representative.

**END OF SECTION**

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**SECTION 31 35 23**  
**ARTICULATED CONCRETE BLOCK (ACB)**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Articulated Concrete Block Mats:

1. Payment: Lump sum price offered in the schedule.
  - a. Includes furnishing all materials, labor, equipment, and incidentals required to install cellular concrete erosion control block mats in accordance with the lines, grades, and design shown on the Drawings.
  - b. Installation shall include:
    - 1) Preparing foundation soils to the lines and grades shown on the Drawings.
    - 2) Placing the geotextile filter fabric, geogrid, and gravel base layer beneath the cellular concrete mats.
    - 3) Installing the pre-manufactured cellular concrete mats.

**1.02 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 35 23-1, Shop Drawings:

1. Plans and shop drawings for the layout and details of the cellular concrete mats. Plans shall show as a minimum: the layout, layout sequence, mat junction details, and details for grade changes.

C. RSN 31 35 23-2, Certification and Laboratory Test Results:

1. Administrative:
  - a. Name and location of concrete block manufacturer and proof of PCI certification.
  - b. Proposed concrete mix design for ACB.
  - c. Manufacturer's installation instructions.
2. Quality Control:
  - a. Laboratory test results, provided by the supplier from a laboratory approved by the Engineer, for the concrete blocks including: compression, absorption, and specific weight. One set of three blocks shall be taken per 50 cubic yards of dry cast concrete. All tests shall be performed on one

sample at 7 days, and two additional samples shall be tested for compressive strength only at 28 days.

- b. Manufacturer's certified test results for the revetment cables, including: permanent elongation, elastic elongation, and total strength.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. All cellular concrete mats shall be prefabricated as an assembly of concrete blocks, laced with revetment cables.
- B. Closed cell blocks shall be used. Parallel strands of revetment cable shall extend through ducts in each block in a manner which provides for longitudinal and lateral binding of the blocks within the mats. Each row of blocks shall be laterally offset by one-half block width from the adjacent row.
- C. Cellular concrete mats shall be cell grid, Class 55S Non-Tapered, Closed-Cell Armorflex Block as manufactured by Armortec, West Chester, Ohio, or equal.
- D. Two cables shall extend through each concrete block in a longitudinal direction and at least one cable in a lateral direction. The cables shall be inserted into the blocks in such a manner to form lifting loops at each end of the mat.
- E. The cellular concrete blocks, cables and fittings shall be shop fabricated into mats with a width of up to 8 feet and a length approved by the manufacturer's representative, suitable for Contractor's handling equipment, and approved by the Engineer.

### **2.02 ARTICULATED CONCRETE BLOCKS**

- A. Cementitious materials and aggregates shall conform to the requirements in Section 03 30 00 – Cast-In-Place Concrete.
- B. At the time of delivery to the site, the units shall conform to the following minimum physical characteristics:
  - 1. Minimum 28-day compressive strength: 4,000 psi
  - 2. Minimum specific weight: 130 pcf
  - 3. Maximum water absorption: 7 percent
  - 4. Minimum weight per area: 33 psf

### **2.03 REVETMENT CABLE AND FITTINGS**

- A. Revetment cables shall be constructed of high tenacity, low elongating, and continuous filament polyester fibers. Cable shall consist of a core construction comprised of parallel fibers contained within an outer jacket or cover. The weight of the parallel core shall be

at least 65 percent of the total weight of the cable. Construction of the cable shall be such that the cover is non-load-bearing and the rope is torque free.

- B. The revetment cable shall have the following physical properties:

<b>POLYESTER CABLE</b>				
Nominal Cable Dia. (in.)	Approx. Ave. Strength		Weight Per Length	
	(lbs)	(kN)	(lbs)/(100 ft)	(kg/m)
1/4	3,000	13.3	2.2	0.03
5/16	7,000	31.1	4.4	0.07
3/8	10,000	44.5	5.5	0.08
1/2	15,000	66.7	9.7	0.14

- C. Elongation requirements specified below are based upon stabilized new, dry cable. Stabilization refers to a process in which the cable is cycled fifty (50) times between a load corresponding to 200D2 and a load equal to 10%, 20%, or 30% of the cable's approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on these values is + 5%.

<b>ELASTIC ELONGATION</b> at Percentage of Break Strength		
10%	20%	30%
0.6	1.4	2.2

- D. The revetment cable shall exhibit resistance to most concentrated acids, alkalis, and solvents. Cable shall be impervious to rot, mildew, and degradation associated with marine organisms. The materials used in the construction of the cable shall not be affected by continuous immersion in fresh or salt water.
- E. Selection of cable and fittings shall be made in a manner that ensures a safe design factor for mats being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 60% of the minimum rated cable strength. Fittings such as sleeves and stops shall be aluminum and washers shall be galvanized steel.

## 2.04 GEOTEXTILE FILTER FABRIC

- A. Filter fabric shall consist of non-biodegradable, woven cloth geotextile consisting of high-tenacity monofilament polypropylene yarns that are resistant to commonly encountered soil chemicals, mildew, and insects. Geotextile filter fabric shall be Mirafi FW 300, or approved equal. Filter fabric shall meet the criteria below, based on minimum average roll values:

TEST PERFORMED	UNITS	REQUIREMENTS	METHOD
Grab Tensile Strength	lbs	300 (min)	ASTM D 4632
Elongation	%	15 (max)	ASTM D 4632
Puncture Strength	lbs	1250 (min)	ASTM D 6241
Trapezoid Tear	lbs	100 (min)	ASTM D 4533
Permittivity	sec <sup>-1</sup>	1.4 (min)	ASTM D 4491
Apparent Opening Size	mm	0.6	ASTM D 4751
Ultraviolet Degradation	% Strength Retained	90 (min)	ASTM D 4355

## 2.05 GEOGRID

- A. Geogrid to be placed over the geotextile filter fabric shall consist of non-biodegradable, high tenacity, high molecular weight woven biaxial polyester coated with polymer. Geogrid shall be Mirafi BXG, or approved equal.

## 2.06 GRAVEL BASE MATERIAL

- A. Gravel Base Material to be placed over the prepared subgrade should match criteria for Gravel Surfacing Material found in Section 32 15 10: Gravel Surfacing. Gravel base material should be placed over Filter Fabric in a uniform, 6-inch layer, in accordance with procedures found in Section 32 15 10: Gravel Surfacing.

## PART 3 EXECUTION

### 3.01 INSPECTION

- A. The Engineer shall visually inspect all units delivered to the site. All units shall be sound and free from defects that would interfere with the proper placing of the unit or impair the strength or performance of construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, will not be deemed grounds for rejection. Cracks exceeding 0.25 inches in width and/or 1.0 inch in depth shall be deemed grounds for rejection. Chipping resulting in weight loss exceeding 10 percent of the average weight of the blocks shall be deemed grounds for rejection. Blocks rejected prior to delivery from the manufacturer shall be replaced prior to delivery. Blocks rejected at the job site shall be repaired by the Contractor with non-shrink grout.

### 3.02 FOUNDATION PREPARATION

- A. Areas on which geotextile, road base, and cellular concrete blocks are to be placed shall be constructed to the lines and grades shown on the Drawings, and as approved by the Engineer.

- B. The prepared soil surface shall be graded to a smooth plane surface. All deformities, grade stakes, and stones which project above the local grade must be regraded or removed. No holes, "pockmarks", slope board teeth marks, footprints, or other voids greater than one inch in depth measured normal to the local slope face shall be permitted. Where such areas are evident, they shall be corrected by placing embankment fill.
- C. Excavation and preparation for anchor trenches shall be done in accordance with the lines, grades, and dimensions recommended by the manufacturer. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than ½-inch over or under the local grade occur.

### **3.03 PLACING GEOTEXTILE FILTER FABRIC AND GEOGRID**

- A. Place geotextile and overlying geogrid beneath the cellular concrete mats as shown on the Drawings, and according to the manufacturer's recommendations.
- B. Provide minimum 12-inch overlap at adjoining panels of geotextile and geogrid.
- C. Secure geotextile and geogrid using 10-inch long steel pins, or as approved by manufacturer.

### **3.04 PLACING GRAVEL BASE LAYER**

- A. Place gravel base layer over geotextile in a uniform, 6-inch layer, in accordance with Section 32 15 10: Gravel Surfacing. Placement of gravel base layer shall protect the geotextile and shall provide a uniform surface for placement of cellular concrete mats.

### **3.05 PLACING CELLULAR CONCRETE MATS**

- A. Cellular concrete mats shall be installed within the specified lines and grades as shown on the Drawings.
- B. The cellular concrete mats shall be placed on the filter fabric in such a manner as to produce a smooth plane surface in intimate contact with the gravel base layer, geogrid, geotextile, and underlying soil. The mat shall be "seated" by two coverages with a rubber-tired backhoe having a maximum operating weight of 22,000 pounds, as approved by the Engineer. Any equipment to be used for "seating" of the mats shall be approved by the cellular concrete block manufacturer prior to use for this purpose. After seating, no individual block shall protrude more than ¼-inch within the plane of the placed mat.
- C. The cellular concrete mats shall be attached to a spreader bar to aid in the lifting and placing of the mats in their proper position by the use of a crane. Alternative lifting and placing methods must be approved by the Engineer and the manufacturer's representative. The equipment used to place the mats should have adequate capacity to place the mats without bumping, dragging, tearing, or otherwise damaging the underlying geotextile or gravel base. The mats shall be placed side by side, or end to end, so that the mats abut each other. Mat seams or openings between mats greater than 2 inches shall be

filled with non-shrink grout. Slope breaks that result in a discontinuous revetment surface shall require a non-shrink grout seam at the grade change location.

- D. Anchor trenches shall be backfilled and compacted flush with the top of the mats. Trenches shall be backfilled and compacted with embankment fill.
- E. Use full-size mats as delivered to the site first and supplement with smaller portions of mats to make up required dimensions shown on the drawings. The minimum dimension of a placed mat or portion of mat, as defined by concrete area with common and continuous revetment cable, shall be 6 feet unless otherwise directed by the Engineer.

**END OF SECTION**



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**SECTION 31 37 00**

**RIPRAP**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. 15-inch Riprap:
1. Measurement: Volume to outlines placed and to thickness shown on drawings.
  2. Payment: Cubic yard price offered in the schedule, which includes rock spalls and gravel to fill voids in riprap.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM C 88-05 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
  2. ASTM C 127-07 Density, Relative Density, (Specific Gravity), and Absorption of Coarse Aggregate
  3. ASTM C 131-06 Resistance to Degradation of Small-Size Coarse Aggregate and Impact in the Los Angeles Machine

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 31 37 00-1, Materials Data and Laboratory Test Results:
1. Name and location of commercial rock source.
  2. Gradation of riprap.
  3. Certified laboratory test results demonstrating rock meets specified material requirements.
- C. RSN 31 37 00-2, Riprap Placement Plan:
1. Include equipment, sequence, and methods.
  2. Location and extent of temporary stockpile area, if required.

**PART 2 PRODUCTS**

**2.01 RIPRAP ROCK**

- A. Obtain from approved commercial source.

- B. Hard, Dense, and Durable:
  - 1. Specific gravity, ASTM C 127, minimum: 2.6.
  - 2. Absorption, ASTM C 127, maximum: 2 percent.
  - 3. Loss, Sulfate Soundness, ASTM C 88, maximum: 10 percent.
  - 4. Loss at 100 cycles, Los Angeles Abrasion, ASTM C 131, maximum: 10 percent.
  - 5. Loss at 500 cycles, Los Angeles Abrasion, ASTM C 131, maximum: 40 percent.
- C. Quarried rock shall be used for riprap.
- D. Shape:
  - 1. Predominantly angular.
  - 2. Maximum dimension not greater than 3 times minimum dimension.
- E. Fifteen-inch Riprap Gradation for Dam Embankment: Reasonably well graded within limits shown in Table 31 37 00A – 15-inch Riprap Gradation.

Table 31 37 00A – 15-inch Riprap  
Gradation

Diameter, in.	Percent Smaller than Given Size by Weight
D <sub>50</sub> Size = 15-inch	
21	100
18	70 – 90
15	35 – 55
6	0 – 20

**2.02 BEDDING MATERIAL**

- 1. Geotextile: Shall meet the geotextile Type B requirement in Section 31 32 32 – Geotextiles.

**PART 3 EXECUTION**

**3.01 REMOVING EXISTING RIPRAP**

- A. Verify with COR or BIA Representative the limits of existing riprap to be removed.

- B. Remove existing riprap at locations shown on drawings and as directed by COR or BIA Representative.
- C. Place removed existing riprap in temporary stockpile at approved location.

### **3.02 AREAS TO RECEIVE RIPRAP**

- A. Place geotextile bedding material to the lines shown on the drawings.
- B. Place riprap to the outlines and thicknesses shown on the drawings.

### **3.03 PLACING**

- A. Place the geotextile on bedding in accordance with Section 31 32 32 – Geotextiles.
- B. Place rock directly on geotextile with drop height not exceeding 1-foot to avoid damage to geotextile. Rock in riprap may be hand placed to avoid damage.
- C. Place rocks so that larger rocks are evenly distributed and small rock fragments fill the spaces.
  - 1. Include rock spalls or gravel in an amount to fill voids in riprap, but not in excess of an amount to be determined by the COR or BIA Representative.
- D. Dump and smooth by moving rocks into position so that material when in place is stable.
- E. Begin riprap placement at toe and proceed up slope.
- F. Leave no unreasonably large unfilled spaces within riprap.

**END OF SECTION**

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**SECTION 32 15 10**  
**GRAVEL SURFACING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Dam Crest Gravel Surfacing:
1. Measurement: Volume of in-place compacted material to outlines as shown on drawings and to thicknesses shown on drawings.
  2. Payment: Cubic yard price offered in the schedule.
- B. Access Road Gravel Surfacing:
1. Measurement: Volume of in-place compacted material to outlines as shown on drawings and to thicknesses shown on drawings.
  2. Payment: Cubic yard price offered in the schedule.
- C. Boat Ramp and Adjacent Parking Area Gravel Surfacing:
1. Measurement: Volume of in-place compacted material to outlines as shown on drawings and to thicknesses shown on drawings.
  2. Payment: Cubic yard price offered in the schedule.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM D 1241-07 Materials for Soil-Aggregate Subbase, Base, and Surface Courses

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 32 15 10-1, Certification:
1. Manufacturer's certification demonstrating gravel surfacing material meets specified requirements.

**PART 2 PRODUCTS**

**2.01 GRAVEL**

- A. Gravel: ASTM D 1241, Type I, Gradation C, surface-course materials, except,

1. Fine aggregate:
  - a. Minimum passing No. 200 sieve: 0 percent at boat ramp, 8 percent elsewhere.
  - b. Fraction passing No. 40 sieve:
    - 1) Liquid limit, maximum: 35.
    - 2) Plasticity index range: 4 to 9.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Grade and prepare subgrade free from depressions and soft spots.
- B. Obtain approval from the COR or BIA Representative of subgrade before placing surfacing.

### **3.02 PLACING**

- A. Place gravel surfacing at locations and to the limits shown on drawings.
- B. Place, moisten, and compact gravel surfacing in accordance with Section 31 24 00 – Fill and Backfill.
- C. Provide compacted gravel surfacing to depths as shown on drawings.

**END OF SECTION**

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**SECTION 32 31 10**  
**SECURITY GATES AND FENCING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Barbed Wire Fence:

1. Measurement: Length of installed barbed wire fence.
2. Payment: Linear foot price offered in the schedule.
  - a. Includes cost of furnishing materials, erecting posts, making fence connections, and performing other work as required for complete erection of barbed wire fencing.

B. Security Gates:

1. Measurement: Number of security gates installed.
2. Payment: Security gate per unit offered in the schedule.
  - a. Includes cost of furnishing materials for security gate and cattle guard, installing gate posts and gate stops, digging and backfilling post holes, placing concrete for posts, attaching gate leaves, and performing other work as required for complete installation of the pipe gates.

**1.02 REFERENCE STANDARDS**

A. American Institute of Steel Construction (AISC)

1. AISC 325-05 Steel Construction Manual - 13th Edition

B. American Society of Mechanical Engineers (ASME)

1. ASME B18.2.1-2010 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. ASTM International (ASTM)

1. ASTM A 36/A 36M-08 Carbon Structural Steel
2. ASTM A 53/A 53M-12 Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless
3. ASTM A 116-11 Metallic-Coated, Steel-Woven Wire Fence Fabric
4. ASTM A 121-07 Metallic-Coated Carbon Steel Barbed Wire

- 
- |      |  |   |
|------|--|---|
| 5.   | ASTM A 123/A 123M-09                             | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products               |
| 6.   | ASTM A 153/A 153M-09                             | Zinc Coating (Hot-Dip) on Iron and Steel Hardware                           |
| 7.   | ASTM A 325-07a                                   | Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength  |
| 8.   | ASTM A 385/A 385M-11                             | Providing High-Quality Zinc Coatings (Hot-Dip)                              |
| 9.   | ASTM A 392-11a                                   | Zinc-Coated Steel Chain-Link Fence Fabric                                   |
| 10.  | ASTM A 563-07a                                   | Carbon and Alloy Steel Nuts   |
| 11.  | ASTM A 641/A 641M-09a                            | Zinc-Coated (Galvanized) Carbon Steel Wire                                  |
| 12.  | ASTM A 702-89(2006)                              | Steel Fence Posts and Assemblies, Hot Wrought                               |
| 13.  | ASTM A 780/A 780M-05(2009)                       | Repair of Damaged and Uncoated Areas of Galvanized Coatings                 |
| 14.  | ASTM A 824-01(2007)                              | Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence |
| 15.  | ASTM A 854/A 854M-08                             | Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire            |
| 16.  | ASTM C 33/C 33-11a                               | Concrete Aggregates   |
| 17.  | ASTM C 94/C 94M-12                               | Ready-Mixed Concrete  |
| 18.  | ASTM C 150/C 150M-12                             | Portland Cement   |
| 19.  | ASTM F 567-11a                                   | Installation of Chain-Link Fence  |
| 20.  | ASTM F 626-08                                    | Fence Fittings  |
| 21.  | ASTM F 900-11                                    | Industrial and Commercial Swing Gates                                       |
| <br> |  |   |
| D.   | American Welding Society, Inc. (AWS)             |   |
| 1.   | AWS D1.1/D1.1M-10                                | Structural Welding Code – Steel   |
| <br> |  |   |
| E.   | American Wood Protection Association (AWPA):     |   |
| 1.   | AWPA U1-10                                       | Use Category System: User Specifications for Treated Wood                   |
| <br> |  |   |
| F.   | Chain Link Fence Manufacturers Institute (CLFMI) |   |
| 1.   | CLFMI 2445-10                                    | Product Manual  |
| <br> |  |   |
| G.   | Federal Specifications (FS)                      |   |
| 1.   | FS RR-C-271D(1)                                  | Chain and Attachments, Welded and Weldless                                  |
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2. FS RR-F-191K/GEN Fencing, Wire and Post, Metal (and Gates, Chain-Link Fence Fabric, and Accessories)

H. Society of Protective Coatings (SSPC)/NACE International (NACE)

1. SSPC-SP7 NACE No.4-2007 Brush-Off Blast Cleaning

**1.03 SUBMITTALS**

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 32 31 10-1, Barbed Wire Fence Certifications:

1. Manufacturer's certification that fence materials, fittings, and accessories meet specified requirements.
2. Include manufacturer's names and product designations and specified product standards in the certification.

C. RSN 32 31 10-2, Pipe Gate Fence Certifications:

1. Manufacturer's certification that fence materials, fittings, and accessories meet specified requirements.
2. Include manufacturer's names and product designations and specified product standards in the certification.

**1.04 QUALIFICATION OF WELDERS**

A. Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

**1.05 DELIVERY, STORAGE, AND PROTECTION**

- A. Protect from corrosion, deformation, and other types of damage.
- B. Store items in an enclosed area free from contact with soil and weather.
- C. Remove and replace damaged items with new items.

**PART 2 PRODUCTS**

**2.01 BARBED WIRE FENCE MATERIALS**

A. Metal Posts and Braces:

1. Line posts:
  - a. ASTM A 702 galvanized line posts.
  - b. Minimum weight: 1.33 pounds per linear foot.

- c. Do not mix shapes.
  2. Corner, gate, and brace posts and post braces: FS RR-F-191/GEN and FS RR-F-191/3 zinc coated, steel pipe posts and braces.
- B. Five Strand Steel Barbed Wire: ASTM A 121.
  1. Coating: Type Z, Class 3.
  2. Design Number: 12-2-4-14R.
- C. Concrete:
  1. Manufacture and delivery: ASTM C 94.
  2. Cement: ASTM C 150, Type V.
  3. Fine and coarse aggregate: ASTM C 33.
    - a. Coarse aggregate size, maximum: 3/4-inch.
  4. Minimum compressive strength at 28 days: 3,000 lb/in<sup>2</sup>.

## 2.02 PIPE GATES

- A. Materials
  1. Arc-Welding Electrodes:
    - a. Filler metal and required shielding gases or fluxes: AWS D1.1.
    - b. Filler metal for steel, minimum tensile strength: 70,000 pounds per square inch (lb/in<sup>2</sup>).
  2. Bolts, Nuts, And Washers:
    - a. Bolts:
      - 1) ASTM A 325.
      - 2) Length of bolt threads: ASME B18.2.1.
      - 3) Thread class: 2 free-fit, American National coarse-thread series.
    - b. Nuts: ASTM A 563.
    - c. Washers:
      - 1) For use with ASTM A 325 bolts: ASTM F 436.
  3. Steel Pipe: ASTM A 53, type E or S, grade B.
    - a. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
    - b. BIA inspection at the mill and hydrostatic tests will not be required.

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4. Structural Steel:
    - a. Plates and bars: ASTM A 36.
- B. Concrete
1. In accordance with Section 03 30 00 - Cast-In Place Concrete.
  2. Cement: ASTM C 150, Type V.
  3. Fine and Coarse Aggregate: ASTM C 33.
    - a. Coarse aggregate size, maximum: 3/4-inch.
  4. Minimum compressive strength at 28 days: 3,000 pounds per square inch (lb/in<sup>2</sup>).
- C. Fabrication
1. Fabricate pipe gates as shown on drawings.
  2. Fabricate pipe gates in accordance with AISC 325 and these specifications.
    - a. Perform welding and related work in accordance with AWS D1.1.
    - b. Grind welds smooth as indicated on the drawing.
  3. If straightening is necessary, use methods that will not injure the metal and are approved by the COR or BIA Representative.
  4. After shop work completion and before galvanizing, if required, clean material of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.
  5. Fabricate Pipe Gates from:
    - a. Standard weight pipe with diameter shown on drawings.
    - b. Steel plates and bars.
  6. Galvanizing:
    - a. Galvanize items of security gate as specified or shown on drawings. Use hot-dip galvanizing, where required after fabrication, in accordance with ASTM A 123 and ASTM A 385.
    - b. Galvanize bolts, nuts, and washers in accordance with ASTM A 153. Remove excess spelter by centrifugal spinning.
    - c. Fabricator's Galvanizing Repair:
      - 1) Redip material with damaged galvanizing unless damage is local and can be repaired by zinc primer or other method approved by the COR or BIA Representative.

- 2) If the galvanized coating becomes damaged after being dipped twice, material will be rejected.
- 3) Repair procedure where local paint repair is authorized:
  - a) Repair in accordance with ASTM A 780, except repair material containing cadmium and lead are not permitted.

### **2.03 CATTLE GUARDS**

- A. Cattle guards will be placed with pipe gates at roadways, as shown on the drawings.
- B. Model H-20 Cattle Gauge, Item Number 036-20812 manufactured by Unit Liner Company, 7901 N. Kickapoo, Shawnee, Oklahoma 74804, Telephone 800-633-4603; or equal, with the following characteristics:
  1. 8' x 12' cattle guard with clean out.
  2. Rated for 16 tons per axle.
  3. Winged at lateral ends.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Clear and remove trees, brush, ground surface irregularities, and other obstacles which interfere with proper erection of fence in advance of starting other fencing work.
  1. Dispose of removed material in accordance with Section 31 11 00 – Clearing and Grubbing.

### **3.02 BARBED WIRE FENCE ERECTION**

- A. Erect barbed wire fence at locations where existing fencing is relocated for construction access or damaged as a result of construction activities.
- B. Posts:
  1. Excavate, backfill, and compact backfill for posts.
    - a. Set plumb in postholes to a minimum depth of 2 feet below ground and extending at least 5 feet above ground.
    - b. Backfill postholes in layers of not more than 8 inches and tamp each layer.
    - c. Set steel corner, gate, and brace posts and post braces in concrete as shown on drawings.
  2. Straight line fence:
    - a. Pull posts: Install so maximum distance between pull posts, corner panels, or end panels is 500 feet.

- b. Provide brace posts in line with fence similar to corner panel shown on drawings.
            - 1) For metal posts, weld a brace post to both sides of line post and anchor in concrete as shown on drawings.
  3. Changes in alignment:
    - a. Angle of deflection 30 degrees or more: Install corner posts and bracing at deflection points.
    - b. Angle of deflection less than 30 degrees: Install bracing where shown on drawings.
    - c. Curves: Install brace posts within rights-of-way perpendicular to fence as shown on drawings.
  4. Metal posts: Approved band and socket-type connectors may be used to connect brace posts to line posts in lieu of welding brace posts to line posts. Bolt or pin socket to brace posts.
- C. Wire:
1. Draw tight and fasten securely to each post. Drive staples diagonally to grain of timber posts in a manner to hold wire securely without causing bends or nicks in wire.
  2. Wire stays: Place as shown on drawings.
  3. Wire placement:
    - a. Tangents: Place wire on sides of posts away to match existing fence.
    - b. Curves: Place wire on sides of posts away from center of curve.
  4. Grade changes where wire tension tends to pull posts from ground, includes stream channels:
    - a. Anchor fencing at critical point with double strand of No. 8 gauge wire connecting each horizontal line of fence wire to a concrete deadman.
    - b. Concrete deadman: Weighing not less than 100 pounds and buried with 2 feet minimum cover.

### **3.03 PIPE GATES INSTALLATION**

- A. Embedded Pipe Posts:
1. Accurately locate posts to be embedded in concrete. Hold posts in correct position and alignment and protect posts from damage and displacement during placing and setting of concrete.
  2. Unless otherwise specified, use only metal braces, supports, and other items to position and align embedded posts, which will be embedded in concrete. Do not

use wooden braces, supports, or other items to position and align embedded posts if they will also be embedded in concrete.

3. Clean surfaces of posts to be in contact with or embedded in concrete or grout in accordance with SSPC-SP7 NACE No.4.
4. Weld chain links as required for attaching wire strands of existing fence to gate posts.

B. Installer's Galvanizing Repair:

1. Repair damaged surfaces of galvanizing due to field welding or during installation in accordance with Section 09 96 20 - Coatings.

C. Gate Posts:

1. Install posts plumb in concrete anchor footing as shown on drawing.
2. Fill posts with concrete and trowel top of support post round for water drainage.
3. Do not install gate or apply loads to posts until concrete has set for 14 days.

D. Reflector:

1. Reflective Sheeting: ASTM D 4956, Type III.
2. Attach as directed by COR or BIA Representative for visual warning to vehicle traffic.

E. Gate Leaf Frames:

1. Set level.
2. Test for smooth operation.

F. Place cattle guard according to manufactures installation requirements.

**3.04 REPAIR OF FENCE MATERIALS**

- A. Repair damage to zinc coatings in accordance with Section 09 96 20 – Coatings.

**3.05 TESTING AND ADJUSTING**

- A. After installation, test and adjust gates for proper operation.

**END OF SECTION**

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**SECTION 32 31 40**  
**EROSION CONTROL**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
1. Lump sum price offered in the schedule.

**1.02 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
1. ASTM D 6461-99(2007) Silt Fence Materials
  2. ASTM D 6462-03(2008) Silt Fence Installation

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 32 31 40-1, Silt Fence Certification:
1. Certify silt fence materials in accordance with ASTM D 6461.

**PART 2 PRODUCTS**

**2.01 SILT FENCE**

- A. ASTM D 6461.
- B. Recovered Material Content: 60 percent minimum.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Erect fence at location shown on drawings.
- B. Install in accordance with ASTM D 6462.

**3.02 MAINTENANCE**

- A. Inspect and maintain installed fence in accordance with ASTM D 6462.

B. Promptly repair or replace damaged fence.

**3.03 REMOVAL**

A. Remove fence in accordance with ASTM D 6462 when no longer required. Undamaged fence materials may be reused at other locations.

B. At completion of work, dispose of removed fence materials in accordance with Section 01 74 00 – Cleaning and Waste Management.

**END OF SECTION**



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**SECTION 32 91 19**  
**REVEGETATION**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Placing Topsoil:
1. Measurement: Volume of topsoil measured to lateral dimensions at 1 foot thickness or as directed by COR or BIA Representative.
    - a. Will not include Contractor use areas.
  2. Payment: Cubic yard price offered in the schedule.
- B. Topsoil Erosion Control Matting:
1. Measurement: Surface area required to be covered, except no allowance will be made for overlaps, repairs, or waste.
  2. Payment: Square yard price offered in the schedule
- C. Seeding and Soil Supplements:
1. Measurement: Surface area of areas with established vegetation measured to lateral dimensions directed by COR or BIA Representative.
  2. Payment: Acre price offered in the schedule.
- D. No payment will be made for seeding stockpile and Contractor use areas.
- E. No payment will be made for seeding surfaces outside of prescribed excavation lines.

**1.02 DEFINITIONS**

- A. Pure live seed (PLS) content: Weight of seed times percent purity times percent germination.

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 - Submittals.
- B. Seeding and Soil Supplements:
1. RSN 32 91 19-1, Seeding Plan:
    - a. Qualifying experience of person responsible for supervision of seeding. Include names, addresses, and telephone numbers of references.
    - b. Name and address of seed suppliers.

- c. Describe equipment and methods to be used for seedbed preparation, seeding, fertilizer application, and mulching.
    - d. Plan describing approach to establish vegetation, including watering and Contractors Quality Control plan.
    - e. Include fertilizer description and application rate.
  2. RSN 32 91 19-2, Certifications:
    - a. Origin of seed.
    - b. Percent purity and germination.
    - c. Certificate demonstrating viability from provider.
    - d. Prohibited and restricted weed seed content.
- C. Topsoil Erosion Control Matting
  1. RSN 32 91 19-3, Sample:
    - a. Size: 1 square yard.
  2. RSN 32 91 19-4, Manufacturer's Information:
    - a. Manufacturer's literature listing specified essential characteristics.
    - b. Manufacturer's installation instructions.
  3. RSN 32 91 19-5, Installation Plan:
    - a. Describe sequence of placing matting.

## **1.04 DELIVERY STORAGE AND HANDLING**

- A. Seed Containers:
  1. Sealed.
  2. Stored according to providers recommendations
  3. Labeled:
    - a. Identify seed origin on label.
      - 1) Intrastate shipping: In accordance with Navajo Nation Seed Laws and Regulations.
      - 2) Interstate shipping: In accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

## **PART 2 PRODUCTS**

### **2.01 SEED**

- A. Weed seeds classified by the Navajo Nation.

1. Prohibited noxious weeds: None.
  2. Restricted noxious weeds: 0.5 percent maximum, by weight.
- B. Seed Mixture:
1. Purity, minimum: 85 percent.
  2. Germination, minimum: 85 percent.
    - a. Germination test: Less than 1-year old at time of seeding.
  3. Uniform mixture shown in Table 32 92 19A - Seed Mixture.

Table 32 92 19A - Seed Mixture

SPECIES	CULTIVAR	POUNDS/PLS/ACRE
Alkali Sacaton		2.0
Galleta	Viva	2.0
Indian Ricegrass	Paloma	3.0
Western Wheatgrass	Arriba	3.0
Needle and Thread		2.0
Scarlet Globemallow		0.5
TOTAL PLS/ACRE		12.5

## 2.02 FERTILIZER

- A. Suitable fertilizer high in phosphorus and potassium which will promote root development and initial growth of plants.

## 2.03 STRAW MULCH

- A. Wheat or barley straw.
- B. Free of mold or other evidence of decomposition.
- C. Free from weed seed.

## 2.04 HYDROMULCH

- A. Mat-Fiber Plus manufactured by Mat Incorporated, 12402 Hwy 2, Floodwood, MN 55736; or equal, having the following essential characteristics:
  1. Wood cellulose fiber.
  2. No germination or growth inhibiting factors.
  3. Dyed appropriate color to allow visual metering of application.
  4. Evenly dispersed and suspended when agitated in water.

5. Forms blotter like ground cover that readily absorbs water and allows infiltration to underlying soil.

## **2.05 TACKIFIER**

- A. Mixture of at least three specially blended compatible hydrocolloids.
  1. One hydrocolloid will act as a slippery agent during suspension.
  2. Will form loose, long-chain-like film on drying
  3. No growth or germination inhibiting factors.
  4. Hydrates and disperses in circulating water to form homogeneous slurry.
  5. Equilibrium air dry moisture content at time of manufacture of 8 percent, plus or minus 2 percent.
  6. Minimum water holding capacity: 6-1/2 times weight of dry material.

## **2.06 TOPSOIL**

- A. Selected materials stripped and stockpiled in accordance with Section 31 14 10 – Stripping.

## **2.07 TOPSOIL EROSION CONTROL MATTING**

- A. AEC Premier Coconut topsoil erosion control matting, as manufactured by American Excelsior Company, 850 Avenue H East, Arlington, TX, Telephone 800-777-7645, or equal, having the following essential characteristics:
  1. Machine-assembled mat with 100 percent aspen or coconut excelsior within two layers of netting stitched to form a three-dimensional matrix.
    - a. Netting: Jute or other natural biodegradable fiber.
  2. Consistent thickness with aspen or coconut excelsior curled, interlocked, and evenly distributed over entire area of mat.
  3. Excelsior color: Green.
  4. Minimum dry unit weight: 8 ounce per square yard.
  5. Thread pattern: 4-inch wide by 4-inch long.
  6. Thickness, minimum: 1/2-inch.
- B. Supply matting in protected, rolled mat form.

## **2.08 ANCHORS**

- A. Biodegradable staples, 6-inch minimum length, as recommended by manufacturer.

---

## **PART 3 EXECUTION**

### **3.01 PLACING TOPSOIL**

- A. Place and spread selected topsoil material on the following areas.
  - 1. Areas disturbed for permanent construction.
  - 2. Material borrow areas.
  - 3. Disposal areas for excavated materials.
  - 4. Contractor use areas.
  - 5. Stockpile areas.
  - 6. Auxiliary spillway channel as shown on drawings.
  - 7. Other areas as directed by COR or BIA Representative.
- B. Till agricultural areas prior to placing topsoil.
- C. Scarify surfaces to receive topsoil.
- D. Transport and place topsoil to cover excavated and borrow areas that are to be seeded to a minimum depth of 4-inches uniformly spread to maximize use of topsoil or as shown on drawings.
- E. Transport and place topsoil to form 4-inch thickness, minimum, on top of finished earthwork surfaces.
- F. Spread remaining topsoil over other areas as directed by COR or BIA Representative.
- G. Do not compact topsoil.
- H. Minimize equipment travel over placed topsoil.

### **3.02 TOPSOIL EROSION CONTROL MATTING INSTALLATION**

- A. Install topsoil erosion control matting on all seeded access road slopes steeper than 3:1 or as directed by COR or BIA Representative and in accordance with manufacturer's recommended installation procedures and submitted, approved installation plan.
- B. At overlaps, shingle the upstream matting over the downstream matting.
- C. Secure topsoil erosion control matting in a 6- by 6-inch anchor trench at top and bottom of berms and at upstream and downstream ends of mats.
- D. Before backfilling anchor trenches, pin or staple the topsoil erosion control matting into anchor trench no more than 12-inch spacing as recommended by manufacturer.

- E. Outside the anchor trench, anchor topsoil erosion control matting with 3 to 4 staples per square yard as recommended by manufacturer.

### **3.03 AREAS TO BE SEEDED**

- A. Seed following areas as directed by COR or BIA Representative.
  - 1. Areas disturbed for permanent construction.
  - 2. Disposal area for excavated materials.
  - 3. Stockpile and Contractor use areas.

### **3.04 SEEDBED PREPARATION**

- A. Scarify or harrow and rake topsoil to minimum depth of three inches.
- B. Contour area so furrows cross water flow caused by rainfall or snowmelt.
- C. Fill and smooth topsoil surface to remove rills, gullies and depressions.
- D. Prepare clean and firm seedbed.
  - 1. Disk a maximum of two times.
  - 2. Create suitable soil conditions for seed adherence.
  - 3. Break down dirt clods.
  - 4. Remove stiff clods, lumps, roots, litter, stones, and other foreign material greater than 6 inches in size from the surface. Dispose of removed materials in accordance with Section 01 74 00 – Cleaning and Waste Management.
- E. Protect prepared seedbed from erosion and washouts. Repair damaged surfaces before seeding.

### **3.05 SEEDING**

- A. Seeding Method:
  - 1. Drilling followed by mulching or hydroseeding followed by hydromulching.
  - 2. Broadcast seeding may be used in areas that are not accessible for drilling or hydroseeding.
- B. Apply seed mixture at rate specified in Table 32 92 19A - Seed Mixture.
- C. Seed between November 1<sup>st</sup> and December 15<sup>th</sup> of each year or as directed by the COR or BIA Representative.
- D. Do not seed or fertilize when ambient temperature is below 38 degrees Fahrenheit without approval of the COR or BIA Representative.

- E. Do not seed or fertilize when ground is snow covered.
- F. Do not seed, fertilize, mulch, or hydroseed when wind velocities prevent uniform application of materials or would drift materials.

### **3.06 DRILLING SEED**

- A. Regulate drill to uniformly distribute seed at rate specified and cover with soil depth of 1/4-inch to 1/2-inch.
- B. Apply seed and fertilizer separately.
- C. Seed on contour.
- D. Drill crosswise to general slope where possible to safely operate equipment.

### **3.07 MULCHING**

- A. Spread within 2 days of spreading seed.
- B. Rate: 2 tons per acre uniformly spread
- C. Anchor with threader.
  - 1. Operate crosswise to slope.
  - 2. Depth: 3 to 4 inches.
  - 3. Interval: 6 to 12 inches across slope.

### **3.08 HYDROSEEDING**

- A. Seed Slurry:
  - 1. Mix to keep homogeneous.
  - 2. Ingredients:
    - a. Water.
    - b. Seed.
    - c. Wood cellulose fiber mulch:
      - 1) Rate: 1,000 pounds per acre at 10 percent moisture content.
      - 2) Add to water slurry after seed.
    - d. Fertilizer may be applied with hydroseeding.
  - 3. Maximum time between batching slurry and application: 1-hour.
- B. Spray apply seed slurry mix uniformly.
- C. Use mulch coloring as metering agent.

- D. Apply seed slurry before mulch slurry.

### **3.09 HYDROMULCHING**

- A. Mulch Slurry:

1. Mix to keep homogeneous.
2. Ingredients:
  - a. Water.
  - b. Tackifier.
  - c. Wood cellulose fiber mulch: 3,000 pounds per acre at 10 percent moisture content.
  - d. Nitrogen fertilizer may be applied with hydromulching.
3. Maximum time between batching slurry and application: 1-hour.

- B. Spray apply mulch slurry mix uniformly.

- C. Use mulch coloring as metering agent.

- D. Apply mulch slurry within 24 hours after applying seed.

### **3.10 BROADCAST SEEDING**

- A. Apply seed and fertilizer separately.

- B. Mechanical broadcasting:

1. Equipment:
  - a. Centrifugal type.
  - b. Pull type similar to fertilizer spreader.
2. Designed and regulated to apply seed uniformly at proper rate per acre.

- C. Hand Broadcasting:

1. By hand broadcaster.
2. By hand.
3. Uniformly applied.

- D. Cover seed with soil to depth of 1/4-inch to 1/2-inch immediately after broadcasting.

1. Use hand rake or float.
2. Do not use log chain or similar device.



### **3.11 ACCEPTANCE**

- A. Acceptance of seeded areas will be granted when a uniform stand of acceptable grass is obtained, with a minimum of 75 percent coverage. Portions of the seeded areas may be accepted at various times at the discretion of the COR or BIA Representative.
- B. Unacceptable seeded areas: Reseed as specified and fertilized at one-half the specified rate.

### **3.12 REPAIR**

- A. Repair or replace any damaged during installation topsoil erosion control matting at Contractor's expense.

**END OF SECTION**

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**SECTION 33 09 12**  
**SONIC FLOWMETER SYSTEMS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Sonic Flowmeter Systems:
1. Payment: Lump sum price offered in the schedule.

**1.02 REFERENCE STANDARDS**

- A. American Society of Mechanical Engineers (ASME)
1. ASME B16.5-2009 Pipe Flanges and Flanged Fittings: ½-inch Through 24-inch
- B. National Electrical Manufacturer's Association (NEMA)
1. NEMA 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 33 09 12-1, Approval Data:
1. Commercial products data for flowmeter, transmitter, and transient protection unit for the signal line. Include manufacturer's name, model number, and specifications that illustrate each component meets these specification requirements.
  2. Detailed installation instructions and drawings showing installation details, detailed dimensions, and locations of conduit connections. Include manufacturer's instructions for attaching flowmeter to pipes and cabling to flowmeter display transmitter.
  3. Schematic and wiring diagrams for all electrical equipment as required by Division 26 – Electrical.
- C. RSN 33 09 12-2, Final Data:
1. Service Manuals: Bound service manuals containing complete parts identification lists, and detailed instructions for installation, operation, and maintenance of flowmeter systems.
  2. Hard copy of the parameters program.

D. RSN 33 09 12-3, Simulated Test Report:

1. Field test report of the simulated field test for each sonic flowmeter system.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Protect all equipment from corrosion, deformation and other types of damage during shipping, storage, and handling.

**PART 2 PRODUCTS**

**2.01 SONIC FLOWMETER SYSTEMS**

A. Design Requirements:

1. One sonic flowmeter system capable of measuring open channel and pressurized flow in the 24-inch diameter and 30-inch diameter steel pipes in the outlet works control structure.
2. Refer to system pipe parameters tabulated in Table 33 09 12A – System Pipe Parameters.

Table 33 09 12A – System Pipe Parameters

Pipe Size, O.D.	24 inches	30 inches
Pipe Thickness	1/4-inch	1/4-inch
Pipe Material	Carbon Steel	Carbon Steel
Minimum Flowrate	0 ft <sup>3</sup> /sec	0 ft <sup>3</sup> /sec
Maximum Flowrate	64 ft <sup>3</sup> /sec	140 ft <sup>3</sup> /sec
Velocity Range (for accuracy requirements)	1 to 33 ft/sec	1 to 33 ft/sec
Design Maximum Pipe Pressure	150 lb/in <sup>2</sup>	150 lb/in <sup>2</sup>

B. Remote Flowmeter Panel:

1. One remote panel for both flowmeters. Transmitters to provide the following essential characteristics:
  - a. LCD display: 3/8-inch characters, 2-line, 16-character backlit alphanumeric to indicate flow units and total flow. All menu commands are visible on display.
  - b. Minimum outputs: Analog 4-20 mA, digital scaled pulse (totalizer), digital scaled frequency (flowrate), and digital port RS232.
  - c. Non-volatile EPROM memory.
  - d. Microprocessor based with integrated keypad.
  - e. Display readout to simultaneously display flowrate and totalized flow.

- f. User selectable flow measurement units of cubic feet per second (ft<sup>3</sup>/sec) and gallons per minute (gal/min) for flowrate. Four-digit minimum display of flowrate in ft<sup>3</sup>/sec with least significant digit in tenths of a ft<sup>3</sup>/sec. Six-digit minimum display for flowrate in gal/min with least significant digit of one gal/min.
  - g. Internal flow totalizer that totalizes volume (acre-feet) of water flow over time. Nine-digit minimum display of totalized volume in acre-foot with least significant digit in hundredths of an acre-foot. Totalizer retains totalized value upon loss of power.
  - h. Analog output: Isolated type output. Provide a minimum of one 4 to 20 mA output for flowrate linear to their respective flows listed in Table 33 09 12A - System Pipe Parameters.
  - i. Suitable for operation with 24-volt dc power supply.
  - j. Remote (wall mounted) flowmeter transmitters in a NEMA 250, type 4X enclosure, with visible display.
  - k. Two acoustic paths per conduit with flow depth sensor for measuring open channel flows.
- C. Manufacturer and Model: Accusonic Model 8510 Flowmeter console with Model 7622/7665 Feedthrough Transducer Assemblies, as manufactured by ADS Environmental Services, 1300 Meridian Street, Suite 3000, Huntsville, AL 35801, Telephone 800-633-7246, or approved equal.
- D. Provide cable between each flowmeter and their respective remote transmitter of the type specified by the flowmeter manufacturer that is suitable for pulling through conduit. Determine exact cable lengths and locations of conduit. Cable splicing not allowed.
- E. Provide brackets, supports, and mounting hardware required to install equipment.
- 2.02 ELECTRICAL**
- A. Furnish all electrical wiring and cable in accordance with Section 26 05 20 – Conductors and Cables.
- B. Furnish power supplies, electrical boxes, and accessories that are required to install signal transmitters in accordance with Section 26 05 02 – Basic Electrical Materials and Methods.
- C. Furnish conduit required to install the flowmeters and signal cables in accordance with Section 26 05 19 – Electrical Conduit.

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## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

#### **A. Flowmeter and Transducers:**

1. Install in accordance with manufacturer's instructions.
2. Install the transducers in the outlet works meter vault as indicated on drawings.
3. Install the remote transmitters to the wall of the outlet works/EWS control structure near the control board enclosure. Mount the transmitters to position the visible display at a height of approximately 54 inches above the grating.

#### **B. Electrical:**

1. Install electrical wiring, shielded telemetry cable, conduit, power supplies, electrical boxes, terminal blocks, and necessary accessories that are required to complete the installation in accordance with Division 26 – Electrical.
2. Make all electrical connections between the flowmeters, remote transmitters, and the distribution panel board.

### **3.02 CONTRACTOR FIELD QUALITY TESTING**

#### **A. General:**

1. Perform after complete installation of the flowmeter systems.
2. Shall be witnessed by the COR or BIA Representative.
3. Manufacturer's representative shall be present for setup, calibration, and testing.
4. Furnish equipment and hardware necessary for complete testing. Tests to be performed by the flowmeter manufacturer's representative.
5. Make appropriate corrections and adjustments to equipment to correct deficiencies found during testing.
6. Retest as required until COR and/or BIA Representative is satisfied that equipment meets specification requirements.

#### **B. Simulated Test Procedure (for each flowmeter system):**

1. Apply simulated flow signal inputs. Simulated signals to cover minimum and maximum flows over velocity range listed in Table 33 09 12A – System Pipe Parameters.
2. Check displays for correct readouts, and check each I/O (input/output) point for correct I/O signal.
3. Test each output connection for correct input conformance.
4. Verify that all instrumentation and indication devices function properly. Test all functions of each flowmeter transmitter for correct operations.

5. Submit field test reports with Final Data.

**END OF SECTION**

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**SECTION 33 11 11**  
**IRRIGATION SYSTEM**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Irrigation System:

1. Payment: Lump sum price offered in the schedule.
  - a. Includes:
    - 1) Feeder Pipe, Lateral Pipe, and Risers.
    - 2) Fittings.
    - 3) Valves.
    - 4) Utility Vault.
    - 5) Pump.
    - 6) Required Excavations.
    - 7) Backfill.

**1.02 REFERENCE STANDARDS**

A. ASTM International (ASTM)

- |    |                            |  |
|----|----------------------------|--|
| 1. | ASTM A 36/A 36M-08         | Carbon Structural Steel  |
| 2. | ASTM A 283/A 283M-03(2007) | Low and Intermediate Tensile Strength<br>Carbon Steel Plates   |
| 3. | ASTM E 165-09              | Liquid Penetrant Examination   |
| 4. | ASTM F 412-09              | Terminology Relating to Plastic Piping<br>Systems  |
| 5. | ASTM F 714-12              | Polyethylene (PE) Plastic Pipe (DR-PR)<br>Based on Outside Diameter  |
| 6. | ASTM F 2206-11             | Fabricated Fittings of Butt-Fused<br>Polyethylene (PE) Plastic Pipe, Fittings,<br>Sheet Stock, Plate Stock, or Block Stock |
| 7. | ASTM F 2620-11             | Heat Fusion of Polyethylene Pipe and<br>Fittings   |

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 33 11 11-1, Approval Data:

1. Excavation plan:
  - a. Method for supporting open trench walls.
2. Installation plan:
  - a. Manufacturer's installation instructions.
  - b. Method to protect pipe and hold pipe in place during backfill.
  - c. Method for working backfill material under haunches.
  - d. Method for cleaning pipe after installation.
  - e. If the Contractor proposes to use construction equipment that exerts a load greater than H-20 loading on the top of the pipe, submit details of the proposed methods, crossing location, equipment type, loading conditions, and other pertinent details.

C. RSN 33 11 11-2, Shop Drawings:

1. Show fitting fabrication details.

D. RSN 33 11 11-3, Fusion Procedures:

1. Fusion temperature.
2. Interface pressure.
3. Cooling time.

**1.04 QUALIFICATIONS**

- A. Pipe Laying Workers: Skilled and experienced in laying pipe with butt fusion joints.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

1. Before shipping, install internal supports in pipe to maintain circularity.
2. Supports:
  - a. Two members at 90 degrees to each other.
  - b. Minimum member cross section: Nominal 2 by 4 inches.
3. Place supports at 5 feet from ends of each pipe section.
4. Orient support legs in same axis along pipe centerline.

- B. Transport fittings with padded bolsters between the pipes. Use heavy padding under ties.

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## **1.06 EXCAVATION SAFETY**

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with requirements of the Occupational Safety and Health Act's (OSHA) excavation safety standards (29 CFR 1926.650 Subpart P) and State requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Contractor is solely responsible for making all excavations in a safe manner. Provide appropriate measures to retain excavation side slopes and prevent caving and rockfalls and ensure that persons in or near the excavation are protected.
- C. Design, install, and maintain shoring, sheeting, bracing, and sloping in areas indicated on the Drawings and as necessary to support the sides of the excavations, to keep and prevent any movement that may damage adjacent structures or foundation, damage or delay the Work, or endanger life and health. Install and maintain shoring, sheeting, bracing, and sloping as required by OSHA and other applicable governmental regulations or agencies. Shoring design must be stamped by a New Mexico Registered Professional Engineer.

## **PART 2 PRODUCTS**

### **2.01 PIPE**

- A. HDPE Pressure Pipe: ASTM F714
  - 1. Material: PE 4710.

### **2.02 FITTINGS**

- A. HDPE Fittings: Tees, crosses, tapers, reducers, adaptors, couplings, bends, and connections at structures in accordance with ASTM F 2206.
  - 1. Material: PE4710.
- B. HDPE Tapping Sleeve:
  - 1. Tapping Sleeves shall be the high strength type having a wide body, made of a minimum material strength of ASTM 285 Grade C, ASTM A-36 Steel or equal, which conforms to and reinforces the pipe. The sleeve shall have as a minimum 7/8" wide gasket of Nitrile Butadiene Rubber (NBR, Buna-N) per ASTM D2000 with hydromechanical activated lip, captured in a recessed groove around the outlet; 3/4" corrosion resistant alloy bolts per ASTM A242/ANSI 21.11/AWWA C111 and nuts (per A563) or equal, and a 3/4" forged steel test outlet. Flanged outlet shall be AWWA C207 Class D, ANSI 150 lb. drilling, recessed for tapping valve per MSS-SP60, outlets 2" - 12" rated for 175 PSI\* maximum operating pressure. Tapping Sleeve shall be furnished with corrosion resistant shop coat paint primer.
  - 2. Tapping Sleeves shall be JCM 412 or approved equal.

C. HDPE Blind Flange:

1. IPS conforming to ANSI B16.5, B16.47, and AWWA C207

D. HDPE Flange Adapter:

1. IPS conforming to AWWA C901 or C906

## 2.03 VALVES

A. Ball Valves:

1. Ball valves shall be of the floating-ball design capable of providing bi-directional, tight shutoff in accordance with MSS SP-72. The valves shall be rated at 125# WSP/200# WOG. Bodies shall be of cast iron per ASTM A126 Class B, with ANSI Class 125 flat-face flanges. The interior and exterior of the body shall be epoxy-coated. The ball shall be PFA infused cast iron, with a stainless steel blowout-proof stem. The seats and body seals shall be PTFE. The stem seal shall be PTFE, externally adjustable chevron type. Valves shall be equipped with locking handles as standard.
2. Ball valves shall be the Series 4000 as manufactured by American Valve, Inc. or approved equal.

## 2.04 UTILITY VAULT

A. Fiberglass Vault:

1. Utility Vault shall be Armorcast A6001506AX54MT or approved equal.
2. Provide torque assist style of lid for ease of operation.

## 2.05 PUMP

A. Portable Diesel-Powered Self-Priming Pump:

1. Pump shall be capable of providing flowrate of 600 gpm at a total dynamic head of 40 feet.
2. Pump shall be Godwin CD150M or approved equal.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish the Work. Excavate within tolerance of plus or minus 0.1 foot except where dimensions or grades are shown or specified as maximum or minimum. Allow for working space, topsoil, and similar items, wherever applicable.
- B. Do not excavate beyond the lines and grades shown without written authorization of Engineer.

- C. Excavation for trenches shall be performed in the dry.
- D. Sequence and coordinate excavation and backfill activities to allow time for drying of wet materials and moisture conditioning of dry materials prior to placement.
- E. Selectively excavate, handle, haul, stockpile and process excavated materials as necessary to yield suitable type and sufficient quantity of backfill materials required for construction of the Work. See Section 31 23 23 – Excavation and Section 31 24 00 – Fill and Backfill.

### **3.02 MOISTURE CONDITIONING OF EXCAVATED MATERIAL**

- A. To the maximum extent practicable, dry wet materials in advance of excavation.
- B. Moisture condition excavated materials at the point of excavation when removed materials will be subsequently placed as backfill.

### **3.03 TRENCH WIDTH**

- A. Minimum trench width: 18 inches greater than outside diameter or width of pipe.
- B. Maximum trench width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work, or will extend outside of work limits.

### **3.04 PRE-INSTALLATION TESTING**

- A. Prior to joining pipe sections, demonstrate quality of joining method, equipment, and personnel.
  - 1. Construct 3 butt-fused pipe sections to length specified in ASTM D 2657.
  - 2. Prior to preparing cutting strips for bent strap test specimens, COR or BIA Representative will visually examine joint for defects. Beads will be examined for uniformity and proper size around entire joint.
  - 3. From each sample, prepare 3 bent strap test specimens for destructive testing in accordance with ASTM D 2657 using sample dimensions specified in standard.
    - a. Cut joints into straps as indicated in standard.
    - b. Test joints as directed by COR or BIA Representative to demonstrate sample response to face bend, outside face bend, tensile elongation, torque, and impact when compared to a control sample.
- B. Do not proceed with pipe joining until COR or BIA Representative has approved butt fusion quality.

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### **3.05 INSTALLATION**

- A. Install and join pipe in accordance with manufacturer's recommendations and as indicated on drawings.
- B. Backfill around pipe as shown on drawings and in accordance with 31 24 00 – Fill and Backfill.
- C. Join pipe by heat fusion in accordance with ASTM D 2657 and manufacturer's instructions. Examine joints for defects.
- D. Remove interior beads caused by pipe welding process from containment pipe prior to joining next section of pipe.
  - 1. Use tools and methods recommended by pipe manufacturer.
  - 2. Use skilled workmen to perform bead removal. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled to remove beads without damaging pipe and joint at beginning of pipe joining.
- E. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled in use of hand-held extrusion welder before use of welder in work.
- F. Maintain in correct position and alignment during installation and subsequent construction operations.
- G. Keep interior of pipes free of embankment materials, concrete, dirt, and foreign materials.

### **3.06 CONTRACTOR FIELD QUALITY TESTING**

- A. Hydrostatic Test:
  - 1. Hydrostatic testing shall be performed prior to backfilling.
  - 2. Hydrostatically test pipe to 50 pounds per square inch before placement of backfill around pipe.
  - 3. Use clean water with temperature of 70 degrees Fahrenheit or less.
  - 4. Maintain pressure in pipe for 3 hours and examine installation for leaks during test.
  - 5. Correct defects identified by test in manner approved by manufacturer and COR or BIA Representative.
  - 6. Provide all pressure testing heads, pumps, gauges, and other equipment necessary to perform tests.

### **3.07 CONTRACTOR FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services:

1. Arrange for pipe manufacturer's representative to perform following field services at jobsite:
  - a. Verify proper equipment and methods will be used in work before work begins.
  - b. Observe pre-installation bent strap tests.
  - c. Observe pipe joining and bead removal and verify proper joining of pipe sections.
  - d. Observe installation and hydrostatic testing of pipes.
  - e. Recommend methods to correct defects.

**END OF SECTION**

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**SECTION 33 46 36**  
**TOE DRAIN PIPES AND CLEANOUTS**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. 12-Inch Diameter Perforated HDPE Drain Pipe:
  - 1. Measurement: Length of pipe installed.
    - a. Length along pipe centerline between ends in place.
    - b. No allowance for lap at joints.
  - 2. Payment: Linear foot price offered in the schedule.
  
- B. 12-Inch Diameter Non-perforated HDPE Drain Pipe:
  - 1. Measurement: Length of pipe installed.
    - a. Length along pipe centerline between ends in place.
    - b. No allowance for lap at joints.
  - 2. Payment: Linear foot price offered in the schedule.
  
- C. Drain Cleanouts:
  - 1. Measurement: Number of drain cleanouts installed.
  - 2. Payment: Drain cleanout price offered in the schedule.
    - a. Includes steel pipe and locking cap and cover.

**1.02 REFERENCE STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M 252-09 Corrugated Polyethylene Drainage Pipe
  - 2. AASHTO M 294-10 Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter
  - 3. AASHTO SSHB-02 Standard Specifications for Highway Bridges, Seventeenth Edition
  
- B. ASTM International (ASTM)
  - 1. ASTM A 53/A 53M-10 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 2. ASTM F 477-10 Elastomeric Seals (Gaskets) for Joining Plastic Pipe

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- |    |                |  |
|----|----------------|--|
| 3. | ASTM F 714-12a | Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter  |
| 4. | ASTM F 2206-11 | Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock |
| 5. | ASTM F 2620-11 | Heat Fusion of Polyethylene Pipe and Fittings  |

### **1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 33 46 36-1, Approval Data:
1. Excavation plan:
    - a. Method for supporting open trench walls.
  2. Pipe data:
    - a. Details and materials for pipe connections and anticipated field fabricated joints.
  3. Installation plan:
    - a. Manufacturer's installation instructions.
    - b. Method for connecting pipes to inspection wells.
    - c. Method to protect pipe and hold pipe in place during backfill.
    - d. Method for working backfill material under haunches.
    - e. Method for cleaning pipe after installation.
    - f. If the Contractor proposes to use construction equipment that exerts a load greater than H-20 loading on the top of the pipe, submit details of the proposed methods, crossing location, equipment type, loading conditions, and other pertinent details.
  4. Testing and inspection plan:
    - a. Details, procedures, and sequences of testing and inspection of drain and outfall.
- C. RSN 33 46 36-2, Certifications:
1. Manufacturer's certification that raw materials and pipe meet specification requirements.
  2. Certifications that filter and drain materials meet specifications.
- D. RSN 33 46 36-3, Samples:
1. Three, 1-foot long samples of each size of perforated pipe and non-perforated pipe sampled from each lot of pipe to be used in work.

2. Label each sample with project name, specifications number, manufacturer's name, product name, date of manufacture, and manufacturer's lot identification number.
  3. Ship samples to COR and the BIA Representative:
- E. RSN 33 46 36-4, Survey Reports:
1. Location (northing, easting, station, offset, and elevation) of pipe, inspection wells and weir plates.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Pipe:
1. Store and handle in accordance with manufacturer's recommendations.
  2. Do not use rope, cable, or chain slings for handling pipe. Canvas slings not less than 12 inches wide may be used for handling pipe.
  3. Protect pipe from damage and prevent dirt from getting inside pipe when lowering pipe into trench, laying pipe, and positioning pipe.

### **PART 2 PRODUCTS**

#### **2.01 POLYETHYLENE PIPES**

- A. Perforated and Non-perforated HDPE Pipe, model N-12 WT IB, manufactured by ADS Pipe, 4640 Trueman Boulevard, Hilliard, OH 43026; or equal, having the following characteristic:
1. Pipe: ASTM F 714, SDR 17.
  2. Material: PE4710.
  3. Watertight joining system.
  4. Double walled with a corrugated exterior wall and smooth interior wall.
  5. Color: Gray (or lighter) to facilitate closed circuit television (CCTV) inspection.
- B. Pipe Perforations:
1. Drill perforations in accordance with following:
    - a. Six rows of Class 2 circular perforations at 2-inch spacing conforming to AASHTO M 294.
    - b. Perforation diameter: 3/8-inch.
    - c. Inlet area: 1.5 to 2.0 square inches per foot of pipe.
    - d. Evenly distribute perforations in rows around length and circumference of pipe.
    - e. Remove burrs from drilled holes.

- C. Joining System: Bell and spigot gaskets meeting requirements of ASTM 3212 and ASTM C 969.
- D. Fittings:
  - 1. Includes bends.
  - 2. In accordance with ASTM F 2206.
  - 3. Material: Same as specified for pipe.

## **2.02 OUTFALL SCREEN**

- A. Stainless Steel Wire Cloth:
  - 1. Stainless steel, Type 304 or 316.
  - 2. Mesh openings per linear inch: ½ by ½ .
  - 3. Wire diameter, minimum: .080 inches.
- B. Bands for Screen:
  - 1. Stainless steel, Type 304 or 316.
  - 2. Thickness, minimum: 10 gauge.
  - 3. Width, minimum: 1/2-inch.

## **2.03 DRAIN CLEANOUT**

- 1. Steel Pipes: ASTM A53, standard weight, galvanized, type E or S, Grade B.
- 2. Cover: Specified in Section 05 50 00 – Metal Fabrications.

## **2.04 RUBBER CHECK VALVE**

- A. Style 730 as manufactured by Proco Products, Inc., 2431 North Wigwam Drive, Stockton, CA 95205, 800-344-3246; or equal, having the following characteristics:
  - 1. Sleeve type installation affixed to pipe with heavy-duty stainless steel clamps.
  - 2. NSF61 standard construction.

## **2.05 FILTER SAND AND GRAVEL DRAIN MATERIALS**

- A. Sand Filter and Gravel Drain in accordance will Section 31 24 00 – Fill and Backfill.
- B. Gradations of filter sand and drain material will be verified in-place after compacting filter.

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## **PART 3 EXECUTION**

### **3.01 PIPE INSTALLATION**

- A. Install pipe at locations indicated on drawings or as directed by the COR or BIA Representative using manufacturers recommended installation procedures.
- B. Lay pipe to the elevations, lines, and grades shown on the drawings or as approved.
- C. Cap or plug ends of pipe during periods of no work.
- D. Protect pipe ends from damage. Remove or replace broken, cracked, or unsuitable pipe and replace at no additional cost to the BIA.
- E. Before and during assembly of a joint, keep all parts free of mud, oil, or grease. Keep the pipe interior free from deposits of mud, sand, gravel, or other foreign matter and in good working condition until the contract is complete and accepted.
- F. Joining Pipe:
  - 1. The couplings shall have close fit with the pipe and shall maintain alignment of the pipe and prevent separation of the joints.
  - 2. Join pipe by heat fusion in accordance with ASTM D 2620 and manufacturer's instructions. Examine joints for defects before installation.
- G. Remove interior beads caused by pipe welding process from containment pipe prior to joining next section of pipe.
  - 1. Use tools and methods recommended by pipe manufacturer.
  - 2. Use skilled workmen to perform bead removal. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled to remove beads without damaging pipe and joint at beginning of pipe joining.
- H. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled in use of hand-held extrusion welder before use of welder in work.
- I. Maintain in correct position and alignment during installation and subsequent construction operations.
- J. Angle Points and Curvilinear Drain Alignments:
  - 1. Construct bends using manufacturer's standard pipe bends. Maximum bend shall be 22.5 degrees. A minimum length of 5 feet of straight pipe shall be installed between bends.
  - 2. Making curvilinear alignments in the field by pulling pipe into radius bends will not be allowed.

K. Cover outfall ends of drain pipe with stainless steel screen. Securely attach to end of pipe with stainless steel bands.

L. Keep excavations dry.

### **3.02 BACKFILL**

A. Maintain pipe grade and alignment during placement of material adjacent to and over pipe. Provide complete circumferential support for pipe to prevent uneven pressures and unacceptable ring deflections.

B. Use special compaction techniques adjacent to pipe in accordance with Section 31 24 00 – Fill and Backfill.

C. Fill trenches above drain materials.

D. Do not backfill until installed pipe has been inspected and approved by the COR or BIA Representative.

E. Do not permit equipment travel over pipe until backfill material has been placed to a minimum depth of 3 feet over the top of the pipe, or to a greater depth when recommended by the pipe manufacturer.

1. After minimum earth covers are in place, the maximum equipment loading allowed over the pipe shall be H-20 loading in accordance with the AASHTO SSHB.
2. Before using construction equipment that exerts a load larger than H-20 loading on the top of the pipe, submit details of the proposed methods, crossing location, equipment type, and loading conditions to COR or BIA Representative for approval.

### **3.03 CLEANING TOE DRAIN PIPE**

A. Maintain inside of pipes clean during construction.

B. Before performing final video inspection, clean drain lines and outfalls to remove deposits of mud, sand, gravel or other foreign matter.

C. If inspection indicates more than one cup of material over a 100-foot length of drain pipe the system must be flushed and re-inspected at no additional cost to BIA.

### **3.04 CONTRACTOR FIELD QUALITY TESTING**

A. Hydrostatic Test:

1. Hydrostatically test non-perforated pipe to 50 pounds per square inch before placement of concrete or fill around pipe.
2. Use clean water with temperature of 70 degrees Fahrenheit or less.

3. Maintain pressure in pipe for 3 hours and examine installation for leaks during test.
4. Correct defects identified by test in manner approved by manufacturer and COR or BIA Representative.
5. Provide all pressure testing heads, pumps, gauges, and other equipment necessary to perform tests.

### **3.05 FIELD QUALITY ASSURANCE**

- A. Navajo Nation Safety of Dams (NNSOD) personnel will inspect interior of pipes using closed circuit television (CCTV) equipment as follows:
  1. After installation of containment pipe, entire length of this pipe will be inspected for defects and damage before installation of carrier pipe.
  2. After installation and hydrostatic testing of carrier pipe, entire length of this pipe will be inspected for defects and damage before placement of concrete around containment pipe.
  3. After placement of concrete around containment pipe, entire length of carrier pipe will be inspected for distortion and damage.
  4. After installation and covering of air vent pipe, entire length of this pipe will be inspected for distortion and damage.
  5. After installation and covering of pipe for hydraulic lines, entire length of this pipe will be inspected for distortion and damage before installation of hydraulic lines in pipe.
- B. Coordinate inspections with COR or BIA Representative. Notify COR and BIA Representative, in writing, of date and time pipe will be ready for inspection at least 10 days before inspection is required.
- C. NNSOD will require 8 hours, maximum, for each inspection.
- D. Provide safe access and working conditions for inspections.

### **END OF SECTION**

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**SECTION 33 82 23**  
**OPTICAL FIBER COMMUNICATIONS DISTRIBUTING CABLING**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Cost:
  - 1. Include in price offered in the schedule for Complete Electrical System.

**1.02 REFERENCE STANDARDS**

- A. Institute of Electrical and Electronic Engineers (IEEE)
  - 1. IEEE C2-2002 National Electric Safety Code (NEC)
- B. National Fire Protection Association (NFPA)
  - 1. NFPA 70-2011 National Electrical Code (NEC)

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 33 82 23-1, Approval Data.
  - 1. Manufacturer's technical data sheets.
- C. RSN 33 82 23-2, Pre-installation Test Reports:
  - 1. Test Reports to include:
    - a. Software and paper copy of each trace made during testing.
- D. RSN 33 82 23-3, Post-installation Test Reports:
  - 1. Test Reports to include:
    - a. Software and paper copy of each trace made during testing.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

**1.05 PROJECT CONDITIONS**

- A. Altitude: 7080 feet above sea level.
- B. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

## **PART 2 PRODUCTS**

### **2.01 FIBER OPTIC MODEM**

- A. Type: RS232 to multi-mode fiber optic.
- B. Power: 12 VDC.
- C. Data rate: 19.2 Kbps, minimum.
- D. Wavelength: 850/1300nm multi-mode.
- E. Temperature: Minus 20 degrees Celsius to plus 70 degrees Celsius.
- F. Loss budget: Minimum 12dB at 62.5/125 $\mu$ m.

### **2.02 DOUBLE JACKETED ALL DIELECTRIC MULTI-MODE FIBER OPTIC CABLE**

- A. Cable Type: All dielectric.
- B. Major Cable Components:
  - 1. Inner and outer polyethylene jackets.
  - 2. Inner and outer polyethylene jackets ripcords.
  - 3. Inner polyethylene jacket, filled buffer tubes, and central member wrapped with water-swellable tape or filled with a non-hygroscopic jell.
  - 4. Optical fibers: 12.
  - 5. Water-swellable yarn.
  - 6. Dielectric strength member.
  - 7. Dielectric central member.
- C. Outer Jacket:
  - 1. Medium density polyethylene.
  - 2. Outer jacket label:
    - a. Interval: regular for entire cable length in unbroken pattern.
    - b. Content:
      - 1) Manufacturer's Name.
      - 2) Manufacturer's cable designation.
      - 3) Words "fiber optic cable."
- D. Strength Members: With expansion and contraction characteristics similar to glass fibers.

- E. Buffer Tubes:
  - 1. Protect each fiber in a buffer tube of loose-tube type construction.
  - 2. Color coded.
- F. Optical Fibers:
  - 1. Dimensions (core/cladding): 62.5/125 microns.
  - 2. Attenuation of 1300 nanometer wavelength light: Less than 1.5 decibels per kilometer.
  - 3. Attenuation of 850 nanometer wavelength light: Less than 3.5 decibels per kilometer.
  - 4. Attenuation: Directly proportional to cable length for an arbitrary cable length section after steady state conditions are reached.
  - 5. Color coded.
- G. Cable Core: Symmetrically stranded buffer tubes around dielectric central member.
- H. Cable Tensile Strength:
  - 1. Long term (installed): 135 pounds.
  - 2. Short term (during installation): 600 pounds.
- I. Operating Temperature Range: Must meet project conditions.
- J. Age: 24 months old, maximum.

### **2.03 TERMINATION/SPLICE ENCLOSURE**

- A. Type: Wall-mount.
- B. Single door NEMA 250 Type 4 or Type 4X with splice tray holder, splice tray, adaptor plates, and radius limiters.
- C. Space for mounting RS232 fiber modem outlined in Article 2.01.
- D. Splice Trays (if used):
  - 1. Same manufacturer as termination/splice enclosure.
  - 2. Fusion splice organizer to retain each splice and its shrink tubing.
  - 3. Manufactured for loose tube type fiber optic cable.
- E. Adaptor Plates:
  - 1. Same manufacturer as termination/splice enclosure.
  - 2. Mount at minimum 6 fibers.

3. Use SC connectors.
4. Each SC with 3 meters of multi-mode fiber optic cable if splice trays are used.

#### **2.04 DUPLEX FIBER PATCH CORDS**

- A. Fibers per Patch Cord: Two.
- B. Type Fiber: multi-mode.
- C. Length: 15 feet.
- D. Connectors:
  1. SC on end connected to splice panel.
  2. As required to connect to fiber optic modem.
- E. Loss per Connector: Less than 0.5 dB.

### **PART 3 EXECUTION**

#### **3.01 GENERAL FIBER OPTIC CABLE INSTALLATION**

- A. Comply with NFPA 70 and IEEE C2.
- B. Conduit Installation:
  1. Clean and de-burr each conduit run prior to pulling in cable.
  2. Pull a clean, dry tight-fitting rag through each conduit immediately before installing cable.
  3. Do not cut or abrade cable insulation (outer jacket).
  4. Do not kink cable.
  5. Do not bend cable tighter than recommended bending radius, 15 to 20 diameters for fiber cable.
- C. Install cable without exceeding allowable pulling tensions and sidewall pressures recommended by cable manufacturer.
- D. Lubricant:
  1. Use only as aid to pulling.
  2. Use materials recommended by cable manufacturer.
- E. Clamp cable entry with fiber type cable clamp.
- F. Leave spare fiber in each termination/splice panel.

- G. Leave sufficient fiber to make connection to adaptor plate pigtail.
- H. Retain fibers at each cable end equal in length to longest single fiber.
- I. Tags:
  - 1. Use: Outdoor.
  - 2. Shape: Rectangular.
  - 3. Color: White.
  - 4. Tag fiber cables at each end.
  - 5. Attach tag by self-locking cable ties.
  - 6. Mark tags with cable designation:
    - a. Computer generated lettering.
    - b. As designated on approved drawings.
- J. Block cable opening in conduits and sleeves with silicone-foam, fire-retardant material in accordance with NFPA 70.

### **3.02 FIBER OPTIC CABLE INSTALLATION SITE REQUIREMENTS**

- A. Test fiber optic cable prior to installation for any manufacturing defects.
- B. Install fiber optic cable from termination splice panel in EWS building to termination splice panel in control house. Route cable in 2-inch conduit between the buildings. See conduit layout on drawing 1743-D-235.
- C. Installation at EWS building and downstream Control House:
  - 1. Furnish and install fiber optic modem and termination/splice panel inside of an enclosure in each building at location close to future RUG9 serial modem. The RUG9 serial modem is future equipment in both locations. It will be located inside the DC Control Enclosure in the Control House and inside the existing enclosure in the EWS.
  - 2. Conduit shall be used between the fiber optic termination/splice enclosure and the enclosure for the RUG9 modem. For DC Control Enclosure location in the Control House see drawing 1743-D-284.
  - 3. Furnish and install RS232 cable to connect RUG9 modem to fiber optic modem at each building. Run cable inside conduit.
  - 4. Furnish and install power cable for fiber optic modem at each building. Run cable inside conduit.
  - 5. Connectorize fiber cables and connect to patch panel.
  - 6. Furnish and install patch cords to connect all dielectric fiber cable to fiber optic modem.

- D. Do not splice fiber optic cables outside of termination splice panels.
- E. Coil 15 feet of fiber cable inside each termination splice panel.
- F. Connectorize cable and connect to patch panel inside control house.

### **3.03 SPLICING**

- A. Method: Arc-fusion.
- B. Splices per set of fusion tips: 50.
- C. Splice loss: 0.1 dB, average bi-directional.

### **3.04 FIBER OPTIC CABLE POST-INSTALLATION TESTING**

- A. Test fiber optic cable after installation.
- B. Notify COR and BIA Representative at least 3 days in advance of time of testing. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.
- C. Test each fiber from EWS building to control house using an Optical Time Domain Reflectometer (OTDR):
  - 1. Purpose and intent of testing:
    - a. Determine if installed cable is free from defects.
    - b. Compare measured attenuation with cable manufacturer's specified attenuation of 1.5dB per kilometer for 1300 nanometer light.
    - c. Compare measured bi-directional splice loss with specified splice loss of 0.01dB per splice.
    - d. Compared measured connector loss with specified connector loss of 0.30dB.
    - e. Verify cable length.
  - 2. OTDR requirements:
    - a. Fiber type: Multi-mode.
    - b. Dynamic Range: 25 dB, minimum.
    - c. Operating temperature: 30 to 90 degrees Fahrenheit.
    - d. Resolution: Selectable 0.1 to 10-m.
    - e. Pulse width: Selectable. One for all tests.
    - f. Reflectance accuracy:  $\pm 2$ dB.
    - g. Loss accuracy (Linearity): 0.02dB/dB.
  - 3. Obtain an OTDR waveform for each fiber to:

- a. Determine actual cable length.
  - b. Determine attenuation and splice loss.
  - c. Identify and locate splices and step discontinuities/possible fiber breaks.
- D. Prepare Test Reports:
1. Generate a software copy and paper copy of each trace made during testing for inclusion in the report:
    - a. OTDR waveform for each fiber showing “A” and “B” range marks.
      - 1) Do not move or change location of either mark.
  2. Include an Analysis Summary Results Table for each fiber:
    - a. Indicate numerical values associated with each event.
    - b. Do not use question marks, dashes, or blanks.
  3. Include following information for each trace:
    - a. Trace name.
    - b. Operator’s name.
    - c. Date and time.
    - d. Fiber type being tested.
    - e. Bundle color.
    - f. Fiber color.
    - g. Fiber number.
    - h. Launch reel length.
    - i. OTDR resolution.
    - j. Pulse width.
    - k. Wavelength.
    - l. Index of refraction.
    - m. Averaging number.
    - n. Receiver bandwidth.
    - o. Sampling point count.
    - p. End to end loss, dB.
    - q. Reflectance, dB.
    - r. Fiber Break, dB.
    - s. Backscatter.
  4. Traces to be viewable and reproducible on a PC using Windows XP.

- E. The BIA will review test reports and determine if fiber cable is suitable for its intended purpose.
1. Contractor shall resolve any damage caused during installation.
  2. If defects are found (splices, connectors, discontinuities, etc.), the BIA will determine how to repair the cable.
  3. After segment is repaired by the Contractor as directed by COR or BIA Representative, repeat testing.

**END OF SECTION**



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## SECTION 35 21 10

### TRASHRACKS

#### PART 1 GENERAL

##### 1.01 MEASUREMENT AND PAYMENT

- A. Trashracks:
1. Payment: Lump sum price offered in the schedule.

##### 1.02 REFERENCE STANDARDS

- A. American Institute of Steel Construction (AISC)
1. AISC-S335-1989 Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary, Part of AISC Manual of Steel Construction (M016) – Allowable Stress design, Ninth Edition
- B. ASTM International (ASTM)
1. ASTM A 36/A 36M-08 Carbon Structural Steel
  2. ASTM A 108-07 Steel Bar, Carbon and Alloy, Cold-Finished
  3. ASTM A 276-10 Stainless Steel Bars and Shapes
  4. ASTM C 881/C 881M-10 Epoxy-Resin-Base Bonding Systems for Concrete

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect from corrosion, deformation, and other types of damage.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Structural Steel: ASTM A 36.
- B. Stainless Steel:
1. Bars and shapes: ASTM A 276, Type 304 or 316.
- C. Headed Anchors:
1. ASTM A 108.
  2. Flux-filled stud anchors suitable for end welding to steel with automatic end welding guns or equivalent manually welded anchors.

D. Epoxy Anchors:

1. Stainless steel bolts with epoxy-resin-bonding system: The epoxy-resin-bonding system to conform to ASTM C 881, type 1.

**2.02 FABRICATION**

- A. Provide trashracks and associated metalwork as specified below and in accordance with design drawings.
- B. Details of fabrication per AISC-S335.

**2.03 FINISHES**

- A. Coat trashracks and associated metalwork in accordance with Section 09 96 20 – Coatings.

**2.04 SOURCE QUALITY CONTROL**

- A. After fabrication, inspect the trashracks and associated metalwork in the shop to ensure that the required dimensions and tolerances have been obtained.
- B. Check to ensure that the top trashracks rotate freely on their respective hinges without binding.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Clean surfaces of all metalwork which are to be embedded in concrete immediately prior to embedment.

**3.02 INSTALLATION**

- A. Embed the hinge angles and seat angles as shown on the drawing, and in accordance with installation tolerances. Accurately position the metalwork to the dimensions, elevations, and tolerances shown on the drawing and rigidly support metalwork during embedment.
- B. Drill holes in concrete for installation of epoxy anchors. Drill holes straight and true to the diameter and depth recommended by the manufacturer to provide minimum embedment shown on the drawing. If embedded steel or reinforcement is encountered during drilling, use core drilling in accordance with the manufacturer's recommendation.
- C. If drilling water is used, clean the exposed concrete surfaces immediately after drilling to prevent discoloration.
- D. Check to ensure that the top trashrack panels rotate freely on their respective hinges without binding after embedment.

- E. Make any required changes or adjustments to the satisfaction of the COR or BIA Representative.
- F. After final installation, repair any damage to coatings.

**END OF SECTION**

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**SECTION 35 21 95**  
**STEEL PIPE**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

A. Steel Pipe and Miscellaneous Fittings and Connections:

1. Payment: Lump sum price offered in the schedule.

**1.02 REFERENCES**

A. American Society of Mechanical Engineers (ASME)

1. ASME B16.3–2011 Malleable Iron Threaded Fittings, Classes 150 and 300.
2. ASME B16.5–2009 Pipe Flanges and Flanged Fittings NPS ½ through 24.
3. ASME B16.9–2007 Factory-made Wrought Buttwelding Fittings.
4. ASME B16.11–2011 Forged Steel Fittings, Socket-welding and Threaded
5. ASME B16.39–2009 Malleable Iron Threaded Pipe Unions

B. ASTM International (ASTM)

1. ASTM A 36/A 36M–08 Carbon Structural Steel
2. ASTM A 53/A 53M–12 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded
3. ASTM A 139/A 139M–10 Electric-Fusion (Arc)- Welded Steel Pipe (Sizes 4 In. and over)
4. ASTM A 193/A 193M–12 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High- Pressure Service and other Special Purpose Applications.
5. ASTM A 283/A 283M–07 Low and Intermediate Tensile Strength Carbon Steel Plates

C. American Water Works Association (AWWA)

1. AWWA C200–05 Steel Water Pipe – 6 In. (150 mm) and Larger
2. AWWA C207–07 Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Thru 144 In. (100 mm Thru 3,600 mm).
3. AWWA C219–11 Bolted, Sleeve-Type Couplings for Plain-End Couplings

- D. Commercial Item Description
  - 1. CID A-A-1923A-1995 Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
- E. American Welding Society (AWS)
  - 1. AWS D1.1/D1.1M:2010 Structural Welding Code

### **1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 35 21 95-1, Shop Drawings:
  - 1. Checked, detailed shop drawings which include all dimensions and tolerances, material data, joint details, welding requirements; and all painting, lining, and coating requirements.
- C. RSN 35 21 95-2, Product Data:
  - 1. Pressure gauge, pipe couplings, and anchor bolts.
  - 2. Data that is comprehensive and fully demonstrates that all equipment provided meets the requirements of these specifications.
  - 3. Complete identifying data giving the manufacturer's name, type, model, size, and construction and performance characteristics of the equipment.
- D. RSN 35 21 95-3, Final Drawings and Data:
  - 1. Submit as-built drawings after steel pipe is installed and accepted by the BIA.
  - 2. Provide detailed drawings which clearly show steel pipe sections exactly as they exist after completion, including all dimensions and tolerances, material data, joint details, painting, and welding.
  - 3. Clearly mark drawings to show all field modifications.

## **PART 2 PRODUCTS**

### **2.01 EQUIPMENT**

- A. Steel Plate:
  - 1. ASTM A 283, grade C or D; or ASTM A 36.
- B. Standard and Schedule Steel Pipe:
  - 1. ASTM A 53, grade B.
    - a. Galvanized for pipe less than 4 inches in diameter.
    - b. Black for pipe 4 inches and larger in diameter.

- 
- C. Electric–fusion– (arc–) Welded, Spiral–seam Steel Pipe:
    - 1. ASTM A 139, grade B or C.
  - D. Welding Fittings:
    - 1. ASME B16.9.
  - E. Threaded Fittings:
    - 1. ASME B16.11 or ASME B16.3.
  - F. Unions:
    - 1. ASME B16.39.
  - G. Flanges:
    - 1. AWWA C 207, with flat face finish suitable for flat gasket.
    - 2. ASME B16.5, with flat face finish suitable for flat gasket.
    - 3. Match flange diameter and bolt hole pattern with valve flange for all valve connections.
  - H. Flange Gaskets:
    - 1. Blue–Gard, style 3000, manufactured by Garlok Incorporated, 1666 Division Street, Palmyra, NY 145221, Telephone 877-427-5625; or equal, having the following essential characteristics:
      - a. AWWA C 207, flat, ring type.
      - b. Non-asbestos.
  - I. Flange Bolts and Nuts:
    - 1. AWWA C 207, grade A or B.
  - J. Pipe Couplings:
    - 1. Depend-O-Lok coupling manufactured by Victaulic Depend-O-Lok Incorporated, 2681 Pleasantdale Road, Doraville, GA 30340, Telephone 770-840-0662; or equal, having the following essential characteristics:
      - a. Two–segment type.
      - b. Steel.
      - c. Coupling housing: Arched, two piece, sleeve-type which when closed compresses elastomeric O-ring gaskets beneath arches of sleeve to create radial seal around pipe ends joined inside of coupling.
      - d. Gaskets: Isoprene, ASTM D 2000, suitable for cold-water service.
      - e. Bolts and nuts: Carbon steel, ASTM A 325, minimum tensile strength of 120,000 pounds per square inch.
-

- f. Type E x E or F x F joint, as shown on drawings.
- g. Width:
  - 1) Pipe diameter 8-inch and greater: 10 inches.
- h. Pipe gap: Gap between pipe ends joined by couplings, shall be gap size recommended by coupling manufacturer.
- i. Suitable for pressure of 25 pounds per square inch gauge (psig).

K. Anchor Bolts:

- 1. Expansion anchors or studs with capsule anchors.
- 2. Expansion anchors: CID A-A-1923A, type 4.
- 3. Studs with capsule anchors:
  - a. Parabond manufactured by Molly Division, Emhart Industries Incorporated, 504 Mount Laurel Avenue, Temple, PA 19560; HVA Adhesive Anchor System manufactured by Hilti, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
    - 1) Each stud with capsule anchor: Consist of a stud and a sealed capsule. The stud and capsule shall be the combination recommended by the manufacturer and furnished by the same manufacturer.
    - 2) End of the stud which will be embedded: double cut point.
    - 3) Capsule: Contain premeasured amounts of polyester or vinyl resin, quartz sand aggregate, and hardener. The hardener shall be in a separate vial inside the capsule.

L. Pressure Gauge:

- 1. Range of 0 to 50 or 0 to 60 psig.
- 2. Bronze bourdon-tube, adjustable-movement type.
- 3. Movement made of phosphor bronze, nylon, nickel, silver, stainless steel, Monel steel, nitrided steel, or any combination thereof.
- 4. Bushings of any of the above-mentioned material but different composition or hardness than the shafts.
- 5. Case of brass or aluminum alloy.
- 6. Dust-proof and moisture-proof case.
- 7. Glycerin liquid filled.
- 8. 2-1/2-inch or larger dial.
- 9. Dial in white with black markings.
  - a. Black indicating pointer.



- b. Shatter resistant window.
  - c. Conform to ASME B40.100.
  - 10. Grade A accuracy or better.
  - 11. Furnished with shutoff cocks and pulsation dampeners.
  - 12. Bottom connected with 1/4-inch male pipe connections.
- M. Grout:
- 1. Refer to Section 03 63 00 – Epoxy Grout for Metal Work.

## **2.02 FABRICATION**

- A. Fabricate steel pipe in accordance with these specifications, as indicated on drawings, and in accordance with AWWA C200.
- B. No buttstraps, lap joints, nor bell-and-spigot joints are allowed.
- C. All longitudinal, girth, and spiral joints, other than field welds:
  - 1. Double-welded butt joints with complete penetration.
  - 2. Stagger longitudinal joints.
  - 3. Longitudinal, girth, and spiral joints shall not intersect at outlet connections.
- D. Cut the plates accurately to size and shape.
- E. Bend or roll plates to true circular sections with curvature continuous from the edges of the plates.
- F. Properly form the edges to be joined by welding to suit the type of welding and to allow complete penetration.
- G. Tolerances:
  - 1. Inside surface of pipe: It shall not be possible to insert at any point a feeler gauge greater than 3/8-inch thickness between a template made to the nominal curvature of the inside surface extending over an arc of 30 degrees and the inside surface of the pipe.
  - 2. Ends of straight pipe sections shall lie in a plane normal to the longitudinal axis of the section with a maximum deviation of 1/8-inch on either side of the plane.
- H. Complete all welding with a process that protects the molten metal from the atmosphere.
  - 1. Where practicable, use automatic machines.
  - 2. Where weld metal is deposited in successive layers, clean each layer thoroughly before the subsequent layer is deposited.

3. Take particular care in aligning and separating the edges of plates to be joined by butt welding so that complete penetration and fusion of the welds will be ensured.
  4. After welding is completed, remove all weld spatter.
  5. Protect the work and the operator from the wind, rain, and snow during welding operations.
  6. Welding of any kind is not permitted on wet surfaces or when the temperature of the steel is lower than 0 degrees Fahrenheit.
  7. At temperatures between 0 and 32 degrees Fahrenheit, heat the surface of all areas within 3 inches of the point where a weld is to be started to at least 60 degrees Fahrenheit.
- I. During the attachment of all flanges to their associated steel piping, take adequate steps to ensure that the face of the flanges remains flat and perpendicular to the centerline of the attached piping.
1. Limit any and all irregularities or warping in the face of all flanges to 0.0015 of an inch measured from (1) a high point on the face of the flange at an inside diameter to a corresponding low point on the face of the flange at an outside diameter, along any radial line, (concave orientation of the flange is not permissible) and (2) a high point on the face of the flange along a circumferential line at the centerline of the flange bolt holes, to a low point on the face of the flange along the same circumferential line, within a distance equal to the circumferential distance between every third bolt hole.
  2. Remove by machining, all initial, residual, or latent irregularities or warping that remain in the face of the flange after its attachment to the steel piping that exceeds the above.
  3. After machining, the flange thickness shall not be reduced below the minimum thickness specified in AWWA C207.
- J. Ends of steel pipe to be joined by pipe couplings: free from weld reinforcement (bead), seams, scars, dents, flats, or other defects likely to interfere with the joint-sealing process in accordance with coupling manufacturer instructions.
- K. Maintain the circularity of the pipe sections during coating, lining, transporting, and installing operations.
1. Provide stulls or adjustable spiders.
  2. The measured thickness between the maximum and minimum diameters at stulls or spiders shall not exceed 0.5 percent of the nominal pipe diameter.
- L. Continuously weld all joints of flange supports and pipe supports.

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## **2.04 CONTRACTOR SOURCE QUALITY TESTING**

- A. Steel Pipe:
  - 1. Fabricate steel pipe in accordance with these specifications, as indicated on drawings, and in accordance with AWWA C200.
  - 2. Girth Weld Tests:
    - a. Test girth welds on miter bends by magnetic particle or liquid penetrant method in accordance with AWS D1.1.
    - b. Repair defects and retest weld.
- B. Continuously weld all joints of flange supports and pipe supports.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install to line and grade as shown on drawings.
- B. Furnish and install supports and bracing as may be required to hold the steel piping in place and prevent distortion during erection, placing of concrete.
- C. Embedment of timber supports will not be allowed.
- D. Contact between pipe and rebar will not be allowed.
- E. Install pipe couplings and anchor bolts in accordance with the manufacturer's instructions.

### **3.02 GROUT**

- A. Grout at base of pipe support in accordance with Section 03 63 00 – Epoxy Grout for Metal Work.
- B. If necessary, use forms to confine grout.

### **3.03 COATINGS**

- A. Refer to Section 09 96 20 – Coatings.

**END OF SECTION**

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## SECTION 35 21 96

### HDPE PIPE

#### PART 1 GENERAL

##### 1.01 MEASUREMENT AND PAYMENT

- A. HDPE Pipe for Outlet Works, Conduits, Intake Air Vent, and Hydraulic Lines:
1. Payment: Lump sum price offered in the schedule.
    - a. Pipe 12 inches in diameter and under measured separately from pipe greater than 12 inches in diameter.
    - b. Length along pipe centerline between ends in place.
    - c. No allowance for lap at joints.
    - d. Includes:
      - 1) Fittings.
      - 2) Pipe bedding.
      - 3) Zone 1 backfill.
      - 4) Pipe zone fill.
      - 5) Required excavations.
- B. Primary Access Road Culverts and Structures:
1. Payment: Lump sum price offered in the schedule.

##### 1.02 REFERENCE STANDARDS

- A. ASTM International (ASTM)
- |    |                            |  |
|----|----------------------------|--|
| 1. | ASTM A 36/A 36M-08         | Carbon Structural Steel  |
| 2. | ASTM A 283/A 283M-03(2007) | Low and Intermediate Tensile Strength Carbon Steel Plates  |
| 3. | ASTM E 165-09              | Liquid Penetrant Examination   |
| 4. | ASTM F 412-09              | Terminology Relating to Plastic Piping Systems   |
| 5. | ASTM F 714-12              | Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter   |
| 6. | ASTM F 2206-11             | Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock |

7. ASTM F 2620-11 Heat Fusion of Polyethylene Pipe and Fittings

B. American Water Works Association (AWWA)

1. AWWA C205-07 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 In. (100 mm) and Larger, Shop Applied

### 1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 35 21 96-1, Shop Drawings:

1. Show fitting fabrication details.

C. RSN 35 21 96-2, Fusion Procedures:

1. Fusion temperature.
2. Interface pressure.
3. Cooling time.

### 1.04 QUALIFICATIONS

A. Pipe Laying Workers: Skilled and experienced in laying pipe with butt fusion joints.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

1. Before shipping, install internal supports in pipe to maintain circularity.
2. Supports:
  - a. Two members at 90 degrees to each other.
  - b. Minimum member cross section: Nominal 2 by 4 inches.
3. Place supports at 5 feet from ends of each pipe section.
4. Orient support legs in same axis along pipe centerline.

B. Transport fittings with padded bolsters between the pipes. Use heavy padding under ties.

## PART 2 PRODUCTS

### 2.01 PIPE

A. HDPE Pressure Pipe: ASTM F714

1. Material: PE 4710.
2. Color: Gray or lighter color to facilitate closed circuit television.

## **2.02 FITTINGS**

- A. HDPE Fittings: Tees, crosses, tapers, adaptors, couplings, bends, and connections at structures and encasements in accordance ASTM F 2206.
  1. Material: PE4710.
- B. Metal Back-up Flange:
  1. Material: Ductile iron, Class 150, ANSI B16.1/B16.5, coat in accordance with Section 09 96 20 - Coatings.
- C. HDPE Blind Flange:
  1. IPS conforming to ANSI B16.5, B16.47, and AWWA C207
- D. HDPE Flange Adapter
  1. IPS conforming to AWWA C901 or C906
- E. Ductile Iron Back-Up Ring
  1. IPS conforming to ANSI B16.5, B16.47, B16.1, and AWWA C207
- F. Steel Fittings:
  1. Steel for fittings: ASTM A 283, grade C or D; or ASTM A 36.
  2. Welding:
    - a. AWS D1.1.
    - b. Temporary or permanent welding for convenience of the Contractor: Not permitted on areas where welding will damage fusion-epoxy lining and coating.
    - c. Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.
  3. Coatings and linings:
    - a. Fusion epoxy or coal-tar epoxy paint in accordance with Section 09 96 20 – Coatings.
    - b. Cement mortar lining and coating: In accordance with AWWA C 205.
      - 1) Coat exposed steel joint surfaces with coal-tar epoxy paint in accordance with Section 09 96 20 – Coatings.
  4. Joints between HDPE pipe and steel fittings: Flanged.

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## **PART 3 EXECUTION**

### **3.01 PRE-INSTALLATION TESTING**

- A. Prior to joining pipe sections, demonstrate quality of joining method, equipment, and personnel.
  - 1. Construct 3 butt-fused pipe sections to length specified in ASTM D 2657.
  - 2. Prior to preparing cutting strips for bent strap test specimens, COR or BIA Representative will visually examine joint for defects. Beads will be examined for uniformity and proper size around entire joint.
  - 3. From each sample, prepare 3 bent strap test specimens for destructive testing in accordance with ASTM D 2657 using sample dimensions specified in standard.
    - a. Cut joints into straps as indicated in standard.
    - b. Test joints as directed by COR or BIA Representative to demonstrate sample response to face bend, outside face bend, tensile elongation, torque, and impact when compared to a control sample.
- B. Do not proceed with pipe joining until COR or BIA Representative has approved butt fusion quality.

### **3.02 INSTALLATION**

- A. Install and join pipe in accordance with manufacturer's recommendations and as indicated on drawings.
- B. Backfill around pipe as shown on drawings and in accordance with 31 24 00 – Fill and Backfill.
- C. Join pipe by heat fusion in accordance with ASTM D 2657 and manufacturer's instructions. Examine joints for defects.
- D. Remove interior beads caused by pipe welding process from containment pipe prior to joining next section of pipe.
  - 1. Use tools and methods recommended by pipe manufacturer.
  - 2. Use skilled workmen to perform bead removal. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled to remove beads without damaging pipe and joint at beginning of pipe joining.
- E. Demonstrate to COR or BIA Representative that workmen are sufficiently skilled in use of hand-held extrusion welder before use of welder in work.
- F. Maintain in correct position and alignment during installation and subsequent construction operations.



- G. Where pipe is installed in embankment, maintain pipe alignment during placement.
  - 1. Use special compaction methods to place material adjacent to pipe in accordance with Section 31 24 00 – Fill and Backfill.
  - 2. Provide complete circumferential support for pipe.
- H. Keep interior of pipes free of embankment materials, concrete, dirt, and foreign materials.

### **3.03 CONTRACTOR FIELD QUALITY TESTING**

- A. Hydrostatic Test:
  - 1. Hydrostatic testing shall be performed prior to concrete encasement.
  - 2. Hydrostatically test pipe to 50 pounds per square inch before placement of concrete around containment pipe.
  - 3. Use clean water with temperature of 70 degrees Fahrenheit or less.
  - 4. Maintain pressure in pipe for 3 hours and examine installation for leaks during test.
  - 5. Correct defects identified by test in manner approved by manufacturer and COR or BIA Representative.
  - 6. Provide all pressure testing heads, pumps, gauges, and other equipment necessary to perform tests.

### **3.04 CONTRACTOR FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services:
  - 1. Arrange for pipe manufacturer's representative to perform following field services at jobsite:
    - a. Verify proper equipment and methods will be used in work before work begins.
    - b. Observe pre-installation bent strap tests.
    - c. Observe pipe joining and bead removal and verify proper joining of pipe sections.
    - d. Observe installation and hydrostatic testing of pipes.
    - e. Observe CCTV inspections of pipes.
    - f. Recommend methods to correct defects.

### **3.05 FIELD QUALITY ASSURANCE**

- A. Navajo Nation Safety of Dams (NNSOD) personnel will inspect interior of pipes using closed circuit television (CCTV) equipment as follows:

1. After installation, entire length of pipe will be inspected for defects and damage before placement of concrete around pipe.
  2. After placement of concrete around pipe, entire length will be inspected for distortion and damage.
  3. After installation and covering of air vent pipe, entire length of this pipe will be inspected for distortion and damage.
  4. After installation and covering of pipe for hydraulic lines, entire length of this pipe will be inspected for distortion and damage before installation of hydraulic lines in pipe.
- B. Coordinate inspections with COR and BIA Representative. Notify NNSOD, COR and BIA Representative, in writing, of date and time pipe will be ready for inspection at least 10 days before inspection is required.
- C. NNSOD will require 8 hours, maximum, for each inspection.
- D. Provide safe access and working conditions for inspections.

**END OF SECTION**

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**SECTION 35 23 15**  
**HYDRAULICALLY-OPERATED GATE**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Furnish and install complete hydraulically-operated gate system which includes gates, thimbles, stainless steel hydraulic lines, couplings, valves, steel table and other required components for the three outlet works control gates.
  - 1. Payment: Lump sum price offered in schedule.
    - a. Lump sum offer shall include pricing for either cast-iron sluice gates or fabricated stainless steel slide gates.
- B. Hydraulic pump motors and required electrical components to be powered by Solar Power System. Coordinate with Section 48 14 00 - Solar and Electrical Equipment

**1.02 REFERENCE STANDARDS**

- A. American Water Works Association (AWWA)
  - 1. AWWA C560-07 Cast-Iron Sluice Gates
  - 2. AWWA C561-14 Fabricated Stainless Steel Slide Gates
- B. Military Specifications (MIL)
  - 1. MIL-H-17672D-95 Hydraulic Fluid, Petroleum, Inhibited
- C. National Fire Protection Association (NFPA)
  - 1. NFPA 70-2011 National Electrical Code (NEC)
- D. Society of Automotive Engineers (SAE)
  - 1. SAE J517-2010 Hydraulic Hose

**1.03 DEFINITIONS**

- A. Face and back pressure heads: Head at vertical distance from center of gate to maximum water surface.

**1.04 PERFORMANCE REQUIREMENTS**

- A. Control Gates shall be capable of opening and closing under unbalanced head conditions at a rate as noted in the design drawings plus or minus 10 percent. The hydraulic height of the reservoir is approximately 21 feet.

- B. Gate operations will be controlled with one or more hydraulic power units. Hydraulic power units will operate under stored energy from the Solar Power System (Section 48 14 00). Gate system provider shall coordinate selected hydraulic power unit configuration and power requirements with the solar power system.
- C. A pressure switch integrated into the hydraulic power unit or other means of stopping the system from over-pressuring upon full open or full close shall be included in the system design. Gate cylinder manufacturer shall determine shut off pressure.
- D. Fluid lines of sufficient size that the fluid velocity in the working lines, both pressure and return, shall not exceed 15-feet per second and 4 feet per second in the suction lines.
- E. The hydraulic control system shall be leak free.
- F. System relief valves shall be sized to limit system pressure to 1,500 pounds per square inch or the maximum allowable pressure determined by the hydraulic system provider for the selected hydraulic components.
- G. Control gates shall be capable of opening and closing using a hand-operated hydraulic pump in addition to battery power from the Solar Power System.

**1.05 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 0 - Submittals.
- B. RSN 35 23 15-1, Approval Drawings and Data:
  - 1. Drawings and data showing assembly, type, size, and detail dimensions of self-contained sluice gate or fabricated stainless steel slide gate and hydraulic cylinder installation. Include cylinder capacity and hydraulic controls product data to demonstrate compliance with the specifications.
  - 2. Installation drawing(s) of hydraulic fluid line installation.
  - 3. Hydraulic schematic drawing showing all line sizes.
  - 4. Drawings and data showing assembly, type, size and detail dimensions of the removable protective cover for the gate hydraulic lines and cylinders.
  - 5. Commercial products data for all commercial products. Provide electric motor information to complete Table 35 22 15A - Electric Motor Information.

Table 35 22 15A - Electric Motor Information

1.	Manufacturer (nameplate)	
2.	Horsepower rating (nameplate)	
3.	Time rating (nameplate)	

Table 35 22 15A - Electric Motor Information

4.	Temperature rise of windings by resistance (not ambient temperature)	
5.	Rated load speed, (R.P.M.)(nameplate)	
6.	Number of phases (nameplate)	
7.	Armature connected (i.e. delta or wye)	
8.	Voltage (nameplate)	
9.	Rated load (amperes)(nameplate)	
10.	Code letter for locked-rotor (Kva/hp)(nameplate)	
11.	Design letter	
12.	Efficiency at nameplate rated load	
13.	Power factor for nameplate-rated load	
14.	Type of enclosure (i.e. drip-proof, TEFC, etc.)	
15.	Stator of insulation class	
16.	Type of stator windings (i.e. form wound or random wound)	
17.	Type of bearings (i.e. ball, roller, sleeve, etc.)	
18.	Net wt. (pounds) each motor	

C. RSN 35 23 15-2, Final Data:

1. Service manuals including lubrication type and schedule and previously-approved data.
2. Test reports for leakage and operating tests.
3. Photographs:
  - a. Front, left and right sides, left and right oblique views of the hydraulic power unit.
  - b. Front and top sides of the gate and hydraulic cylinder installed.

**PART 2 PRODUCTS**

**2.01 OUTLET WORKS GATES**

- A. Provide three (3) gates as shown in the drawings.
- B. Gates may be either Sluice Gates or Fabricated Stainless Steel Slide gates as specified below. Contractor to select gate type.

- C. Gate nominal dimensions shall be 36-inch by 36-inch, 30-inch by 30-inch, and 24-inch by 24-inch.
- D. Seating Head shall be a maximum of 21 feet as measured from the centerline of the gate.
- E. Unseating Head shall be less than 5 feet.
- F. Gates to be installed in the seating head configuration.

## **2.02 SLUICE GATE**

- A. Sluice gates shall be as manufactured by Waterman Industries, Inc., Series 5000 Sluice Gates, 1701 N. Nashville, Lubbock, TX 79415, [www.watermanusa.com](http://www.watermanusa.com), or equal.
- B. Cast-Iron.
- C. Hydraulically-operated.
- D. Design and manufacture in accordance with applicable AWWA C560, except:
  - 1. Seating faces: Bronze.
  - 2. Capscrews, studs, assembly bolts, anchor bolts, and gate stem: Stainless steel conforming to any 300 series.
  - 3. Nuts: Bronze.
- E. Seating and unseating heads: Design to be suitable for heads indicated on drawings.
- F. Closure type: Bullnosed bottom edge for throttling flows.
- G. Flat-back type.
- H. Frame and sluice:
  - 1. Sluice: Square bottom type.
  - 2. Frame: Standard, self-contained.
  - 3. Design and fabricate cross beam that supports the operator so that the opening in the structure deck is fully covered or filled with no gap remaining greater than 2-inch wide.
  - 4. Raised surfaces: Only as necessary for attaching seats and wedges.

## **2.03 FABRICATED STAINLESS STEEL SLIDE GATE**

- A. Fabricated Stainless Steel Slide gates shall be as manufactured by Waterman Industries, Inc., Series SS 250 Slide Gates, Orbinox MU Gates, or equal.
- B. Design and manufacture in accordance with applicable AWWA C561

C. Frame and guides:

1. The gate frame shall be composed of stainless steel guide rails with UHMW seat/seals upstream and downstream. The seat/seals shall form a tight seal between the frame and the slide.
  - a. The UHMW seats will impinge on the slide (disc) by way of a bulb or double lip seal. Seal shall be synthetic rubber, either EPDM or Neoprene.
  - b. The neoprene seal will perform the function of a seal between the frame and the UHMW as well as a spring force to maintain contact between the UHMW and the slide.
  - c. This tight seal shall provide an allowable leakage rate of no more than 0.1 gallons per minute (GPM) per peripheral foot of perimeter opening for seating head and unseating heads.
2. Stainless steel retainer bars, cross bars and head rails (for self-contained gates only) shall be provided.
  - a. The clear opening shall be the same size as the waterway, unless otherwise specified.
  - b. The guides will be of sufficient length to support  $\frac{1}{2}$  of the height of the slide when in the full open position.
3. Gates shall be furnished with a flush seal arrangement. A resilient seal shall be securely attached to the slide along the invert thus preventing heavy damaging debris from impinging on the seal during flowing conditions.. The resilient seal shall be mounted mechanically to the slide plate in a captive arrangement with stainless steel fasteners penetrating the seal along the length of the invert.

D. Slide Cover

1. The slide cover shall be stainless steel plate reinforced with structural shapes welded to the plate.
  - a. The slide cover shall not deflect more than  $\frac{1}{720}$ th of the span, or  $\frac{1}{16}$ " at the sealing surface of the gate under maximum specified head.
  - b. The stem connection shall be either the clevis type, with structural members welded to the slide and a bolt or bolts to act as a pivot pin, or a threaded and bolted (or keyed) thrust nut supported in a welded nut pocket.
  - c. The clevis or pocket and yoke of the gate shall be capable of taking, without damage, at least 50 percent more thrust than that designed to be applied by the hydraulic system

## 2.04 WALL THIMBLES

- A. Provide Cast-Iron thimbles for cast-iron sluice gate or Stainless Steel (Option A) thimbles for stainless steel slide gates.

- B. Square to round type flange.
- C. Upstream flange machined and tapped for attachment to gate frame.
- D. Downstream flange tapped with compatible threading and bolt pattern suitable for connection with 36-inch, 30-inch, and 24-inch diameter HDPE flanges.

## **2.05 STEM**

- A. Stem shall be stainless steel, designed and manufactured in accordance with AWWA C560/C561, meeting the following criteria:
  - 1. No portion of stem shall have cross-sectional area smaller than root area of threaded portion of stem.
  - 2. Stem diameter selected so that maximum unsupported stem length is not greater than 200 times the radius of gyration of the stem.
  - 3. Stems machined to match stem nut.
  - 4. Stem may have upset end or stem block.
  - 5. Stem block:
    - a. Thread or screw onto bottom end of stem, or designed for an upset stem end.
    - b. Rigidly pin or key to stem.

## **2.06 HYDRAULICALLY-OPERATED GATE CYLINDER**

- A. Hydraulic cylinder having the following essential characteristics:
  - 1. Flange suitable for mounting on gate cross beam.
  - 2. Maximum operating pressure: at least 3,000 pounds per square inch.
  - 3. Hydraulic operator operates both open and close direction under maximum reservoir head.
  - 4. Made of stainless steel, bronze, and non-corrosive materials.
  - 5. Stainless steel stem.
  - 6. Stainless steel hydraulic cylinder.
  - 7. Submersible.
  - 8. Ports: SAE O-ring.
  - 9. Leak-free construction.
  - 10. Heavy-duty design.
  - 11. Wiper scraper to remove deposits from stem before they pass through the packing.



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## 2.07 HYDRAULIC POWER UNIT

- A. Contractor has option to provide an individual hydraulic power unit for each gate or a single common hydraulic power unit to operate all three gates.
- B. Hydraulic oil tank having the following essential characteristics:
1. At least 1.25 times the total return oil volume required for the gate(s) .
  2. Base mounted suitable for mounting on steel plate table.
  3. Breather cap.
  4. Drain Plug.
  5. Oil level gage with thermometer.
  6. Strainer.
  7. Made of coated steel, stainless steel, bronze, and non-corrosive materials.
- C. Suction oil filter having the following essential characteristics:
1. Removable filter-element type.
  2. Filters all the oil passing through the line.
  3. Visual indicator to show when the element needs cleaning.
  4. Automatic bypass that limits the pressure drop through the filter to not more than 2 pounds per square inch.
  5. Filtering media is corrosion-resistant No 200-mesh or liner wire cloth.
  6. Nominal flow rating of not less than 1.5 times the maximum pump capacity when filtering oil with a viscosity of 150 SUS at 100 degrees Fahrenheit.
- D. Induction motor for oil pump, (M1) having the following essential characteristics:
1. Flange suitable for mounting on steel plate table.
  2. Squirrel-cage induction type.
  3. Conforms to NEMA publication No. MG1 (most recent edition).
  4. Fan cooled.
  5. Operating Voltage: 24V DC.
  6. Horsepower rating: Sufficient to operate gate(s). Coordinate with solar and electrical system.
  7. Class B insulation.
  8. Motor efficiency: 85 percent minimum.
  9. Bearings having the following essential characteristics:
    - a. Oil or grease lubricated.

- b. Sealed against loss of lubricant or entrance of dirt.
- E. Motor Starter/Electrical Controls:
- 1. Electrical power controls, operating devices, and monitoring devices required on the HPCS shall be factory wired in a NEMA 1-rated enclosure.
- F. Oil pump having the following essential characteristics:
- 1. Rotary, fixed-displacement type.
  - 2. Flange suitable for mounting on the electric motor or separately mounted on a motor-and-pump mounting plate.
  - 3. Coupling guard provided if flexible coupling is used.
  - 4. Pump shaft provided with suitable bearings and shall be adequately packed or sealed to prevent leakage.
- G. Pressure oil filter having the following essential characteristics:
- 1. Removable filter-element type.
  - 2. Capable of withstanding a working pressure of at least 3,000 pounds per square inch.
  - 3. Filter element capable of removing particles as small as 10-microns in size.
  - 4. Filter subplate, flange, or straight-thread O-ring type which permits mounting or removing without disconnecting the fluid line.
  - 5. If the filters sit in a bowl, a drain port is provided in the bottom of the bowl to allow removal of sediment and water.
  - 6. Visual indicator to show when servicing is required.
  - 7. Pressure-actuated bypass valve to limit pressure drop across the filter to 50 pounds per square inch maximum, either during cold startup, or as a result of contamination buildup.
  - 8. Rated for passing not less than the maximum combined pump capacity while filtering hydraulic oil with a viscosity of 150 SUS at 100 degrees Fahrenheit.
  - 9. Single-element type.
- H. Pressure gauge, (SPG), having the following essential characteristics:
- 1. Suitable for hydraulic oil.
  - 2. Stainless steel Bourdon tube operates a rustproof and corrosion-resistant movement.
  - 3. Pressure range of 0 to 2,000 pounds per square inch.
  - 4. Dial diameter approximately 4 inches.
  - 5. Liquid filled.
- I. Relief valve, (SRV) having the following essential characteristics:

1. Pilot type with internal drain.
  2. Rated capacity of not less than the maximum pump capacity and working pressure of at least 3,000 pounds per square inch.
  3. Adjustable valve setting through a pressure range with the lower limit not higher than 500 pounds per square inch and the upper limit not lower than 3,000 pounds per square inch.
- J. Four-way valves having the following essential characteristics:
1. NFPA D03 subplate mounting.
  2. Dual solenoid controlled, three-position, detent, and internally drained. Self-centering with spring return when power is removed from solenoid.
  3. Rated flow capacity of not less than 1.5 times the maximum combined pump capacity with a maximum pressure drop of 50 pounds per square inch and a working pressure of at least 1,000 pounds per square inch.
  4. Subplate-mounted type which will permit mounting or removing the valve without disconnecting the fluid line.
  5. Porting and operation of the valve such that:
    - a. With the one solenoid energized, pump flow is directed to one port and return flow from the other port is directed to tank.
    - b. With the other solenoid energized, pump flow and return tank flow are reversed.
    - c. With both solenoids de-energized, the spool returns to center, P, A and B ports open to T.
- K. Pilot operated check valve:
1. NFPA D03 subplate mounting.
  2. Double poppet, port A and B.
- L. Hand-operated hydraulic pump: Series CPS13-LR as manufactured by Star Hydraulics, 2727 Clinton Street, River Grove, IL 60171, Telephone 708-453-0297, [www.starhyd.com](http://www.starhyd.com); or equal, having the following essential characteristics:
1. Base mounted suitable for mounting on steel plate table.
  2. Two-stage.
    - a. High-volume, low-pressure: 3 to 5 cubic inches per stroke less than 300 pounds per square inch.
    - b. Low-volume, high-pressure: 0.2 to 0.4 cubic inches per stroke greater than 300 pounds per square inch.
    - c. Automatically switches to low-volume, high pressure when pressure increases above 300 pounds per square inch.

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## **2.08 HYDRAULIC FLUID-LINE TUBING**

- A. Dead-soft, annealed stainless steel.
- B. Minimum burst pressure: 12,000 pounds per square inch.
- C. Pressure and return lines: minimum 1/2-inch tubing, 0.065-inch wall thickness.

## **2.09 STRUT-TYPE MOUNTS**

- A. Material: Stainless steel.
- B. 1-5/8-inch x 1-5/8-inch channel type metal framing.

## **2.10 BALL VALVES**

- A. Stainless steel body and stem.
- B. Carbon steel, zinc plated or stainless steel ball.
- C. Fully ported.
- D. Working pressure of at least 3,000 pounds per square inch.
- E. Submersible.

## **2.11 HYDRAULIC OIL**

- A. Non-petroleum-based biodegradable or “food grade” hydraulic fluid, compatible with drinking water standards for raw water.

## **2.12 REMOVABLE PROTECTIVE COVER**

- A. Contractor-designed removable fiberglass protective cover with mounting brackets and hardware. Covers hydraulic lines, and gate hoist to prevent damage by debris that might get past the trashracks.
- B. Materials:
  - 1. Fiberglass reinforced plastic (FRP) items: Composed of fiberglass reinforcement and resin in dimensions shown on the drawings.
  - 2. Grating, curb angles, and accessories: Fiberglass reinforced plastic.
    - a. Molded fiberglass grating: Duragrate molded fiberglass grating, as manufactured by Strongwell, 400 Commonwealth Avenue, Bristol, VA 24201-3820, Telephone 276-645-8000, [www.strongwell.com](http://www.strongwell.com); or Supergrate molded fiberglass grating, as manufactured by Creative Pultrusions, 214 Alum Bank, PA 15521, Telephone 814-839-4276,

www.creativepultrusions.com; or equal, having the following essential characteristics:

- 1) Size: 1-1/2-inch deep with 1-inch by 1-inch mesh pattern.
  - 2) Color: Gray or Yellow.
- b. Pultruded curb angle: Extren curb angle, as manufactured by Strongwell, 400 Commonwealth Avenue, Bristol, VA 24201-3820, Telephone 276-645-8000, www.strongwell.com., or Pultex Concrete Embedment Angles, as manufactured by Creative Pultrusions, 214 Alum Bank, PA 15521, Telephone 814-839-4276, www.creativepultrusions.com; or equal, having the following essential characteristics:
- 1) Size: 1-1/2-inch by 1-1/2-inch to accommodate 1-1/2-inch deep grating.
  - 2) Color: Gray or Yellow, to match grating color.
- c. Accessories:
- 1) Hold down clips: Standard fiberglass grating clips.
    - a) Fasten each grating panel to curb angles with a minimum of four hold down clips.
    - b) Clips shall be easy to remove and re-install by divers.
3. Grating fasteners: Fiberglass or stainless steel studs and bronze nuts.
- a. Size: 3/8-inch diameter with 16 UNC threads.
4. As an option, Contractor may fabricate and install removable protective cover using 3/16-inch minimum thickness stainless steel plate with stainless steel fasteners.

**C. FRP Fabrication:**

1. Fabricate FRP components and accessories in accordance with the manufacturer's recommendations and these specifications.
2. Verify measurements in the field for work fabricated to fit field conditions as required by FRP manufacturer to complete the work.
3. All shop fabricated cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. Coat field fabricated cuts or drilling in accordance with the manufacturer's instructions.

**2.13 BANDS**

A. Stainless Steel Banding: Pipe-Covering Metal Banding, Product Number 4582K22, as manufactured by McMaster-Carr, 200 New Canton Way, Robbinsville, NJ 08691, Telephone 630-600-3600, www.mcmaster.com; or equal, having the following essential characteristics:

1. Material: Stainless steel.

2. 1/2-inch minimum band width.
3. 350-pound minimum breaking strength.

B. Include stainless steel buckles and other components required for installation.

## **2.14 EXPANSION ANCHORS**

A. Stainless Steel Expansion Anchor: Kwik Bolt II, as manufactured by Hilti Incorporated, 5400 South 122<sup>nd</sup> East Avenue, Tulsa, OK 74146, Telephone 800-879-8000, [www.us.hilti.com](http://www.us.hilti.com); or equal, having the following essential characteristics:

1. Material: ASTM A 304 stainless steel.
2. Minimum embedment depth: 2 inches.
3. Diameter suitable for holes drilled in angle support and concrete wall.
4. Allowable Shear working load of at least 500 pounds in 4000 pounds per square inch (lb/in<sup>2</sup>) concrete.
5. On each anchor bolt, a minimum of three threads shall be exposed past the nut.

## **2.15 STEEL TABLE**

A. Fabricate steel table for hydraulic control equipment in accordance with specification drawings.

B. Material: Steel, 0.3 percent carbon maximum.

## **2.16 PAINTING**

A. Paint in accordance with Section 09 96 20 - Coatings.

# **PART 3 EXECUTION**

## **3.01 CONDUIT AND CABLE INSTALLATION**

- A. Install conduit in accordance with section 26 05 33 – Raceways and Boxes for Instrumentation.
- B. Install cable in accordance with section 26 05 20 – Conductors and Cables.

## **3.02 INSTALLATION**

A. EWS Building Structure:

1. Install table with anchors in location shown on the drawings.
2. Utilize the HDPE carrier pipes as indicated in the drawings to route the hydraulic lines between the Hydraulic Power Unit and gate cylinders.

3. Adequately support the tubing within the EWS structure to ensure that it will not bend or break.
  4. Provide centralizers to ensure the hydraulic tubing does not rest on the edge of the HDPE carrier pipes.
- B. Install sluice gate or fabricated SS slide gate thimble as shown on drawings.
1. Install thimble in manner to prevent leakage between thimble and HDPE flange.
  2. Locate upstream flange flush with the vertical concrete structure wall.
  3. Support firmly and accurately in position, during concrete placement, thimble, anchor bolts and other metalwork that will be embedded in concrete.
  4. Leakage between thimble and concrete not allowed.
- C. Install sluice gate or fabricated SS slide gate in accordance with applicable AWWA C560/C561 guidelines and as shown on drawings.
1. Install gates in manner to prevent leakage past seats.
  2. Leakage between gate frame and thimble not allowed.
- D. Install the hydraulic power unit(s), valves, and fittings. Fasten hydraulic control unit(s) to the table top with suitable fasteners so that handle and valves operate unobstructed.
1. Mount 32-inch above finish grade.
- E. Install stainless steel hydraulic fluid lines as shown on the drawing and as follows:
1. Cut, thread, or prepare for welding; ream, fit, clean thoroughly, and install random length tubing so that joints are oil-tight and installation is neat in appearance.
  2. Completely de-burr and thoroughly clean each fluid line subassembly after fabrication but before installation in system. Clean inside surfaces near welded joints, using power-driven flue or tube wire brush. In addition, clean all fluid lines by drawing lint-free cloth impregnated with suitable solvent through fluid lines. Then dry interior of fluid lines with blast of clean compressed air which has been filtered through dirt and moisture trap.
  3. No couplings are allowed within the HDPE carrier pipes. Utilize sufficiently sized stainless steel tubing lengths to avoid couplings within these carrier pipes.
  4. Flush and clean each hydraulic fluid line subassemblies by circulating hydraulic fluid through the fluid line subassemblies and an external 5 micron filter until no contaminants remain on the filter.
  5. Vent all air from the system before allowing the system to achieve operating pressure.
  6. After making all connections within a subassembly perform pressure leak test. Fill with hydraulic oil and vent the subassembly. Apply pressure of 2,000 pounds per square inch for 2 hours or until all joints are inspected for leaks. Repair any leaks and re-test until no leaks are found.

7. Install the tubing in the HDPE carrier pipe while taking care to protect the tubing and fittings and preventing contaminants from entering the fluid line. Complete the connections to the hydraulic cylinder and control unit. Fill with oil and vent the system for each gate.
  8. Test the entire assembled system for leaks through all ranges of gate positioning. Repair any leaks and re-test until no leaks are found.
  9. Fill the system and vent so that, with the gate in the open position, the reservoir level is at maximum with at least 10% air space.
- F. Install removable protective cover over the gate hoist and hydraulic fluid lines.
1. Attach protective cover assembly to the structure per manufacturer's recommendations.

### **3.03 CONTRACTOR FIELD QUALITY TESTING**

- A. Test after gate, hoist, and controls have been installed in the presence of COR or BIA Representative.
1. Perform operation test by opening and closing gate at least 3 times through its full range of operation.
    - a. One full range of operation shall be performed using only the hand pump. The remaining 2 times shall be performed using the motor.
    - b. One full range of operation shall be performed with the reservoir at the normal maximum operating level.
  2. Make required changes or adjustments until operation of gate, cylinder, and hydraulic control unit is approved by COR or BIA Representative.
  3. Notify the COR and BIA Representative 3 days prior to testing.

**END OF SECTION**



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**SECTION 48 14 00**  
**SOLAR AND ELECTRICAL EQUIPMENT**

**PART 1 GENERAL**

**1.01 MEASUREMENT AND PAYMENT**

- A. Solar and Electric Equipment:
1. Payment: Lump sum price offered in the schedule.

**1.02 REFERENCE STANDARDS**

- A. National Electrical Manufacturer's Association (NEMA)
1. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. National Fire Protection Association (NFPA)
1. NFPA 70 (2011) National Electrical Code (NEC)
  2. NFPA 70E (2012) Electrical Safety in the Workplace
- C. Underwriters Laboratories, Inc. (UL)
1. UL 98 (2004) Enclosed and Dead-Front Switches
  2. UL 248 (2011) Low-Voltage Fuses
  3. UL 1703 (2002) Flat-Plate Photovoltaic Modules
  4. UL 1741 (2010) Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

**1.03 SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittals.
- B. RSN 48 14 00-1, Approval Data:
1. Manufacturer's technical data sheets.
- C. RSN 48 14 00-2, Approval Drawings:
1. Provide drawings and calculations showing the following:
    - a. Azimuth angle and tilt of solar panels.
    - b. Roof layout of solar panels.
    - c. Calculations showing solar panels will supply the required battery load. See Section 26 33 00 – Battery Equipment for battery requirements.

- d. Service entrance point from combiner to battery enclosure.
  - e. Calculations showing the proper size of conductor and conduit for service entrance.
  - f. Details for roof top mounting system.
- D. RSN 48 14 00-3, Test Report:
- 1. Provide test report as stated in Article 3.02.
- E. Manufacturer's Solar System Power Calculations:
- 1. The Solar System shall be sized/rated to maintain power for all electrical equipment and recharge the Battery System to 100% capacity in less than 72 hours.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

#### **1.05 PROJECT CONDITIONS**

- A. Altitude: 7080 feet above sea level.
- B. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.
- C. Wind:
  - 1. Sustained: 40 knots.
  - 2. Maximum gust: 65 knots.

#### **1.06 DESIGN REQUIREMENTS**

- A. Contractor to design photovoltaic system including roof mounting.
- B. Mounting structure shall be designed for optimal tilt to mount photovoltaic modules. Total structure must fit on roof of control house without hindering hatch removal and access.
- C. Photovoltaic modules shall supply batteries with required electrical capacity. The Solar System shall be sized/rated to maintain power for all electrical equipment and recharge the Battery System to 100% capacity in less than 72 hours. See Section 26 33 00 – Battery Equipment for battery requirements.

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## **PART 2 PRODUCTS**

### **2.01 PHOTO-VOLTAIC MODULE MOUNTS**

- A. Type: Contractor design.
- B. Material: Steel or aluminum. Corrosion proof.
- C. Mounting Equipment:
  - 1. As necessary to mount on roof structure and meet wind load requirements.

### **2.02 PHOTO-VOLTAIC SOLAR MODULES**

- A. SBM 258W Module as manufactured by SBM Solar, <http://sbmsolar.com>; or equal, having the following essential characteristics:
  - 1. Amorphous silicon solar cells with bypass diodes.
  - 2. Glass-free, hail impact resistant and vandal resistant.
  - 3. Electrical Characteristics (during standard testing conditions):
    - a. Rated Power (per module): 258 watts.
    - b. Maximum Power Current (per module): 8.16 Amps.
    - c. Maximum Power Voltage (per module): 31.62 Volts.
  - 4. Total system array size shall be based on manufacture's recommended installation.
  - 5. Warranty: 5 years minimum.
  - 6. Efficiency:
    - a. 92 percent original output at 10 years.
    - b. 84 percent original output at 20 years.
    - c. 80 percent original output at 25 years.
  - 7. Conforms to UL 1703.

### **2.03 SWITCHED COMBINER**

- A. Type: Fused switching combiner with internal surge protection device (SPD).
  - 1. Combiner shall be capable of disconnecting means.
  - 2. Lockable.
- B. Construction: steel or aluminum.
- C. Enclosure: Type 3R in accordance with NEMA 250.
- D. Finish:
  - 1. Manufacturer's standard powder coat.

- 2. Rated for outdoor use.
- E. Size: Able to accommodate all photovoltaic sources required with 20 percent expansion capable.
- F. Input fuses: Calculated per NFPA 70, Article 690.8 and conforming to UL 248.
- G. Conform to UL 98, UL 1741, and marked suitable for NFPA 70, Article 690.

## **2.04 CHARGE CONTROLLER**

- A. System voltage rating: 24 VDC.
- B. The Solar System and Charge Controller shall be sized/rated to maintain power for all electrical equipment and recharge the Battery System to 100% capacity in less than 72 hours.
- C. Current Consumption:
  - 1. Controller: 20 mA, maximum.
  - 2. Meter: 7.5 mA, maximum.
- D. Remote Temperature Sensor:
  - 1. Same manufacturer as the charge controller.
  - 2. Temperature range: -30 degrees Celsius to 80 degrees Celsius.
  - 3. Accuracy: +/- 1.5 degrees Celsius.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Provide all photovoltaic module output cables, module interconnect cables, grounding, and associated equipment required for a complete independent solar electrical supply system.
- B. Install conduit in accordance with Section 26 05 19 – Electrical Conduit.
- C. Install cable in accordance with Section 26 05 20 – Conductors and Cables.
- D. Install grounding and bonding connections in accordance with Section 26 05 26 – Grounding and Bonding.
  - 1. See drawings for grounding switched combiner.
- E. Installed structures and equipment must be suitable for installation in project conditions.

- F. Mounting structures shall be installed at a minimum of 24 inches above roof top structure to prevent snow accumulation from degrading service.
- G. COR or BIA Representative will provide daily estimated equipment times upon request to aid in solar system sizing.
- H. Install photovoltaic modules, mounting hardware, and interconnection equipment so as to not impede any roof access hatches.
- I. Photovoltaic module shall be mounted a minimum of 24 inches above the surface of the roof.
- J. Photovoltaic modules shall be mounted at the optimum angle for year round performance.

### **3.02 CONTRACTOR FIELD QUALITY TESTING**

- A. Notify COR or BIA Representative at least 3 days in advance of time of testing. Testing dates to be mutually agreeable between Contractor and COR or BIA Representative.
- B. All electrical testing shall be done in accordance with NFPA 70E.
- C. To demonstrate the system is fully functional perform the tests below:
  - 1. Continuity of conductors including module interconnection.
  - 2. Insulation resistance of the electrical installation.
  - 3. Resistance testing on all grounded equipment to grounding electrode including mounting structure and combiner box grounding.
  - 4. Record all string fuse ratings and verify it correlates with the module manufacture recommendations.
  - 5. Check polarity on all strings in the combiner box.
  - 6. Measure the voltage between the positive and negative ends at the combiner box.
- D. Testing Report:
  - 1. Record date and time of testing as well as signatures from contractor personnel performing testing, and COR or BIA Representative.
  - 2. State all resistance values from grounding tests.
  - 3. The report shall contain the Voc, Isc, Vmp, and Imp for the modules from the manufacture's data sheets.
  - 4. Calculated string voltage:  $V_{mp} \times \text{module per string} \times \text{temperature coefficient}$ .
  - 5. Calculated string current:  $I_{mp} \times \text{irradiation factor} \times \text{performance factor}$ .
  - 6. State the voltage measurement at the combiner box.
  - 7. State the operating current measurements for each string.

- 8. State the operating current measurement at the output of the combiner box.
- 9. State, if any, modifications that were necessary to pass testing.
- E. COR or BIA Representative will furnish a discrepancy list to Contractor 20 days after satisfactory completion of on-site test.
- F. Contractor shall resolve discrepancies.
- G. COR or BIA Representative shall provide final acceptance.

**END OF SECTION**

**SECTION 51 00 30**  
**RESERVOIR HISTORY DATA**

**PART 1 GENERAL**

**1.01 RESERVOIR HISTORY DATA**

A. Red Lake Dam reservoir water surface elevations are included.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION

