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SECTION 31 05 13

COMMON FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Common fill materials.

1.2 REFERENCES

- A. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D 1883: Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.
- C. ASTM D 2487: Standard Test Method for Classification of Soils for Engineering Purposes.
- D. ASTM D 2844: Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.
- E. ASTM D 3282: Standard Practice for Classification of Soils and Soil- Aggregate Mixtures for Highway Construction Purposes.
- F. ASTM D 3740: Standard Recommended Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 SUBMITTALS

- A. Prior to delivering material to site, identify:
 - 1. Name of Supplier and source
 - 2. Gradation of common fill material
- B. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material prior to delivery to site.

1.4 QUALITY ASSURANCE

- A. Use a laboratory that follows and complies with Section 01 45 00 and ASTM D 3740.
- B. Reject common fill products that do not meet requirements of this section.
- C. Remove any product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 ACCEPTANCE

- A. General:
 - 1. Acceptance is by Lot. One Lot is one day's production.
 - 2. Dispute resolution; Section 01 35 10.
- B. Roadway Backfill: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 BORROW

- A. Classifications A-1-a through A-4, ASTM D 3282.

2.2 GRANULAR BORROW

- A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D 3282.
- B. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.3 GRANULAR BACKFILL BORROW

- A. Classification A-1, ASTM D 3282.
- B. Well graded.
- C. Particle size; 2 inch maximum.
- D. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.4 NATIVE

- A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate Proctor data (see Section 33 05 05).

2.5 CLAY

- A. Classification CL, CL-ML, or ML, ASTM D 2487.
- B. Free of organic matter, frozen material, debris, rocks, and deleterious materials.
- C. Homogeneous, relatively uniform.

2.6 SAND

- A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

| Percent Passing Sieve | by Weight |
|------------------------------|------------------|
| 3/8 | 100 |
| 100 | 1 – 10 |

2.7 GRAVEL

- A. Material: Rock, stone, or other high quality mineral particle or combination.
- B. Gradation: ASTM D 448 narrow band.
 - 1. Sewer Rock.

| ASTM Nominal Size | Size No. |
|--------------------------|-----------------|
| 3.5 to 1.5" | 1 |
| 2.5 to 1.5" | 2 |
| 2 to 1" | 3 |
| 1.5 to 3/4" | 4 |
| 1 to 1/2" | 5 |

2. Pea Gravel

| Nominal Size | ASTM Size No. |
|---------------------|----------------------|
| 3/4 to 3/8" | 6 |
| 1/2 to No. 4 | 7 |
| 3/8 to No. 8 | 8 |
| No. 4 to No. 16 | 9 |
| No. 4 (screenings) | 10 |

2.8 TOPSOIL

A. Chemical Characteristics:

1. Acidity/alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO₃N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Containing more than 2 percent organic matter.
3. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.
4. Composition.

| Material | Percent Passing |
|-----------------|------------------------|
| Sand | 15 – 60 |
| Silt | 10 – 70 |
| Clay | 5 - 30 |

2.9 SOURCE QUALITY CONTROL

- A. Verify gradation, ASTM C 136.
- B. Select Samples on a random location and time basis.
- C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Trenches, Section 33 05 20.
- B. Structures or landscaping, Section 31 23 23.
- C. Pavements, Section 32 05 10.

END OF SECTION

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SECTION 31 10 00

SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolition of structural and utility items on site.
- B. Salvage.

1.2 PAYMENT PROCEDURES

- A. Payment for structures or obstructions which are not designated for removal and disposal in the Bidding Documents, and which cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for by Change Order.
- B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

1.3 RELATED WORK

- A. Demolition of Pavements, sidewalks, Driveway Approaches, curbs, gutters, Section 02 41 14.
- B. Existing pipelines not to be salvaged are considered a part of excavation work, Section 31 23 16.
- C. For use of explosives in the Work; Section 31 23 17.

1.4 SITE CONDITIONS

- A. Protect structures to be removed and their contents from vandalism and theft.
- B. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Review all work procedures with ENGINEER.
- B. Locate and preserve all active utilities which are to remain in service.

3.2 PROTECTION

- A. Avoid or minimize damage to tree roots. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property.
- B. Provide certified arborist observation of root cuts larger than 4 inches diameter. Notify ENGINEER of such root cut.

3.3 STRUCTURE DEMOLITION

- A. Remove structures and incidentals such as but not limited to foundations, sidewalks, Pavement slabs, fences and outbuildings.
- B. Remove foundation walls at least 2 feet below the finished grade or 2 feet below the natural ground surface. Remove floor slab or break it into pieces no larger than 3 feet square.

- C. Backfilling and compaction of Excavations for structures, Section 31 23 23.
- D. Building components, Section 02 41 19.

3.4 PIPELINE DEMOLITION

- A. Salvaging Pipe: Do not damage.
- B. Plugs: Plug disconnected pipe lines near the right-of-way line with a water-tight concrete plug extending into the remaining pipe at least 2 feet.
- C. Service Laterals: Excavate and shut off the corporation stop. Disconnect.

3.5 BRIDGE AND ABUTMENT DEMOLITION

- A. Remove existing bridges and abutments indicated.
- B. Remove structures so that no remaining portion is closer than 3 feet to any water course or closer than 2 feet to the Subgrade and Embankment surface, or within 2 feet of the natural ground surface.
- C. Remove structures so that compacted backfill can be provided as required in backfilling operation, Section 31 23 23.

3.6 BURIED FUEL TANK DEMOLITION

- A. Remove buried fuel storage tanks and dispose of tank contents in accordance with Laws and Regulations.
- B. Do not spill fuel on Subgrade.
- C. Comply with the local authority having jurisdiction over fuel tank removals.

3.7 MISCELLANEOUS DEMOLITION

- A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements.
 - 1. Backfill is stable.
 - 2. Burial does not interfere with construction.
 - 3. Permission to do so is obtained from the ENGINEER.
 - 4. No remaining portion is within 2 feet of the final ground surface contours.

3.8 SALVAGE

- A. Salvage designated equipment and materials.
- B. All other salvageable materials become the property of the CONTRACTOR unless such materials are not owned by OWNER or OWNER requests such materials be returned to them.

END OF SECTION

SECTION 31 10 10

PAVEMENT REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of roadway Pavement.
- B. Milling roadway Pavement.
- C. Removal of curb, gutter, sidewalk, Driveway Approach, waterway, or similar flatwork.
- D. Disposal of removed materials.

1.2 RELATED WORK

- A. Demolition of structures and utilities.

1.3 DEFINITIONS

- A. ADA: Americans with Disabilities Act.

1.4 SUBMITTALS

- A. Traffic control plan, Section 01 55 26.

1.5 SITE CONDITIONS

- A. Control dust, Section 01 57 00.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. General
 - 1. Coordinate utility location, Section 01 31 13.
 - 2. Preserve all active utilities.
 - 3. Notify neighborhood of day and time of operation.
 - 4. Make sure invert covers are properly installed in storm drain and sanitary sewer systems, Section 01 71 13.
 - 5. Mark existing utilities on redline drawings.
- B. Traffic Control: Provide worker and public safety, Section 01 55 26.
- C. Tree Roots:
 - 1. Avoid or minimize damage to tree roots. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property.
 - 2. Provide certified arborist observation of root cuts larger than 4 inches diameter. Notify ENGINEER of such root cut.
- D. Existing Surfaces:
 - 1. Do not damage adjacent concrete surfaces that are not scheduled for removal.
 - 2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
 - 3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

3.2 SAW-CUT PEDESTRIAN TRIP HAZARDS

- A. Make saw cuts 1:8 slope measured to grade.
- B. Eliminate trip hazards across the full width of the hazard.

3.3 SAW-CUT CURB HORIZONTALLY

- A. Saw cut curbs for ADA ramps at 1:12 slope. No trip hazard at gutter flow line.
- B. Saw cut curbs for flares:
 - 1. 1:4 slope measured to grade, or
 - 2. 1:12 slope measured horizontally when complying with ADA.

3.4 REMOVE PORTLAND CEMENT CONCRETE

- A. Remove concrete to the nearest expansion joint or vertical saw cut.
- B. Make concrete cuts straight, vertical to the surface, true, full depth.
- C. DO NOT use machine mounted impact hammers.

3.5 REMOVE ASPHALT CONCRETE

- A. Saw cut full depth and remove pavement.
- B. When asphalt concrete overlays Portland cement concrete pavements do not use a machine mounted impact hammer.

3.6 MILLING

- A. Machine:
 - 1. Equipped to prevent air pollution.
 - 2. Equipped with a system to control slope of mill cut.
- B. Tolerances:
 - 1. Milling Depth: As indicated plus or minus 10 percent not uniformly high or uniformly low.
 - 2. Striation Texture: Uniform, discontinuous, longitudinal, 3/16 inch deep maximum, 3/4 inch center to center.
 - 3. Smoothness: Plus or minus 5/16 inch in 25 feet.
 - 4. Cross Slope: Plus or minus 1/4 inch in 10 feet.
- C. Performance:
 - 1. Lower utility frames, covers, and other Street Fixtures.
 - 2. Mill surfaces to the depth shown on the Drawings or indicated by ENGINEER. Do not disfigure adjacent work or existing surface improvements.
 - 3. If milling exposes smooth underlying Pavement surfaces, mill the smooth surfaces to make them rough.
 - 4. Mill off material if it ponds water or if it has been damaged by water.
 - 5. Where vehicles or pedestrians must pass over milled edges provide safe temporary ramps suitable to speed of user vehicles (or suitable for wheel chair user needs).
 - 6. Remove excess material and clean milled surfaces.
 - 7. If work equipment is removed from the milling site and milled surface awaits further work, provide appropriate traffic control and cleaning.

3.7 GRINDING

- A. Machine:
 - 1. Cutting head 36 inches wide minimum.
 - 2. 50 to 60 diamond blades per foot of head.
- B. Preparation:
 - 1. Control traffic.
 - 2. Provide water truck, waste truck, and other support machinery.
 - 3. Mark areas to be ground.

END OF SECTION

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SECTION 31 11 00

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of trees, stumps, roots, and tree debris.
- B. Clearing site of plant life, root systems and shrubs.
- C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 REFERENCES

- A. NAA: Pruning Standards for Shade Trees.
- B. Utah Shade Tree Pruning Standards.

1.3 QUALITY ASSURANCE

- A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 SITE CONDITIONS

- A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 PROTECTION

- A. Protect roots and branches of trees to remain.
- B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least 3 feet high.
- C. When setting posts, avoid damaging tree roots.
- D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.
- E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 STUMP TREATMENT SOLUTION

- A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Drawings do not purport to show all trees and shrubs existing on site.
- B. Verify with ENGINEER which plantings are to be removed or to remain.
- C. Tree root inspection:
 - 1. Assist ENGINEER by removing and replacing existing surface improvements.
 - 2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using Modification prices.

3.2 PREPARATION

- A. Locate utilities. Preserve utilities that are to remain in service.
- B. Review work procedures with ENGINEER.
- C. Schedule work carefully with consideration for property owners and general public.
- D. Before starting, arrange for the disconnection of all utility services that are to be removed or which interfere with work.

3.3 SITE CLEARING

- A. Remove all vegetation to outside Excavation, fill slope lines, and limits of slope rounding.
- B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 TREE REMOVAL

- A. Remove branches, limbs, and debris.
- B. Remove stumps and roots to 18 inches below proposed grade.
- C. For stumps larger than 6 inches caliper remove and treat as follows:
 - 1. Remove chips and debris from around remaining stump.
 - 2. Apply stump treatment solution in accordance with manufacturer's recommendations.
 - 3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
 - 4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation and disposal of excavated materials.
- B. Protection of existing facilities, utilities, and structures affected by excavation.

1.2 DEFINITIONS

- A. Extra Excavation: Upper limit of Excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.
- B. Classified Excavation: The excavation of specified materials.
- C. Incidental Excavation: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of Excavation, slough, or over-break.
- D. Unclassified Excavation: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or Rock fragments will not be sufficient cause to change classification of surrounding materials.

1.3 STORAGE AND HANDLING

- A. Stockpile excavated material to cause a minimum of inconvenience to public and provide for emergency services as necessary.
- B. Provide free access to all existing fire hydrants, water and gas valves, and meters.
- C. Provide free flow of storm water in all gutters, conduits, and natural water courses.
- D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.
- E. Promptly remove other material from site.

1.4 SITE CONDITIONS

- A. Prior to excavation, photograph existing surfaces along which work may take place in order to determine, after construction is completed, whether any damage to existing improvements occurred prior to construction operations. Refer to construction photograph requirements, Section 01 78 39.
- B. Perform Incidental Excavation at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 MATERIALS FOR OVER EXCAVATED AREAS

- A. Common fill, Section 31 05 13.
- B. Crushed aggregate base, Section 32 11 23.
- C. Stabilization fill, crushed aggregate base or common fill with maximum rectilinear particle size of 2 inches.
- D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

- A. Use white paint and mark the proposed Excavation.
- B. Call the one-call center and wait the required amount of time. Colors of one-call center marks indicate the following.
 - 1. White: Proposed Excavation
 - 2. Pink: Temporary survey markings
 - 3. Red: Electric power lines, cables, conduit and lighting cables
 - 4. Yellow: Gas, oil, steam, Petroleum or gaseous materials
 - 5. Orange: Communications, alarm, signal, cables or conduits.
 - 6. Blue: Potable water.
 - 7. Purple: Reclaimed Water, irrigation and slurry lines
 - 8. Green: Sewer and storm drain lines

3.2 PROTECTION

- A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.
- B. Pothole, expose or otherwise locate utilities as necessary to give utility company at least 4 days' notice to protect, preserve, or relocate a utility that interferes with or may be damaged by excavation work.
- C. Where utilities or structures conflict with design grades, report conflict to the appropriate utility company and ENGINEER 14 days prior to the initiation of work within the conflict area.
- D. For temporary controls, refer to Section 01 57 00.
- E. Support and protect from damage any existing facility and structure that exists in, passes through, or passes under the site.
- F. No Contract Time extension shall be granted and no additional compensation shall be made if CONTRACTOR fails to pothole and identify buried utilities or structures which conflict with the Work.

3.3 TOPSOIL

- A. Excavate topsoil only to depth that will preserve topsoil quality. B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.4 LANDSCAPE SPRINKLER SYSTEMS

- A. Protect existing landscape sprinkler systems.
- B. When disturbance of existing sprinkler system is required, interrupt and repair system so operation of system is maintained.

3.5 SHORING

- A. Slope, shore, sheet, brace or otherwise support Excavations over 4 feet deep, Section 31 41 00.
- B. When soil conditions are unstable, Excavations shallower than 4 feet deep must also be sloped, supported or shored.

3.6 DEWATERING

- A. Keep Excavation free from surface and ground water.
- B. If ground water table is in the intended construction operations, dewater Excavations.
- C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.
- D. If any evidence of contamination in the water, based on olfactory or visual indications, cease

excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.

- E. Pay for damages and costs resulting from dewatering operations.

3.7 GENERAL EXCAVATION REQUIREMENTS

- A. Excavate topsoil from areas to be re-landscaped or regraded and other marked areas.
- B. Excavate site to line and grade indicated.
- C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.
- D. Where soil has been softened or eroded by flooding or hardened by drying during unfavorable weather, rework all damaged areas or replace with approved material at no additional cost to OWNER.
- E. Notify ENGINEER of unexpected subsurface conditions.
- F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by Excavation work.
- G. Protect Excavation walls as required. If conditions permit, slope Excavation Sides to maintain a safe and clean working area. Remove loose materials.
- H. Where ENGINEER deems Subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.8 ROADWAY EXCAVATION

- A. In advance of setting line and grade stakes, clean Subgrade area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts that contain water.
- B. Backfill and compact over excavation, Section 33 05 05.

3.9 STRUCTURAL AND LANDSCAPE EXCAVATION

- A. Provide Shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.
- B. For piling work, coordinate special requirements for piling. Protect Excavation walls.
- C. If conditions permit, slope Excavation Sides as excavation progress. Maintain a safe and clean working area.
- D. Support Excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.10 TRENCH EXCAVATION

- A. Grade bottom of Trenches to provide uniform bearing surface.
- B. If necessary, make bellholes and depressions required to complete joining of pipe or box.
- C. Limit width of Trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.
- D. In public thoroughfares and regardless of Trench depth, limit length of open Trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect Trenches overnight.

3.11 EXTRA EXCAVATION

- A. If unstable material is encountered at the bottom or face of any Excavation, do not perform extra excavation without written consent.
- B. Correct excavations beyond the specified lines and grades by filling and compacting the resulting voids with acceptable fill.
- C. Volume of Excavation within any specified pay limit will be determined by the method of average-end-areas in the original position.

3.12 TOLERANCE

- A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 26

COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Compaction of granular fill materials.

1.2 REFERENCES

- A. ASTM D 698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN- m/m³)).
- B. ASTM D 1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- C. ASTM D 2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
- D. ASTM D 2922: Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D 3017: Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D 3282: Standard Practice for Classification of Soils and Soil- Aggregate Mixtures for Highway Construction Purposes.
- G. ASTM D 3740: Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS

- A. A-1 Soil: Defined in ASTM D 3282.
- B. Modified Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 1557 using procedure A, B or C as applicable.
- C. Relative Density (or Relative Compaction): The ratio of field dry density to the maximum laboratory density expressed as a percentage.
- D. Standard Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE

- A. Use a laboratory that follows and complies with ASTM D 3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION

- A. Moisten or dewater backfill material to obtain optimum moisture for compaction.
- B. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.
- C. When no density compactivity effort is specified, compact the entire area to eliminate unstable zones.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform control testing of materials. Perform additional testing at no additional cost to OWNER.
 - 1. Because of changes in source of materials or proportions requested by CONTRACTOR.
 - 2. Because of Failure of materials to meet specification requirements.
 - 3. For other testing services needed or required by CONTRACTOR.
- B. Report: For each material tested, record the following.
 - 1. Vertical and horizontal location of the test.
 - 2. Optimum laboratory moisture content.
 - 3. Field moisture content.
 - 4. Maximum laboratory dry density.
 - 5. Field density.
 - 6. Percent compaction results.
 - 7. Certification of test results by testing agency.
- C. Optimum Soil Density: Use ASTM D 2216 and the following industry standards.
 - 1. For A-1 Soils: Use test method C of ASTM D 1557 (Modified Proctor)
 - 2. For All Other Soils: Use test method C of ASTM D 698 (Standard Proctor).
- D. Field Density:
 - 1. Use ASTM D 3017 and test method C of ASTM D 2922 for shallow depth nuclear testing.
 - 2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Erosion control and slope protection facilities including blankets or mulches.
- B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

- A. Submit prior to using:
 - 1. Sample of blanket or geotextile materials.
 - 2. Mulch formula.
 - 3. Grass mixture listing.
 - 4. Plant list.
 - 5. Geotextile manufacturer's certification.
- B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.
- B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.
- C. Deliver blanket in original wrapping showing name of manufacturer and product weight.
- D. Deliver plant materials immediately prior to placement.
- E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced prior to planting.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Riprap.
- B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.
- C. Geotextiles.
- D. Erosion Control Vegetation Mats: Permanent three dimensional mats which allow for revegetation where high water flows are expected.
- E. Fiber Mulches: Straw, hay, wood or paper free from weeds or foreign matter detrimental to plant life.
- F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.
- G. Topsoil and Fertilizer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove foreign materials, roots, rocks, and debris.
- B. Grade to eliminate rough spots, and ponding areas.

- C. Grade soil to drain perimeter water away from protected areas.

- D. As applicable.
 - 1. Temporary controls.
 - 2. Grass.

3.2 SLOPE PROTECTION BLANKET

- A. Cover seeded slopes where grade is greater than 3 horizontal to 1 vertical with blanket. Roll down over slopes carefully and loosely without stretching or pulling.
- B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow Trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.
- C. Toe-in top end of each section in narrow Trench at least 12 inches deep. Toe-wrap fabric at bottom of slope.
- D. Staple loosely the outside edges and overlaps.
- E. In ditches, lay matting in upstream direction. Overlap and staple ends 6 inches with upstream section on top.
- F. If natural drainage water traverses protected or controlled area; construct a channel or riprap according to Drawings.
- G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.
- H. Present alternative methods of protection for approval prior to starting any work.

3.3 GEOTEXTILE

- A. Placement per drawings.

3.4 MULCHES

- A. Apply mulches at the rate indicated.
- B. When installed with a tackifier, apply at the rate recommended by the tackifier supplier.

3.5 SURFACE COVER

- A. Grass, Per Landscape Specifications
- B. Ground cover, Per Landscape Specifications

3.6 MAINTENANCE

- A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.
- B. Protect and repair geotextiles.
- C. Keep surface of soil damp only as necessary for seed germination.
- D. Apply water slowly so surface of soil will not puddle and crust.
- E. Replant damaged grass areas showing root growth Failure, deterioration, bare or thin spots, and eroded areas.
- F. Re-fertilize 60 days after planting.
- G. Remove weeds that are over 3 inches high.

END OF SECTION

SECTION 32 11 23

CRUSHED AGGREGATE BASE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Treated or untreated base course requirements.

1.2 REFERENCES

- A. ASTM C 29: Standard Test Method for Unit Weight and Voids in Aggregate.
- B. ASTM C 131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- D. ASTM D 75: Standard Practice for Sampling Aggregates.
- E. ASTM D 448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- F. ASTM D 1883: Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.
- G. ASTM D 2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- H. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials.
- I. ASTM D 3740: Standard Recommended Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- J. ASTM D 4318: Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- K. ASTM D 5821: Standard Test Method for determining the percentage of Fractured Particles in Coarse Aggregate.

1.3 DEFINITIONS

- A. Aggregate Grading Band: Allowable deviation from Target Gradation Curve based upon the number of gradation tests in a Lot. It is possible that gradation for any sieve may lie outside of its respective Master Grading Band limits.
- B. Master Grading Band: Gradation limits allowed for various sieve sizes ranging from the maximum size sieve to the No. 200 sieve.
- C. Mean of Deviations: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.
- D. Target Gradation Curve: A smooth locus of points within the limits of the Master Grading Band.

1.4 SUBMITTALS

- A. Name of Supplier and aggregate source.
- B. Target Gradation Curve.

1.5 QUALITY ASSURANCE

- A. Use a laboratory that follows and complies with Section 01 45 00 and ASTM D 3740.

1.6 ACCEPTANCE

A. General:

1. Defective work, Section 01 29 00.
2. Dispute resolution, Section 01 45 00.

B. Treated or Untreated Base Course: Lot size is one day's production. Sub-lot size is 500 tons.

1. ENGINEER is not obligated to accept changes in Target after any material is delivered to site.
2. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than pay factor 0.70 limits may stay in place at 50 percent cost.

| Table 1- Pay Factors for Price Determination | | | | | | |
|---|-------------------|--|------------------|------------------|------------------|--------------------------|
| Criteria | Pay Factor | Mean of Deviations of Acceptance Tests From the Target Gradation Curve Expressed in Percentage Points | | | | |
| | | 1 Sample | 2 Samples | 3 Samples | 4 Samples | 5 or More Samples |
| 1/2" Sieve | 1.00 | 0 – 15 | 0.0 – 12.1 | 0.0 – 10.8 | 0.0 – 10.0 | 0.0 – 9.5 |
| | 0.95 | 16 – 17 | 12.2 – 13.9 | 10.9 – 12.4 | 10.1 – 11.5 | 9.6 – 11. |
| | 0.90 | 18 – 19 | 14.0 – 15.1 | 12.5 – 13.5 | 11.6 – 12.5 | 11.1 – 11.9 |
| | 0.80 | 20 – 21 | 15.2 – 17.2 | 13.6 – 15.3 | 12.6 – 14.2 | 12. – 13.5 |
| | 0.70 | 22 – 23 | 17.3 – 18.8 | 15.4 – 16.7 | 14.3 – 15.5 | 13.6 – 14.7 |
| 3/8" Sieve | 1.00 | 0 – 15 | 0.0 – 11.5 | 0.0 – 9.8 | 0.0 – 8.8 | 0.0 – 8.0 |
| | 0.95 | 16 – 17 | 11.6 – 13.2 | 9.9 – 11.3 | 8.9 – 10.1 | 8.1 – 9.2 |
| | 0.90 | 18 – 19 | 13.3 – 14.4 | 11.4 – 12.3 | 10.2 – 11 | 9.3 – 10.0 |
| | 0.80 | 20 – 21 | 14.5 – 16.3 | 12.4 – 13.9 | 11.1 – 12.5 | 10.1 – 22.4 |
| | 0.70 | 22 – 23 | 16.4 – 17.9 | 14.0 – 15.2 | 12.6 – 13.6 | 11.5 – 12.4 |
| No. 4 Sieve | 1.00 | 0 – 14 | 0.0 – 10.5 | 0.0 – 8.8 | 0.0 – 7.8 | 0.0 – 7.0 |
| | 0.95 | 15 – 17 | 10.6 – 12.1 | 8.9 – 10.1 | 7.9 – 9.0 | 7.1 – 8.0 |
| | 0.90 | 18 | 12.2 – 13.1 | 10.2 – 11 | 9.1 – 9.8 | 8.1 – 8.7 |
| | 0.80 | 19 – 20 | 13.2 – 14.9 | 11.1 – 12.5 | 9.9 – 11.1 | 8.8 – 10.0 |
| | 0.70 | 21 – 22 | 15.0 – 16.3 | 12.6 – 13.6 | 11.2 – 12.1 | 10.1 – 10.8 |
| No. 16 Sieve | 1.00 | 0 – 11 | 0.0 – 8.2 | 0.0 – 6.9 | 0.0 – 6.2 | 0.0 – 5.6 |
| | 0.95 | 12 – 13 | 8.3 – 9.4 | 7.0 – 7.9 | 6.3 – 7.1 | 5.7 – 6.4 |
| | 0.90 | 14 | 9.5 – 10.3 | 8.0 – 8.6 | 7.2 – 7.8 | 6.5 – 7.0 |
| | 0.80 | 15 – 16 | 10.4 – 11.6 | 8.7 – 9.8 | 7.9 – 8.8 | 7.1 – 8.0 |
| | 0.70 | 17 | 11.7 – 12.7 | 9.9 – 10.7 | 8.9 – 9.6 | 8.1 – 8.7 |
| No. 50 Sieve | 1.00 | 0 – 9 | 0.0 – 7.0 | 0.0 – 6.1 | 0.0 – 5.5 | 0.0 – 5.2 |
| | 0.95 | 10 | 7.1 – 8.0 | 6.2 – 7.0 | 5.6 – 6.3 | 5.3 – 6.0 |
| | 0.90 | 11 | 8.1 – 8.8 | 7.1 – 7.6 | 6.4 – 6.9 | 6.1 – 6.5 |
| | 0.80 | 12 – 13 | 8.9 – 10.0 | 7.7 – 8.7 | 7.0 – 7.8 | 6.6 – 7.4 |
| | 0.70 | 14 | 10.1 – 10.9 | 8.8 – 9.5 | 7.9 – 8.5 | 7.5 – 8.1 |
| No. 200 Sieve | 1.00 | 0 – 4.5 | 0.0 – 3.4 | 0.0 – 2.9 | 0.0 – 2.5 | 0.0 – 2.3 |
| | 0.95 | 4.6 – 5.2 | 3.5 – 3.9 | 3.0 – 3.3 | 2.6 – 2.9 | 2.4 – 2.6 |
| | 0.90 | 5.3 – 5.6 | 4.0 – 4.3 | 3.4 – 3.6 | 3.0 – 3.1 | 2.7 – 2.9 |
| | 0.80 | 5.7 – 6.4 | 4.4 – 4.9 | 3.7 – 4.1 | 3.2 – 3.6 | 3.0 – 3.3 |
| | 0.70 | 6.5 – 7.0 | 4.9 – 5.3 | 4.2 – 4.5 | 3.7 – 3.9 | 3.5 – 3.6 |

3. Suitability of Source: Meet Table 2 properties. A reduction in aggregate class will be

accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase the Contract Price.

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. Material: Crushed rock, gravel, sand or other high quality mineral particle, or combination.

| Table 2 – Properties | | | | | |
|------------------------------|--------------|------------------------|----------|----------|------------------|
| Physical Property | Units | Aggregate Class | | | ASTM Test |
| | | A | B | C | |
| Dry Rodded Unit Weight, min. | lb/ft3 | 75 | | | C 29 |
| Liquid Limit, max. | | 25 | | | D 4318 |
| Plastic Index, max. | | 0 | 0 | 6 | D 4318 |
| Sand Equivalent, min. | percent | 35 | | | D 2419 |
| Wear (hardness), max. | percent | 50 | | | C 131 |
| Gradation | | Table 3 | | | C 136 |
| Two Fractured Faces, min. | percent | 90 | 50 | 50 | D 5821 |
| CBR, min. | percent | 70 | 55 | 40 | D 1883 |

NOTES

(a) Liquid limit, plastic limit, sand equivalent: Passing No. 40 sieve.
 (b) Wear: Retained on No. 8 sieve.
 (c) CBR: Use a 10 lb surcharge measured at 0.20 inch penetration at 95 percent of modified Proctor.
 (d) Faces: Retained on No. 4 sieve.

| Table 3 – Gradation | | | |
|----------------------------|------------------------------------|----------------|------------------|
| US Sieve Size | Master Grading Bands Limits | | |
| | Grade 1-1/2 | Grade 1 | Grade 3/4 |
| 2" | – | – | – |
| 1-1/2" | 100 | – | – |
| 1" | – | 100 | – |
| 3/4 " | 81 – 91 | – | 100 |
| 1/2 " | 67 – 77 | 79 – 91 | – |
| 3/8" | – | – | 78 – 92 |
| No. 4 | 43 – 53 | 49 – 61 | 55 – 67 |
| No. 16 | 23 – 29 | 27 – 35 | 28 – 38 |
| No. 200 | 6 – 10 | 7 – 11 | 7 – 11 |

2.2 ASPHALT TREATED BASE COURSE

- A. Meet requirements of this Section Article 2.1 and the following.
1. Sand equivalent and fractured face measured after asphalt residue is burned off.
 2. Plasticity and wear requirements apply to virgin aggregate portion only.
 3. Allowable asphalt content is controlled by CBR.

- B. If aggregate contains RAP.
 - a. Screen crushed RAP to remove debris.
 - b. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

2.3 SOURCE QUALITY CONTROL

- A. Sample, ASTM D 75 on a random basis, ASTM D 3665.
- B. Reject crushed aggregate base products that do not meet requirements of this Section.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Trenches, Section 33 05 20.
- B. Structures, Section 31 23 23.
- C. Landscaping, Section 32 91 19.
- D. Backfilling Roadways, Section 32 05 10.

3.2 FIELD QUALITY CONTROL

- A. Remove any product found defective after installation and install acceptable product at no additional cost to the OWNER.

END OF SECTION

SECTION 32 12 03

PAVING ASPHALTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance graded asphalt, asphalt cement, cutback asphalt, emulsified asphalt, recycle asphalt, and crack patch asphalt.
- B. Requirements for accepting non-complying paving asphalts.

1.2 REFERENCES

- A. ASTM D 113: Standard Test Method for Ductility of Bituminous Materials.
- B. ASTM D 977: Standard Specification for Emulsified Asphalt.
- C. ASTM D 2026: Standard Specification for Cutback Asphalt (Slow- Curing Type).
- D. ASTM D 2027: Standard Specification for Cutback Asphalt (Medium- Curing Type).
- E. ASTM D 2028: Standard Specification for Cutback Asphalt (Rapid- Curing type).
- F. ASTM D 2397: Standard Specification for Cationic Emulsified Asphalt.
- G. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
- H. ASTM D 4552: Standard Practice for Classifying Hot-Mix Recycling Agents.
- I. ASTM D 5710: Standard Specification for Trinidad Lake Modified Asphalt.
- J. ASTM D 6373: Standard Specification for Performance Graded Asphalt Binder.

1.3 SUBMITTALS

- A. Submit bill of lading for each shipment of paving asphalt from vendor. Identify the following.
 - 1. Source of product (manufacturer);
 - 2. Type and grade of asphalt, And
 - 3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE

- A. Reject paving asphalts which are not uniform in appearance and consistency or which foam when heated to mixing temperature.
- B. Do not use storage containers contaminated with other types or grades of Petroleum products.
- C. Do not use Petroleum product that does not comply with contract requirements.

1.5 ACCEPTANCE

- A. General:
 - 1. Acceptance is by Lot. One Lot is one day's production.
 - 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation.
- B. Performance Graded Asphalt Binder (PGAB): Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly from oil storage unit.
 - 1. Refer to limits identified in Section 209 of UDOT's "Manual of Instruction Part 8 Materials". Pay factors are as follows.
 - a. If none of the critical properties are outside rejection limit a composite price adjustment of 25 percent or less is allowed.

- b. If one or more of the critical properties falls outside the rejection limit or if a composite price adjustment is more than 25 percent, paving asphalt will be rejected.
- C. Asphalt Cement (AC) Binder: Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly from oil storage unit.
 - 1. Ductility: Meet this Section's requirements, or
 - 2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials".
 - a. Lot may be accepted using the published graphics. If price adjustment exceeds 30 percent, reject paving asphalt, or
 - b. If allowed to remain after placement, price adjustment will be 50 percent.
- D. Cut-back Binder: Meet this Section's requirements for ductility.
- E. Trinidad Lake Modified Asphalt: Supplier's certificate for ASTM compliance.
- F. Emulsified Asphalt: Supplier's certificate for ASTM compliance.
- G. Recycle Asphalt: Identity of source (asphalt cement or tar products).
- H. Crack Patch: Meet material requirements.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

- A. Petroleum asphalt that complies with ASTM D 6373. Blending the paving asphalt with polymers or natural asphalts is CONTRACTOR's choice.

2.2 ASPHALT CEMENT (AC)

- A. Petroleum asphalt that complies with Table 2 of ASTM D 3381 except as follows:
 - 1. Replace ductility at 77 deg. F. (25 deg. C.) with ductility at 39.2 deg. F. (4 deg. C.). Use the following values.
 - AC-5: greater than 25.
 - AC-10: greater than 15.
 - AC-20: greater than 5.
 - 2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".
- B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low- temperature copolymer consisting of 2 percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

- A. Petroleum asphalt that complies with ASTM D 5710 (a blend of natural asphalts).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

- A. Petroleum asphalt that complies with ASTM D 2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

- A. Petroleum asphalt that complies with ASTM D 2027 (fluxed or blended with a kerosene-type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg. F. (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

- A. Petroleum that complies with ASTM D 2028 asphalt (fluxed or blended with a naphtha-solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

- A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted.
 - 1. Anionic, ASTM D 977 (breaks by evaporation).
 - 2. Cationic, ASTM D 2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

- A. Petroleum asphalt that complies with ASTM D 4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage).
 - 1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP when less than 30 percent virgin aggregate is added.
 - 2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to the RAP.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Tack coat, Section 32 12 14.
- B. Prime Coat, Section 32 12 13.

END OF SECTION

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SECTION 32 12 05

ASPHALT CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Composition of asphalt - aggregate mix.
- B. This specification does not apply to polymer modified asphalt concrete.

1.2 REFERENCES

- A. AI Manual Series No. 2: Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- B. AASHTO T 324: Hamburg Wheel-track Testing of Compacted Hot- Mix Asphalt (HMA).
- C. ASTM C 29: Standard Test Method for Unit Weight and Voids in Aggregate.
- D. ASTM C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- E. ASTM C 117: Standard Test Method for Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.
- F. ASTM C 131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- G. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregate.
- H. ASTM C 142: Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- I. ASTM D 75: Standard Practice for Sampling Aggregates.
- J. ASTM D 140: Standard Practice for Sampling Bituminous Materials.
- K. ASTM D 242: Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
- L. ASTM D 979: Standard Methods for Sampling Bituminous Paving Mixtures.
- M. ASTM D 2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- N. ASTM D 3203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- O. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
- P. ASTM D 3515: Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- Q. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials.
- R. ASTM D 3666: Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
- S. ASTM D 4318: Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- T. ASTM D 4552: Standard Practice for Classifying Hot-Mix Recycling Agents.
- U. ASTM D 4791: Standard Test Method for Flat or Elongated Particles in Coarse Aggregate.
- V. ASTM D 4867: Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.
- W. ASTM D 5444: Standard Test Method for Mechanical Size Analysis of Extracted Aggregate.
- X. ASTM D 5581: Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6-jnch_Diameter Specimen)
- Y. ASTM D 5821: Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
- Z. ASTM D 6307: Standard Test Method for Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

AA. ASTM D 6373: Standard Specification for Performance Graded Asphalt Binder.

1.3 DEFINITIONS

- A. Asphalt-Aggregate Designator: Alpha-numeric code that indicates type and grade of asphalt, and type and grade of aggregate in an asphalt-aggregate mix. For example;
 - 1. "AC-20-DM-3/4" means asphalt-aggregate mix shall be composed of AC-20 type and grade asphalt cement and DM-3/4 type and grade aggregate.
 - 2. "RA-1-DM-1" means asphalt-aggregate mix shall be composed of RA-1 type and grade asphalt recycling agent and DM-1 type and grade aggregate.
 - 3. "RS-1-SS-II" means asphalt-aggregate mix shall be composed of RS-1 type and grade asphalt emulsion and SS-II type and grade aggregate.
- B. Mean of Deviations: Defined in Section 32 11 23.

1.4 SUBMITTALS

- A. Quality Assurance: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM standards.
- B. Mix Design: Submit.
 - 1. Date of mix design. If older than 365 days, recertify mix design.
 - 2. Asphalt cement source, type and chemical composition.
 - 3. Aggregate gradation target.
 - 4. Asphalt cement target, dust to asphalt ratio, moisture sensitivity (tensile strength) stability, flow and voids in the bituminous mix.
 - 5. Paving asphalt grade if RAP is used in the mix.
 - 6. RAP, mineral filler, antistripping, and recycle agent percentages.
- C. Pre-approved mix design, submit name and address of Supplier.
- D. Before changing mix design, submit a new design and give ENGINEER 10 days to evaluate the changes.
- E. Source Quality Control Inspections and Testing Report: If requested, submit report describing CONTRACTOR's and Supplier's quality control activities and test results.

1.5 QUALITY ASSURANCE

- A. Use a laboratory that follows and complies with ASTM D 3666.
- B. Do not change aggregate source or paving asphalt source without ENGINEER's written approval. Do not use non-complying sources.

1.6 ACCEPTANCE

- A. General:
 - 1. Acceptance is by Lot. One Lot is one day's production.
 - 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation.
- B. Installation: Accepted as specified in Section 32 12 16.
- C. Materials:
 - 1. At the Source:
 - a. Aggregate: Verify gradation. Collect sample from conveyor belt or stockpile if belt is not accessible.
 - b. Paving Asphalt: See Section 32 12 03 provisions.
 - c. Mix: 325 deg. F. maximum in transport vehicle.
 - d.
 - 2. At the Site:

- a. One sub-lot is 500 tons.
- b. Sampling: Two random samples per sub-lot. Location as follows.
 1. Behind paver before compaction, or
 2. Where sub-lot exhibits non-uniform appearance.
3. At the Laboratory:
 - a. Air Voids:
 1. Basis of evaluation is laboratory compacted samples (not field compacted samples).
 2. If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to ENGINEER.
 - b. Dust to asphalt ratio.
 - c. Asphalt Content, Aggregate Gradation: Lot is acceptable if test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than pay factor 0.85 limits may stay in place at 50 percent cost.

| Table 1 – Pay Factors for Non-complying Materials | | | | | | |
|--|-------------------|---|-------------------|-------------------|-------------------|--------------------|
| Criteria | Pay Factor | Range of Mean of Deviations of Tests Results from the Design Mix Target in Percentage Points | | | | |
| | | 500 Tons | 1,000 Tons | 1,500 Tons | 2,000 Tons | ≥2,500 Tons |
| Asphalt Content | 1.00 | 0.00–0.70 | 0.00–0.54 | 0.00–0.46 | 0.00–0.41 | 0.00–0.38 |
| | 0.975 | 0.71–0.80 | 0.55–0.61 | 0.47–0.52 | 0.42–0.46 | 0.39–0.43 |
| | 0.95 | 0.81–0.90 | 0.62–0.68 | 0.53–0.58 | 0.47–0.52 | 0.44–0.47 |
| | 0.90 | 0.91–1.00 | 0.69–0.75 | 0.59–0.64 | 0.53–0.56 | 0.48–0.52 |
| | 0.85 | 1.01–1.10 | 0.76–0.82 | 0.65–0.69 | 0.57–0.61 | 0.53–0.56 |
| 1/2" and larger Sieve | 1.00 | 0.0–10.9 | 0.0–7.3 | 0.0–6.5 | 0.0–5.6 | 0.0–5.2 |
| | 0.975 | 11.0–12.9 | 7.4–8.3 | 6.4–7.1 | 5.7–6.3 | 5.3–5.8 |
| | 0.95 | 13.0–13.9 | 8.4–9.3 | 7.2–7.9 | 6.4–7.0 | 5.9–6.4 |
| | 0.90 | 14.0–14.9 | 9.4– 10.3 | 8.0–8.7 | 7.1–7.7 | 6.5–7.1 |
| | 0.85 | 15.0–16.0 | 10.4–11.3 | 8.8–9.5 | 7.8–8.4 | 7.2–7.7 |
| 3/8" Sieve | 1.00 | 0.0–9.9 | 0.0–6.9 | 0.0–5.9 | 0.0–5.3 | 0.0–4.9 |
| | 0.975 | 10.0–10.9 | 7.0–7.8 | 6.0–6.6 | 5.4–6.9 | 5.0–5.5 |
| | 0.95 | 11.0–11.9 | 7.9–8.7 | 6.7–7.3 | 6.0–6.6 | 5.6–6.1 |
| | 0.90 | 12.0–13.9 | 8.8–9.6 | 7.4–8.0 | 6.7–7.2 | 6.2–6.6 |
| | 0.85 | 14.0–15.0 | 9.7–10.5 | 8.1–8.9 | 7.3–7.9 | 6.7–7.2 |
| No. 4 Sieve | 1.00 | 0.0–9.9 | 0.0–6.7 | 0.0–5.7 | 0.0–5.2 | 0.0–4.8 |
| | 0.975 | 10.0–11.0 | 6.8–7.6 | 5.8–6.3 | 5.3–5.8 | 4.9–5.4 |
| | 0.95 | 11.1–11.9 | 7.7–8.5 | 6.4–6.9 | 5.9–6.4 | 5.5–5.9 |
| | 0.90 | 12.0–12.9 | 8.6–9.4 | 7.0–7.5 | 6.5–7.0 | 6.0–6.5 |
| | 0.85 | 13.0–14.0 | 9.5–10.2 | 7.6–8.0 | 7.1–7.6 | 6.6–7.0 |
| No. 8 Sieve | 1.00 | 0.0–7.9 | 0.0–5.6 | 0.0–4.8 | 0.0–4.3 | 0.0–4.0 |
| | 0.975 | 8.0–8.9 | 5.7–6.3 | 4.9–5.4 | 4.4–4.8 | 4.1–4.5 |
| | 0.95 | 9.0–9.9 | 6.4–7.0 | 5.5–6.0 | 4.9–5.3 | 4.6–4.9 |
| | 0.90 | 10.0–10.9 | 7.1–7.7 | 6.1–6.6 | 5.4–5.8 | 5.0–5.4 |
| | 0.85 | 11.0–12.0 | 7.8–8.5 | 6.7–7.2 | 5.9–6.4 | 5.5–5.8 |

| | | | | | | |
|---|-------|-----------|---------|---------|---------|---------|
| No. 16 Sieve | 1.00 | 0.0–7.9 | 0.0–5.2 | 0.0–4.6 | 0.0–4.2 | 0.0–3.9 |
| | 0.975 | 8.0–8.9 | 5.3–5.8 | 4.7–5.1 | 4.3–4.6 | 4.0–4.3 |
| | 0.95 | 9.0–9.9 | 5.9–6.4 | 5.2–5.6 | 4.7–5.1 | 4.4–4.7 |
| | 0.90 | 10.0–10.9 | 6.5–7.0 | 5.7–6.1 | 5.2–5.5 | 4.8–5.1 |
| | 0.85 | 11.0–12.0 | 7.1–7.6 | 6.2–6.6 | 5.6–5.9 | 5.2–5.4 |
| No. 50 Sieve | 1.00 | 0.0–6.9 | 0.0–4.3 | 0.0–3.8 | 0.0–3.4 | 0.0–3.2 |
| | 0.975 | 7.0–7.9 | 4.4–4.8 | 3.9–4.1 | 3.5–3.8 | 3.3–3.5 |
| | 0.95 | 8.0–8.9 | 4.9–5.3 | 4.2–4.5 | 3.9–4.1 | 3.6–3.8 |
| | 0.90 | 9.0–9.9 | 5.4–5.8 | 4.6–4.9 | 4.2–4.4 | 3.9–4.1 |
| | 0.85 | 10.0–11.0 | 5.9–6.4 | 5.0–5.5 | 4.5–4.9 | 4.2–4.5 |
| No. 200 Sieve | 1.00 | 0.0–3.0 | 0.0–2.4 | 0.0–2.0 | 0.0–1.8 | 0.0–1.7 |
| | 0.975 | 3.1–3.5 | 2.5–2.7 | 2.1–2.2 | 1.9–2.0 | 1.8–1.9 |
| | 0.95 | 3.6–4.0 | 2.8–3.0 | 2.3–2.4 | 2.1–2.2 | 2.0–2.1 |
| | 0.90 | 4.1–4.5 | 3.1–3.3 | 2.5–2.7 | 2.3–2.4 | 2.2–2.3 |
| | 0.85 | 4.6–5.0 | 3.4–3.6 | 2.8–3.0 | 2.5–2.6 | 2.4–2.5 |
| <p>NOTES</p> <p>(a) Test paving asphalt content using a burn-off oven, ASTM D 6307.</p> <p>(b) Determine aggregate gradation by extraction, ASTM D 5444.</p> | | | | | | |

PART 2 PRODUCTS

2.1 PAVING ASPHALT

A. Asphalt Cement: Section 32 12 03. Substitutes for asphalt cement are as follows.

| ASTM D 3381 | ASTM D 6373 |
|--------------------|-------------------------|
| AC 10 | PG 64-22 or PG 70-28 |
| AC 20 | PG 70-28 |

B. Recycle Asphalt: Section 32 01 16.

2.2 AGGREGATE

A. Material: Clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.

B. Source: Use the following requirements to determine suitability of aggregate source and not for project control.

1. Coarse Aggregate:

- a. Angularity (fractured faces), ASTM D 5821: 50 percent maximum by weight of particles with at least 2 fractured faces.
- b. Hardness (toughness), ASTM C 131: 40 percent minimum wear of aggregate retained above the No. 4 sieve unless specific aggregates having higher values are known to be satisfactory.
- c. Flat or Elongated Particles, ASTM D 4791: 20 percent maximum retained above 3/8 inch sieve has a 3:1 length to width ratio.

2. Fine Aggregate:

- a. Friable Particles, ASTM C 142: 2 percent maximum passing No. 4 sieve.
- b. Plasticity, ASTM D 4318: Aggregate passing No. 40 sieve is non-plastic even when filler material is added to the aggregate.
 1. Liquid limit: Less than 25.
 2. Plastic limit: Less than 6.

2.3 ADMIXTURES

- A. Reclaimed Asphalt Pavement (RAP) Aggregate: Restrictions include.
 - 1. 15 percent by weight maximum providing grading and voids in the bituminous mix are met.
 - 2. Greater than 15 percent requires separate mix design.
- B. Mineral Filler: ASTM D 242.
- C. Recycle Agent: ASTM D 4552.
- D. Antistrip: Heat stable cement slurry or lime slurry.

2.4 MIX DESIGN

- A. Selection of Materials:
 - 1. Paving Asphalt, Section 32 12 03:
 - a. AC-10 or AC-20: Light traffic pavement.
 - b. AC-20: Medium traffic pavement.
 - c. RA: For hot-laid recycled asphalt pavement. Choice by CONTRACTOR.
 - 2. Aggregate: This Section Article 2.2.
- B. Selection of Design Aggregate Structure:
 - 1. Gradation: Maximum particle size is 1/2 compacted lift thickness.
 - a. Target Gradation Curve must lie within one of the Master Grading Bands in the following table, or
 - b. If acceptable to ENGINEER, use fractionated proportioning to select or adjust gradation.

| Table 2 – Master Grading Bands | | | | | | | |
|--------------------------------|---------|---------|---------|---------|----------|----------|----------|
| Sieve Size | Dense | | | | Open | Friction | |
| | DM-1 | DM-3/4N | DM-3/4 | DM-1/2 | OM-1/2 | FM-1 | FM-2 |
| 1 inch | 100 | | | | | | |
| 3/4 inch | | 100 | 100 | | | 100 | |
| 1/2 inch | 75 – 91 | 74 – 99 | | 100 | 100 | 90 – 100 | 100 |
| 3/8 inch | | 69 – 91 | 75 – 91 | | 93 – 100 | 60 – 100 | 90 – 100 |
| No. 4 | 47 – 61 | 49 – 65 | 46 – 62 | 60 – 80 | 36 – 44 | 15 – 40 | 30 – 50 |
| No. 8 | | 33 – 47 | | | 14 – 21 | 4 – 12 | 5 – 15 |
| No. 16 | 23 – 33 | 21 – 35 | 22 – 34 | 28 – 42 | | | |
| No. 50 | 12 – 22 | 6 – 18 | 11 – 23 | 11 – 23 | | | |
| No.200 | 3 – 7 | 2 – 6 | 3 – 7 | 3 – 7 | 2 – 4 | 2 – 5 | 2 – 5 |

NOTES

- (a) Gradation expressed in percent passing by weight, ASTM C 136.
- (b) It is assumed fine and coarse aggregate have same bulk specific gravity.
- (c) Friction Mixture: See ASTM D 3515.
- (d) DM -3/4N is 100% crushed.
- (e) Percentage of fines passing No. 200 sieve determined by washing, ASTM C 117.

2. Aggregate Blend:
 - a. Dry-rodded Unit Weight, ASTM C 29: 75 pounds per cubic foot minimum.
 - b. Weight Loss (soundness), ASTM C 88: 16 percent maximum using sodium sulfate.
 - c. Clay Content (cleanliness), ASTM D 2419: Sand equivalent value after going through the dryer or prior to the drum mixer.
 1. 45 percent minimum if Medium Traffic Classification.
 2. 60 percent minimum if Heavy Traffic Classification. The sand equivalent requirement is waived for the RAP aggregate but applies to the remainder of the aggregate blend.
- C. Selection of Admixture: CONTRACTOR's choice.
 1. RAP: Adjust paving asphalt grade to account for RAP binder viscosity.
 2. Cement or Hydrated Lime: Add if mix is moisture sensitive.
- D. Selection of Mix Properties: Use AI Manual Series No. 2 procedure for stability, flow and voids.
 1. Stability, Flow Voids: If traffic classification is not specified elsewhere, use Medium Traffic Classification.

Table 3 – Stability, Flow, Voids Limits

| Criteria | Traffic Classifications | | |
|---|-------------------------|---------|---------|
| | Light | Medium | Heavy |
| Number of compaction blows each end of specimen | 50 | 75 | 112 |
| Stability, lbs., minimum | 750 | 1200 | 1800 |
| Flow, in 0.01 inch units | 10 – 18 | 10 – 18 | 10 – 18 |
| Voids in Mineral Aggregate (VMA), percent minimum | | | |
| 1" nominal maximum particle size | 13 | 13 | 13 |
| 3/4" nominal maximum particle size | 14 | 14 | 14 |
| 1/2" nominal maximum particle size | 15 | 15 | 15 |
| 3/8" nominal maximum particle size | 16.5 | 16.5 | 16.5 |
| Voids in Bituminous Mix, percent | 3 – 5 | 3 – 5 | 3 – 5 |

NOTES

- (a) Traffic Classifications:
 - Light: (ESAL <104 per year)
 - Class I: Parking lots, Driveways, light traffic residential streets, light traffic farm roads.
 - Medium: (ESAL between 104 and 106 per year)
 - Class II: Residential streets, rural farm and residential roads.
 - Class III: Urban minor collector streets, rural minor collector roads.
 - Heavy: (ESAL >106 per year)
 - Class IV: Urban minor arterial and light industrial and light industrial streets, rural major collector and minor arterial highways.
 - Class V: Urban major arterial and heavy industrial streets, freeways, expressways, arterial highways, rural interstate and other principal arterial highways.
- (b) Stability, Flow, Voids: ASTM D 5581.
- (c) VMA: ASTM D 3203
- (d) Nominal maximum particle size is the largest sieve size listed in this Section upon which any material is retained.

2. Dust to Asphalt Ratio: 0.8 to 1.6.
3. Moisture Sensitivity, ASTM D 4867: Tensile strength ratio less than 0.80 using freeze-thaw conditioning. Test specimen shall be 150 mm in diameter and 95 mm in height and compacted at 7 percent plus or minus 1 percent air voids)
4. Rut Susceptibility, AASHTO T 324: Maximum rut depth is 10 mm at 20,000 passes.

2.5 SOURCE QUALITY CONTROL

- A. General: Collect samples, ASTM D 3665. Do not change sampling points.
 1. Aggregate sampling, ASTM D 75.
 2. Paving asphalt sampling, ASTM D 140. Test for viscosity and penetration.
- B. Asphalt-Aggregate Mix: Sample, ASTM D 979. Test for the following.
 1. Air voids, ASTM D 3203 or ASTM D 5581.
 2. Paving asphalt content, ASTM D 6307.
 3. Aggregate gradation, ASTM D 5444.
 4. Tensile strength of bitumen-aggregate mixtures, ASTM D 4867.
- C. Mixing Plant: ASTM D 3515.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Roadway paving, Section 32 12 17.
- B. Cold-Mix Asphalt Paving, Section 33 05 25.

END OF SECTION

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SECTION 32 12 14

TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Application of asphaltic material to existing asphalt concrete or Portland cement concrete surfaces preparatory to placing an asphalt concrete Pavement.

1.2 SUBMITTALS

- A. Certificate showing asphaltic material complies with Section 32 12 03.
 - 1. Identify water/asphalt dilution ratio.
 - 2. Identify tack coat application rate.
- B. Identify asphalt material recommended by fabric manufacturer.

1.3 WEATHER

- A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg. F. The temperature restrictions may be waived only upon written authorization from ENGINEER.
- B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

1.4 NOTICE

- A. Send written notice to residents or business owners 24 hours prior to applying coat.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

- A. Select from the following.
 - 1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
 - 2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
 - 3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

PART 3 EXECUTION

3.1 PREPARATION

- A. Select and advise ENGINEER of the type of tack material to be used.
- B. Clean the surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.
- C. Provide surface for pedestrian access across tack coat.
- D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

3.2 APPLICATION

- A. General:
 - 1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
 - 2. Apply tack only to area covered with asphalt concrete in the same day.

- B. Application rate: Typically as follows.
 - 1. Emulsions, 0.05 to 0.15 gallons per square yard.
 - 2. Cutback, CONTRACTOR's choice.
- C. Tack Substrate for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows.
 - 1. Dry Pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce the application rate to no less than 0.20 gallons per square yard.
 - 2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

3.3 PROTECTION

- A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.
- B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

- A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.
- B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.
- C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION

SECTION 32 12 16

PLANT MIX - ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Place Superpave or plant-mix asphalt concrete in base, leveling and surface courses, or overlay.

1.2 REFERENCES

- A. AASHTO T 324: Hamburg Wheel-track Testing of Compacted Hot- Mix Asphalt (HMA).
- B. ASTM D 979: Standard Practice for Sampling Bituminous Paving Mixtures.
- C. ASTM D 2041: Standard Test Method for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
- D. ASTM D 3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
- E. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials.
- F. ASTM E 950: Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
- G. ASTM E 1274: Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

1.3 SUBMITTALS

- A. Before Delivery:
 - 1. Traffic control plan, Section 01 55 26.
 - 2. Type and number of rollers.
 - 3. Manufacturer's certificate of compliance for paving geotextiles, Refer to Section 31 05 19.
 - 4. Location and name of asphalt concrete production facility.
 - 5. Proof of profilograph and profilograph operator certification.
- B. At Delivery: Supply batch ticket identifying.
 - 1. Serial number of ticket.
 - 2. Date and truck number.
 - 3. Job name, location, and mix identification.
 - 4. Type, grade, and weight of asphalt.
 - 5. Type, grade, and weight of aggregate.
 - 6. Mix design method.
- C. After Delivery:
 - 1. Profile deviation report.
 - 2. Profile roughness index report.
 - 3. Quality Control Inspections and Testing Report: Upon ENGINEER's request, submit report describing source and field quality control activities and test results performed by CONTRACTOR and CONTRACTOR's Suppliers.

1.4 QUALITY ASSURANCE

- A. Do not change asphalt or aggregate sources until ENGINEER accepts new source and new mix design.
- B. Reject product and work that does not meet requirements of this Section.
- C. Remove product found defective after installation and install acceptable product at no

additional cost to OWNER.

- D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

1.5 WEATHER

- A. Do not pave until air temperature is 45 deg F. and rising.
- B. Cease paving if air temperature falls below 50 deg F.
- C. Do not pave if surface is wet or weather is unsuitable.
- D. Do not pave if wind or ground cools mix material before compaction.

1.6 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before start of paving.
- B. Indicate paving time and when new surface can be used.
- C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- D. Should work not occur on specified day, send a new notice.

1.7 ACCEPTANCE

- A. General:
 - 1. Acceptance is by Lot. Lot size is specified below.
 - 2. Opening a paved surface to traffic does not constitute acceptance.
- B. Mix: Accepted as specified in Section 32 12 05, or Section 32 12 06.
- C. Installation:
 - 1. Mix Temperature:
 - a. Reject mixes exceeding 325 deg F. in transport vehicle.
 - b. Dispose of cold mix in paver hopper as thin spread underlay.
 - 2. Compaction and Thickness:
 - a. Lot size is 1,000 square yards or part thereof.
 - b. Verify with at least 2 tests per Lot.
 - c. Select test locations by ASTM D 3665 and sample per ASTM D 979 after compaction.
 - d. Compaction determinations are full core depth or overlay depth in overlay construction.
 - e. Thickness measurement will not apply in overlay construction.
 - f. Based upon core samples, compaction and thickness is acceptable if test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than Reject may stay in place at 50 percent cost.

| Table 1 – Compaction Pay Factors | | |
|----------------------------------|-----------------------------------|---------------|
| Pay Factor | Density, in Percent (ASTM D 2041) | |
| | Average | Lowest Test |
| 0.70 | More than 96 | – |
| 1.00 | 92 to 96 | 89 or greater |
| 0.90 | 92 to 96 | Less than 89 |
| Reject | Less than 92 | – |

NOTES

- (a) At CONTRACTOR's discretion and expense, do Hamburg wheel track test (AASHTO T 324) on 3 additional random core samples from a non-complying sub-lot. The sub-lot will be accepted if average rut depth is less than 10 mm at 20,000 passes.

| Table 2 – Thickness Pay Factor | |
|---------------------------------------|--|
| Pay Factors | Thickness Deficiency, in Inches (ASTM D 3549) |
| 1.00 | 0.00 to 0.25 |
| 0.90 | 0.26 to 0.50 |
| 0.70 | 0.51 to 0.75 |
| Reject | 0.76 to 1.00 |

3. Grade, Cross Slope: Verify tolerance is not exceeded.
4. Roughness: Verify “must grind” bumps are removed and tolerance for profile roughness index is not exceeded.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphalt concrete, Section 32 12 05.
- B. Tack coat, Section 32 12 14.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

- A. Lay Down Machine: Use track equipment when operating on fabrics, geogrids or Pavement mats hotter than 180 deg. F.
- B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

- A. General:
 1. Coordinate utility location. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
 2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
 3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
 4. Fill cracks and fix Potholes, Section 32 01 17.
 5. Stabilize concrete Subgrade slabs.
- B. Trees, Plants, Ground Cover:
 1. Protect trees, plants and other ground cover from damage.
 2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.
- C. Traffic Control:

1. Provide worker and public safety, Section 01 55 26.
 2. Apply temporary traffic and lane marking tape or paint after layout has been verified with ENGINEER.
- D. Aggregate Base Course:
1. Verify base course is placed to grade and compacted.
 2. If indicated, follow Section 31 25 00 for herbicide treatment or Section 32 12 13 for prime coat.
- E. Tack Coat: Apply tack coat, Section 32 12 14 if inlay or subbase Pavement surface is dirty or older than 24 hours.

3.3 TEMPORARY SURFACING

- A. Place, roll, maintain, remove and dispose of temporary surfaces.
- B. In sidewalk areas construct temporary Pavements at least 1 inch thick and in all other areas at least 2 inches thick. At major intersections and other critical locations a greater thickness may be required.

3.4 PLACE PAVING FABRIC

- A. Section 31 05 19.

3.5 PLACE PAVEMENT MIXTURE

- A. General:
 1. Provide continuous forward movement such that minimum temperature 10 feet behind paver is as follows.

| Table 3 – Minimum Temperature, Degrees F. | | | | | | |
|--|--------------------------------|-----------|---------------|-----------|-----------|------------|
| Air Temperature Deg F. | Compacted Mat Thickness | | | | | |
| | 3/4" | 1" | 1-1/2" | 2" | 3" | 4"+ |
| 45 – 50 | – | – | – | – | 280 | 265 |
| 50 - 59 | – | – | – | 280 | 270 | 255 |
| 60 - 69 | – | – | 285 | 275 | 265 | 250 |
| 70 - 79 | 285 | 285 | 280 | 270 | 265 | 250 |
| 80 - 89 | 280 | 275 | 270 | 265 | 260 | 250 |
| 90 + | 275 | 270 | 265 | 260 | 250 | 250 |

2. Do not leave unsafe butt joints if paving operation stops.
 3. Barricade or eliminate fall off edges.
- B. Overlays or Subsequent Lifts:
1. Allow new base Pavement or new inlay Pavement to harden (cure) prior to placing overlays.
 2. Apply tack coat per Section 32 12 14 if inlay or sub-base pavement surface is dirty or older than 24 hours.
- C. Irregular Areas: Handwork is acceptable if specified grades, slopes, compaction and smoothness is achieved.
- D. Compaction:
1. Do not over compact or under compact.
 2. Complete compaction before temperature drops to 180 deg. F.
- E. Joints:
1. Construct joints to have same texture, density and smoothness as other sections of new Pavement course.

2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new Pavements, or between successive day's work.
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least 6 feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges prior to making another pass with the paver if the mix has cooled to 90 deg. F.

3.6 TOLERANCES

- A. Compaction: 94 percent plus or minus 2 percent of theoretical maximum specific gravity, ASTM D 2041 (Rice Method).
- B. Lift Thickness:
 1. Not less than 2 times the maximum aggregate size in compacted asphalt concrete mixes.
 2. Not less than 4 times the nominal maximum aggregate size in compacted SUPERPAVE mixes.
 3. Not more than limits established by pneumatic or vibratory compactor equipment manufacturer.
- C. Grade: 1/8 inch in 10 feet parallel to centerline.
- D. Cross Slope: 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.
- E. Roughness:

| Table 4 – Roughness Tolerance | | | | | | |
|--|-------------|---|-----|-----|-----|--|
| Speed and Traffic Class | | Profile Roughness Index, (PRI) Inches / Mile | | | | Profile Deviation Inches/25 feet Maximum |
| | | IRI | | PI | | |
| | | Min | Max | Min | Max | |
| 0 to 29 mph | I or II | – | – | – | – | 0.4 |
| | III or IV | 129 | 177 | 46 | 66 | 0.4 |
| 30 to 44 mph | I or II | 90 | 115 | 35 | 50 | 0.4 |
| | III or IV | 70 | 90 | 21 | 35 | 0.4 |
| 45 mph + | All Classes | – | 70 | – | 21 | 0.3 |
| <p>NOTES</p> <p>(a) Use a zero blanking band.</p> <p>(b) As a minimum, trace right wheel path in direction of travel</p> <p>(c) Traffic class is defined in Table 3 of Section 32 12 05.</p> <p>(d) IRI (International Roughness Index), ASTM E 950</p> <p>(e) PI (Profile Index), ASTM E 1274.</p> | | | | | | |

1. Profile Deviation: Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas exceeding profile deviation tolerance are “must grind” areas.
2. Profile Roughness Index: (PRI)
 - a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding Lot. Treat partial segments longer than 250 feet as a Lot.

- b. Exclude from the Lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than 8 percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

3.7 PROTECTION AND REPAIR

- A. General: All expenses are at no cost to OWNER.
- B. Protection.
 1. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
 2. Remove spatter, over-coat, or mar.
 3. Do not discharge bituminous materials into borrow pits or gutters.
 4. Protect hot pavement from traffic until mixture has cooled enough not to become marked.
 5. Protect neighborhood, storm drains and down-stream fish habitat.
- C. Repair.
 1. Corrective Action for Profile Deviations ("Must Grinds"): Grinding is acceptable, Section 02 41 14. Apply Section 32 12 03 cationic or anionic emulsion and sand friction blotter over grind areas.
 2. Corrective Action for Profile Roughness Index: Grinding is acceptable. Skin patch for depressions is not acceptable. Raise depressions by milling and inlay. Re-profile corrected segments to verify index meets tolerance. Apply a Section 32 12 03 cationic or anionic emulsion and sand friction blotter over grind areas.
 3. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.
 4. Defective Joints, Seams, Edges: Repair.
 5. Unacceptable Paving: Remove and replace.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete base course and concrete surface course.
- B. Concrete product is not specified in this Section. Refer to Section 03 30 04.

1.2 REFERENCES

- A. ACI 305: Hot Weather Concreting.
- B. ACI 306: Cold Weather Concreting.
- C. APWA Plan No. 261: Manual of Standard Plans for Concrete Pavement Joints.
- D. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- E. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- F. ASTM C 78: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
- G. ASTM C 150: Standard Specification for Portland Cement.
- H. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.
- I. ASTM D 3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
- J. ASTM D 5249: Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.
- K. ASTM E 950: Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
- L. ASTM E 1274: Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

1.3 SUBMITTALS

- A. Before delivery.
 - 1. Traffic control plan.
 - 2. Joint layout plan.
 - 3. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of the concrete. Refer to ACI 305.
 - 4. Proof of finisher's ACI certification.
 - 5. Make and model name of paving machine.
 - 6. Concrete mix design and number, Section 03 30 04.
 - 7. Proof of profilograph calibration and profilograph operator certification.
 - 8. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.
- B. At Delivery: Batch ticket, Section 03 30 10. C. After delivery.
 - 1. Profile deviation report.
 - 2. Ride index report.
 - 3. Upon ENGINEER's request, submit a written quality control inspections and testing report describing source and field quality control activities and test results performed by CONTRACTOR and CONTRACTOR's Supplier.

1.4 QUALITY ASSURANCE

- A. Do not change concrete Supplier until ENGINEER accepts new source and new mix design.
- B. Reject product that does not meet requirements of Section 03 30 04.
- C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.
- D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

1.5 WEATHER

- A. Hot weather, ACI 305.
- B. Cold weather, ACI 306.

1.6 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before start of paving.
- B. Indicate paving time and when new surface can be used.
- C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- D. Should work not occur on specified day, send a new notice.

1.7 ACCEPTANCE

- A. General:
 - 1. Acceptance is by Lot. Lot size is specified below.
 - 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation.
 - 3. Dispute resolution.
 - 4. Opening a paved surface to traffic does not constitute acceptance.
- B. Concrete Mix:
 - 1. Testing Frequency: Section 03 30 05. Sample per ASTM C 172.
 - 2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until 2 consecutive batches are compliant then continue in random batch testing for acceptance.
 - 3. Strength: Lot is acceptable if strength test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than Reject may stay in place at 50 percent cost.

- a. Compression: ASTM C 39. Lot size is 500 square yards.

| Pay Factor | PSI Below 28 day Compressive Strength |
|-------------------|--|
| 1.00 | 0 |
| 0.98 | 1 to 100 |
| 0.94 | 101 to 200 |
| 0.88 | 201 to 300 |
| 0.80 | 301 to 400 |
| Reject | Greater than 400 |

- b. Flexural: ASTM C 78. Lot size is 750 square yard.

| Pay Factor | PSI Below 28 day Flexure Strength |
|-------------------|--|
| 1.00 | 0 |
| 0.95 | 1 to 29 |

| | |
|--------|-----------------|
| 0.85 | 30 to 60 |
| Reject | Greater than 60 |

C. Installation:

1. Placement, finishing and protection, Section 03 30 10.
 - a. Verify grade, cross slope, finish and dimensions.
 - b. No standing water in curb and gutter.
2. Thickness. Lot size is 1,000 square yards.
 - a. Thickness will be determined on ASTM D 3549 cored or sawed specimens. Acceptance will be based on the average of all Lot thickness tests.

| Pay Factor | Tolerance (inches less than specified thickness) |
|-------------------|---|
| 1.00 | 0.00 to 0.25 |
| 0.90 | 0.26 to 0.50 |
| 0.70 | 0.51 to 0.75 |
| 0.50 | 0.76 to 1.00 |

- b. When any thickness measurement is less than specified by more than 1 inch, the actual thickness of the Pavement will be determined by taking additional cores at intervals less than 10 feet parallel to the centerline in each direction from the affected location, until in each direction a core is found which is not deficient by more than 1 inch. Exploratory cores for deficient thickness will not be used in averages for price adjustments.
 - c. Payment may be made for areas deficient in thickness by more than 1 inch at 50 percent. If not, remove and replace.
 - d. Price adjustments and Pavement removal will be applied only to those areas showing the deficient thickness which is defined by an additional set of cores taken at the 100 percent pay point as determined in a straight line basis between the original cores. If the second set of cores is deficient, the area will be defined on a straight-line basis using all scores for the different pay factors.
 3. Roughness: "Must grind" bumps are removed and tolerance for profile roughness index is not exceeded.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Compression Design:
 1. Cast-in-place: Class 4000, Section 03 30 04.
 2. Slump per accepted mix design.
- B. Flexure Design.
 1. Tensile Strength: 650 psi per ASTM C 78.
 2. Cement Content: 6.5 bags.
 3. Water Cement Ratio: 0.44 maximum by weight (prior to pozzolan exchange), ACI 318.
 4. Entrained Air: 5 to 7 percent, ASTM C 231 (pressure).
 5. Slump per accepted mix design

2.2 MISCELLANEOUS MATERIALS

- A. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00.
- B. Hook Bolts: Steel, ASTM A 307 Grade A nuts and bolts, internally and externally threaded.
- C. Expansion Joint Filler: F1 sheet, Section 32 13 73.

- D. Contraction Joint Filler (Backer Rod): Type 1 round, closed cell, ASTM D 5249.
- E. Contraction Joint Sealant: HAS1, HAS4, or CAS6, Section 32 13 73.
- F. Curing Compound: Liquid membrane, Section 03 39 00.
- G. Bond Breaker: Wax based compound.
- H. Grout: Epoxy adhesive.
- I. Evaporative Reducer: Water-based mono-molecular polymer liquid at application rates recommended by the manufacturer. Not to be used as a finishing aid.

PART 3 EXECUTION

3.1 PREPARATION

- A. General:
 - 1. Coordinate utility location. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
 - 2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
 - 3. Coat surface of Street Fixtures with oil to prevent bond with concrete Pavement.
 - 4. Remove sand, leaves and other objectionable materials prior to placing the paving course.
 - 5. Notify ENGINEER minimum 24 hours prior to commencement of concreting operations.
- B. Trees, Plants, Ground Cover:
 - 1. Protect trees, plants and other ground cover from damage.
 - 2. Prune trees, Section 02231 to allow equipment passage underneath. Repair tree damage at no additional cost to the OWNER.
- C. Traffic Control:
 - 1. Provide worker and public safety.
 - 2. Apply temporary traffic and lane marking tape or paint after placement layout has been verified with ENGINEER.
- D. Base Course:
 - 1. Apply herbicide treatment where necessary.
 - 2. Verify base course is placed to grade, compacted and dampened.
 - 3. If indicated, apply Tack coat, Section 02406.
- E. Cement Treated or Lean Concrete Base: Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course. Moisten the surface but do not place concrete over puddled water. Apply a double coat of bond breaker prior to placing surface concrete.

3.2 FORM CONSTRUCTION

- A. Section 03 11 00.
- B. Check formwork for grade and alignment variance from the following tolerances:
 - 1. Top of forms not more than 1/4 inch from true grade.
 - 2. Vertical face on longitudinal axis not more than 1/4 inch from true line.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.3 REINFORCEMENT PLACEMENT

- A. Section 03 20 00.
- B. Interrupt reinforcement at expansion joints.
- C. Use load transfer bars on longitudinal construction and transverse construction joints.
- D. Use smooth dowel in expansion joints.
- E. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.
- F. Position mats on bar chair supports and properly tie before any concrete is poured. Keep

mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide a minimum of 2 inch overlap to adjacent mats.

3.4 JOINTS

- A. General:
 - 1. Review joint layout with ENGINEER.
 - 2. Follow Section 32 13 73 requirements.
 - 3. Follow joint requirements in APWA Plan No. 261.
- B. Construction Joint: Construction joints (contact joints) (cold joints) are those made by placing concrete against cured concrete.
 - 1. The contact joint between separately laid lanes cannot deviate from a true line by more than 1/4 inch in any direction at any point.
 - 2. Tie both sides of longitudinal and transverse construction joints together with tie bars or key-way. Before placing concrete in adjoining slab, straighten tie bars to 0.1 feet of straight position.
 - 3. Do not cause edge slump when placing tie-bars or by over-working edge of slab.
- C. Contraction Joints: Contraction joints (crack control joints) are scorelines made to force crack joint locations in concrete. Keep a minimum of 3 working power saws on the Project when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.
 - 1. Joint spacing measured in feet = twice the slab thickness measured in inches or a maximum of 15 feet.
 - 2. Joint Depth = T/3.
 - 3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
 - 4. Longitudinal Joints: Make longitudinal joints the same dimension as transverse joints.
 - 5. Make transverse joints across width of the Pavement full length and meet curb and gutter joints.
 - 6. Leave forms in place until paving operations are resumed on the other side of the joint.
- D. Volunteer Crack Joint:
 - 1. If a volunteer crack joints falls within 5 feet of the location of proposed contraction joint, omit the contraction joint.
 - 2. Rout volunteer crack joints to a 1-1/4 inch depth by 3/8 inch width. Clean and fill crack joint with backer rod and joint sealant.
 - 3. When crack joints occur within 2 feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.
- E. Expansion Joints:
 - 1. If a deformed rebar is used in an expansion joint, provide sleeve for movement.
 - 2. Secure fillers to prevent movement. When butted together, do not leave voids or gaps between filler units.
 - 3. Set joint fillers full depth if no joint sealant is specified.
 - 4. Recess joint fillers if backer rods and joint sealant are specified or provide a plastic cap.
- F. Joint Sealing: Section 32 13 73.
- G. If CONTRACTOR chooses to open the roadway to construction or public traffic prior to final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

3.5 CONCRETE PLACEMENT

- A. Section 03 30 10.
- B. At the beginning of concrete placement, test slump and air. If corrections are necessary,

placement may proceed after 2 subsequent and consecutive batches pass testing.

- C. Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping placement work.**
- D. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around Manholes or other structures until they are at required finish elevation and cross-slope.
- E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
- F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained an ASTM C 78 flexural strength (modulus of rupture) of 450 psi.
- G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint.
- H. Place the concrete to the full width of the Pavement in a single construction operation unless indicated otherwise.

3.6 FINISHING

- A. Section 03 35 00.
- B. Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct the difficulties.
- C. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- D. After floating, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities. Refloat repaired areas to provide a continuous smooth finish.
- E. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.
- F. Surface Texture: After floating when excess moisture or surface sheen has disappeared.
 - 1. For speed less than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.
 - 2. For speed greater than 45 mph: 1/8 inch deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2 inches.
- G. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.7 CURING

- A. Section 03 39 00.
- B. Type II Class A or B (white pigmented) membrane forming compound applied in two directions for total white coverage on all exposed surfaces after texturing.
- C. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air temperature.

3.8 TOLERANCES

- A. Grade: 1/8 inch in 10 feet parallel to centerline.
- B. Cross Slope: 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.
- C. Thickness: Not less than 1/4 inch deficient.
- D. Roughness:

| Table 1 – Roughness Tolerance | | | | | | |
|-------------------------------|-------------|---|-----|-----|-----|--|
| Speed and Traffic Class | | Profile Roughness Index, (PRI) Inches / Mile | | | | Profile Deviation Inches/25 feet Maximum |
| | | IRI | | PI | | |
| | | Min | Max | Min | Max | |
| 0 to 29 mph | I or II | – | – | – | – | 0.4 |
| | III or IV | 129 | 177 | 46 | 66 | 0.4 |
| 30 to 44 mph | I or II | 90 | 115 | 35 | 50 | 0.4 |
| | III or IV | 70 | 90 | 21 | 35 | 0.4 |
| 45 mph + | All Classes | – | 70 | – | 21 | 0.3 |

NOTES

(a) Use a zero blanking band.
 (b) As a minimum, trace right wheel path in direction of travel
 (c) Traffic class defined in Table 3, Article 02405.
 (d) IRI (International Roughness Index), ASTM E 950
 (e) PI (Profile Index), ASTM E 1274.

1. Profile Deviation: Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas exceeding profile deviation tolerance are “must grind” areas.
2. Profile Roughness Index: (PRI)
 - a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding Lot. Treat partial segments longer than 250 feet as a Lot.
 - b. Exclude from the Lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than 8 percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

3.9 OPENING TO TRAFFIC

- A. Not less than 3,000 psi compressive or 400 psi flexure strength.

3.10 PROTECTION AND REPAIR

- A. General: All expenses are at no cost to OWNER.
- B. Protection: Section 03 30 10 and as follows.
 1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either
 - a. Maturity meter.
 - b. Concrete cylinders.
 2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and

- spillage of materials as they occur.
3. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.
- C. Repair: Section 03 30 10.
1. Corrective Action for "Must Grinds": Grinding per Section 02 41 14 is acceptable after concrete cure.
 2. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance.
 3. Corrective Action for Cracks: Consider repair options published in Guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with Portland cement concrete bonded to Pavement with epoxy adhesive.

END OF SECTION

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joints and joint sealants in horizontal traffic surfaces for concrete sidewalks, curb, gutter and Pavement slabs.

1.2 REFERENCES

- A. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
- B. ASTM D 545: Standard Methods of Testing Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).
- C. ASTM D 994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- D. ASTM D 1190: Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type.
- E. ASTM D 1191: Standard Method for Testing Concrete Joint Sealers.
- F. ASTM D 1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- G. ASTM D 1752: Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- H. ASTM D 1850: Standard Specification for Concrete Joint Sealer, Cold-Application Type.
- I. ASTM D 1851: Standard Methods of Testing Concrete Joint Sealers, Cold-Application Type.
- J. ASTM D 2240: Standard Test Method for Rubber Property - Durometer Hardness.
- K. ASTM D 2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- L. ASTM D 3405: Standard Specification for Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.
- M. ASTM D 3406: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.
- N. ASTM D 3407: Standard Methods of Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.
- O. ASTM D 3408: Standard Methods of Testing Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.
- P. ASTM D 3542: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Bridges.
- Q. ASTM D 3569: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.
- R. ASTM D 3575: Standard Test Method for Flexible Cellular Materials Made from Olefin Polymers.
- S. ASTM D 3581: Standard Specification for Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.
- T. ASTM D 3582: Standard Methods for Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.
- U. ASTM D 3583: Standard Methods of Testing Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type, for Portland Cement Concrete Pavements.
- V. ASTM D 5249: Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.
- W. ASTM D 5893: Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- X. FS SS-S-200: Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 SYSTEM PERFORMANCES

- A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.
- B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

- A. Manufacturer's certification that product was manufactured, tested and supplied per source quality control requirements specified herein, together with a report of the test results and the date each test was completed.
- B. Manufacturer's instruction for joint preparation, type of cleaning and installation.
- C. Manufacturer's Product Data and Samples for each joint sealant product required.
- D. Safety data sheets.

1.5 QUALITY ASSURANCE

- A. Installation of joint systems are to follow manufacturer's published directions.
- B. For cold applied joint sealant installation, use installers approved by the joint sealant Supplier.
- C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 PRODUCTS

2.1 GENERAL

- A. Compatibility: Provide joint fillers, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.2 JOINT VOID – FORMER

- A. Plastic with a water stop.
- B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

- A. F-1: Bituminous (asphalt or tar) mastic, ASTM D 994. Formed and encased between 2 layers of bituminous saturated felt or 2 layers of glass-fiber felt.
- B. F-2: Cane or other cellulosic fiber, ASTM D 1751. Saturated with asphalt.
- C. F-3: Granulated cork, ASTM D 1751. In an asphalt binder; encased between 2 layers of asphalt saturated felt or 2 layers of glass-fiber felt.
- D. F-4: Sponge rubber fully compressible, ASTM C 1752. With resiliency recovery rate of 90 percent minimum.
- E. F-5: Cork, ASTM C 1752. Impregnated and bound with asphalt, compressible with resiliency

recovery rate of 90 percent if not compressed more than 50 percent of original thickness.

- F. F-6: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 lb/ft³ density maximum, And of size and shape to control sealant depth and performance.

2.4 JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE

- A. Backer material, ASTM D 5249 for cold- and hot-applied joint sealant in Portland cement concrete or asphalt Pavements joints.
 - 1. Type 1: Round rods.
 - 2. Type 2: Sheets or strips, laminated or skived.
 - 3. Type 3: Poured fills which completely fill Pavement joint.

2.5 JOINT SEALANT – GENERAL

- A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 JOINT SEALANT - HOT-APPLIED

- A. HAS-1: Asphalt base type, ASTM D 3405.
- B. HAS-2: Thermoplastic type, ASTM D 3581. Jet-fuel resistant without rubber unless indicated otherwise.
- C. HAS-3: Elastic type, ASTM D 1190.
- D. HAS-4: Elastomeric type, ASTM D 3406. One component, for Portland cement concrete Pavements.
- E. HAS-5: Elastomeric type, ASTM D 3569. One component, jet-fuel resistant, for Portland cement concrete Pavements.

2.7 JOINT SEALANT - COLD-APPLIED

- A. CAS-1: Elastomeric type, ASTM C 920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield Pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O.
 - 1. Self-leveling.
 - 2. Shore A Hardness: 40 \pm 5 ASTM D 2240.
 - 3. Final cure: 4 days maximum.
 - 4. Service range: -10 to 150 deg. F.
- B. CAS-2: Mastic type, ASTM D 1850. Single or multiple component; for joints having a minimum width of 1/2 inch.
- C. CAS-3: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.
- D. CAS-4: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio.
 - 1. For concrete Pavement seal, ASTM D 2628.
 - 2. For concrete bridge seals, ASTM D 3542.
- E. CAS-5: Silicone type, ASTM D 5893. Single component, non-sag or self-leveling, chemically curing sealant based on polymers of polysiloxane structure intended for use in Portland cement concrete Pavements.
- F. CAS-6: Asphalt base meeting ASTM D 3405.
- G. CAS-7: Olefin polymer, ASTM D 3575 as follows.
 - 1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
 - 2. Tensile strength 115 psi minimum, Suffix T
 - 3. Density 2.9 plus or minus 3 lbs/cf, Suffix W, Method A
 - 4. Water Absorption 0.025 lbs/sf maximum, Suffix L.

2.8 SOURCE QUALITY CONTROL

- A. Preformed Expansion Joint Fillers: Nonextruding and resilient types, ASTM D 545.
- B. Hot-Applied Joint Sealants:
 - 1. Elastic type used in concrete Pavements, bridges, other structures, ASTM D 1191.
 - 2. Bituminous type for hydraulic and asphaltic concrete Pavements, ASTM D 3407.
 - 3. Elastomeric type for hydraulic concrete Pavement, ASTM D 3408
- C. Jet-Fuel-Resistant Joint Sealant: Hot-applied, ASTM D 3582 and ASTM D 3583.
- D. Cold-Applied Mastic Joint Sealant: Cold-applied, ASTM D 1851.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus 5 degrees.
- B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.
- C. Remove frost and moisture in concrete joint substrates before commencing sealing.
- D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 JOINT SEALING

- A. General:
 - 1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.
 - 2. Except as otherwise indicated, fill sealant rabbet flush with surface.
 - 3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.
- B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:
 - 1. For sidewalks, Pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
 - 3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.
- C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.
- D. Heating: Do not use overheated hot-applied sealants.
- E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

- A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.
- C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

- A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of Substantial Completion.
- B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

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SECTION 32 16 13

DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete flatwork such as but not limited to waterways, waterway transition structures, sidewalks, curbs, gutters, Driveway Approaches.

1.2 REFERENCES

- A. American Public Works Association (Utah Chapter).
 - 1. Plan 205: Curb and Gutter.
 - 2. Plan 209: Curbs.
 - 3. Plan 211: Waterway.
 - 4. Plan 213: Waterway Transition Structure.
 - 5. Plan 215: Dip Driveway Approach.
 - 6. Plan 216: Mountable curb driveway approach.
 - 7. Plan 221: Flare Driveway Approach.
 - 8. Plan 225: Open Driveway Approach.
 - 9. Plan 229: Pipe Driveway Approach.
 - 10. Plan 231: Concrete Sidewalk.
- B. ASTM A 36: Standard Specifications for Structural Steel.
- C. ASTM C 39. Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- D. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.

1.3 DEFINITIONS

- A. Driveway: A paved or unpaved vehicular thoroughfare outside of, but connected to a public road right-of-way or highway right-of-way.
- B. Driveway Approach: (1) A vehicular thoroughfare connecting a public road or highway to a driveway. (2) A concrete structure composed of sidewalk, apron and any curb and gutter abutting the apron. When an apron is built as a bridge over curb and gutter, the bridge is included in this definition.

1.4 SUBMITTALS

- A. Traffic control plan, Section 01 55 26.
- B. Concrete mix design, Section 03 30 04.
- C. Batch ticket, Section 03 30 10.
- D. Quality Control Inspections and Testing Report: Upon ENGINEER's request, submit a report describing source and field quality control activities and test results performed by CONTRACTOR and CONTRACTOR's Suppliers.

1.5 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before work starts.
- B. Indicate when concrete work will take place and when driveway approach can be used.
- C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- D. Should work not occur on specified day, send a new notice.

1.6 ACCEPTANCE

A. General:

1. Acceptance is by Lot. One Lot is one day's production.
2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. Concrete Mix:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C 172.
2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until 2 consecutive batches are compliant then proceed in random batch testing for acceptance.
3. Strength: ASTM C 39. Lot size is 50 cubic yards. At ENGINEER's discretion, a Lot with sub-lot test deviations greater than Reject may stay in place at 50 percent cost.

| Pay Factor | PSI Below 28 day Compressive Strength |
|-------------------|--|
| 0.98 | 1 to 100 |
| 0.94 | 101 to 200 |
| 0.88 | 201 to 300 |
| 0.80 | 301 to 400 |
| Reject | Greater than 400 |

C. Placement, finishing and protection, Section 03 30 10

1. Verify line, grade, cross slope and finish.
2. No standing water in curb and gutter.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Mix

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Maximum slump per mix design.

B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel per Section 03 20 00.

C. Expansion Joint Filler: F1 sheet 1/2 inch thick per Section 32 13 73.

D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round Section 32 13 73.

E. Contraction Joint Sealer: HAS1 or HAS4 hot applied per Section 32 13 73.

F. Curing Compound: Membrane forming compound per Section 03 39 00.

G. Plate Steel: ASTM A 36 galvanized per Section 05 05 10.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Slip Form Machines.

1. Placement must produce required cross-section, lines, grades, finish, and jointing as specified for formed concrete.
2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION

- A. Control pedestrian and vehicular traffic, Section 01 55 26.
- B. Examine surfaces scheduled to receive concrete formwork for defects.
- C. Do not start work until defects are corrected.
- D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 LAYOUT

- A. Curb, Gutter, Curb and Gutter: Plan 205, 209, 211, 213 or as specified on the drawings.
 - 1. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
 - 2. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final cure has been reached. Remove and replace any area where ponding is found.
- B. Sidewalk: Plan 231 or as specified on the drawings.
 - 1. Cross slope 2 percent.
 - 2. Landing slope 2 percent maximum in any direction.
 - 3. Ramp slope, Section 32 16 14.
- C. Driveway Approaches: Plan 215, 216, 221, 225, 229 or as specified on the drawings.

3.4 CONCRETE PLACEMENT

- A. Section 03 30 10.
- B. Make sure base course is uniformly damp at time of concrete placement.
- C. Obtain ENGINEER's review of base course and forms before placing concrete.
- D. Do not use methods that segregate the mix.
- E. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.
- F. Consolidate concrete with vibrator or other acceptable method. Do not use mechanical vibrators. Prevent dislocation of inserts.

3.5 CONTRACTION JOINTS

- A. Geometrics:
 - 1. Tooled Joints (Score Lines):
 - a. Depth = $T/4$. T is the depth of the concrete slab in inches.
 - b. Top radius = 1/2 inch.
 - 2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.
 - 3. Template Joints: 1/8 to 3/16 inch wide 1/4-depth of slab.
- B. Sidewalks.
 - 1. At intervals equal to the width of the sidewalk and transverse to the line of walk.
 - 2. Radial at curbs and walk returns.
 - 3. Place longitudinal joints in walks when width of walk in feet is greater than 2 times the walk thickness in inches. (e.g. maximum width of a 4 inch thick walk before placement of a longitudinal contraction joint is 8 feet). Make longitudinal joints parallel to, or concentric with, the lines of the walk.
 - 4. In walk returns make 1 joint radially midway between the beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with the adjacent walks.
- C. Curb, Gutter, Waterway.
 - 1. Place joints at intervals not exceeding 12 feet.
 - 2. At curb radius and walk returns make the joints radial.
 - 3. Where integral curb and gutter is adjacent to concrete Pavement, align the joints with the Pavement joints where practical.
- D. Additional Contraction Joint Requirements: Section 32 13 73.

3.6 EXPANSION JOINTS

- A. Geometrics: 1/2 inch wide full depth filler that is flush with concrete surface. Do not place seal over top of filler
- B. Sidewalks, Sidewalk Ramps.
 - 1. Place expansion joints to separate sidewalk from utility poles, hydrants, Manhole frames, buildings and abutting sidewalks.
 - 2. Place expansion joints between the sidewalk and the back of curb returns and between the sidewalk and sidewalk ramps.
 - 3. Do not place expansion joints in sidewalk ramp surfaces.
 - 4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.
- C. Curb, Gutter, Waterway.
 - 1. Do not place longitudinal joints in drain gutter flow-lines.
 - 2. Where drain gutter transitions extend beyond the curb return, place expansion joints at the ends of the drain gutter transition.
 - 3. Place expansion joints at beginning of curb radius (BCR) and end of curb radius (ECR).
- D. Slip Form Work: Expansion joints are not required except at BCR or ECR.
- E. Driveway Approach: Do not place expansion joints in curb returns.
- F. Street Intersection Corner: Place expansion joints at BCR and ECR.
- G. Additional Expansion Joint Requirements: Section 32 13 73.

3.7 FINISH

- A. Section 03 35 00.
- B. Round edges exposed to public view to a 1/2 inch radius.
- C. Apply broom finish longitudinal to curb and gutter flowline.
- D. Apply broom finish transverse to sidewalk centerline as follows.
 - 1. Fine hair finish where grades are less than 6 percent.
 - 2. Rough hair finish where grades exceed 6 percent.
- E. Remove form marks or irregularities from finish surfaces.

3.8 CURING

- A. Section 03 39 00.
- B. Type ID Class A (clear with fugitive dye) membrane forming compound. Apply total coverage in 2 directions after texturing.
- C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.9 PROTECTION AND REPAIRS

- A. General: All expenses are at no cost to OWNER.
- B. Protection: Section 03 30 10.
 - 1. Protect concrete work from deicing chemicals during the 28 day cure period.
 - 2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.
- C. Repair: Section 03 30 10.
 - 1. Correct all humps or depressions.
 - 2. Secure ENGINEER's acceptance of method of correction.

END OF SECTION

SECTION 32 16 14

CURB RAMP

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete flatwork for curb cut assemblies.

1.2 REFERENCES

- A. American Public Works Association (Utah Chapter).
 - 1. Plan 235: Corner Curb Cut Assembly.
 - 2. Plan 236: Tangent Curb Cut Assembly.
 - 3. Plan 237: Islands and Median.
 - 4. Plan 238: Detectable Warning Surface.
 - 5. Or as specified on the drawings.
- B. Work Zone Traffic Control Guide: Publication of the Utah LTAP Center.

1.3 DEFINITIONS

- A. Clear Space: A 4 feet minimum by 4 feet minimum surface located within the width of the crosswalk and adjacent to a curb cut.
- B. Cross Slope: Grade perpendicular to the direction of pedestrian travel usually expressed in percent.
- C. Running Slope: Grade parallel to the direction of pedestrian travel usually expressed in percent.
- D. Ramp: A flat surface with a maximum Running Slope of 1:12 (8.33 percent) and a maximum Cross Slope of 1:48 (2 percent) with sides perpendicular to its ends and ends parallel to each other.
- E. Curb Ramp: A Ramp that cuts through a curb.
- F. Detectable Warning Surface: A surface of truncated domes aligned in a square or radial grid pattern.
- G. Cross Width: Distance perpendicular to the direction of pedestrian travel usually expressed in lineal measure.
- H. Running Width: Distance parallel to the direction of pedestrian travel usually expressed in lineal measure.

1.4 SUBMITTALS

- A. Traffic control plan, Section 01 55 26.
- B. Concrete mix design, Section 03 30 04.
- C. Batch ticket, Section 03 30 10.
- D. Detectable Warning Surface product data sheet.

1.5 ACCEPTANCE

- A. Clear Space: Running Slope.
- B. Flow-line: No standing water, no trip hazard.
- C. Detectable Warning Surface:
 - 1. Color contrast, dome geometry, joints between units.
 - 2. Cross Width, Running Width.
- D. Curb Cut: Cross Width (appropriate to number of crosswalks served).
- E. Landing: Running Slope, Cross Slope, dimensions.

- F. Ramp: Running Slope, Cross Slope, Cross Width, transition ends.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cast-in-place Concrete: Class 4000, Section 03 30 04.
- B. Pavers:
 - 1. Concrete, Section 32 14 13.
 - 2. Brick, Section 32 14 16.
- C. Other Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 PREPARATION

- A. Refer to Work Zone Traffic Control Guide.
- B. Refer to Plan 235, 236, 237, and 238.

3.2 TRAFFIC CONTROL

- A. Provide safe passage for pedestrians and vehicles.
- B. Assist visually impaired and wheel chair users.
- C. Provide continuous access to fire hydrants.
- D. Keep passage ways free of construction materials, trash and debris.
- E. Remove graffiti immediately.

3.3 LAYOUT

- A. Curb Cut excluding flare or curb radius measurement):
 - 1. Cross Width at Curb Ramp.
 - a. 4 feet minimum serving one crosswalk.
 - b. 8 feet minimum serving two or more crosswalks.
 - 2. Cross Slope at Curb Ramp: 2 percent maximum.
- B. Detectable Warning Surface:
 - 1. Running Length: 2 feet minimum.
 - 2. Cross Width:
 - a. 4 feet minimum serving one crosswalk.
 - b. 8 feet minimum serving two or more crosswalks.
 - 3. Joint Between Units: 3/16 inch maximum or manufacturer's recommendation
- C. Landing: Determine landing position and elevation so ramps that slope to and from the landing meet ramp slope requirements.
- D. Ramp:
 - 1. Do not exceed maximum slope or 15 feet length.
 - 2. It may be necessary to include a transition zone between a curb cut and ramp.
- E. Curb Wall: Set top of curb wall equal to elevation of extended lateral lines of sidewalk.

3.4 INSTALLATION

- A. Pour concrete, Section 03 30 10.
- B. Install Detectable Warning Surface full length and full width across the pedestrian access route.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Paints for Pavement striping.
- B. Words and other markings in paint or plastic film.
- C. One or two-way prismatic reflectors for Pavement marking.

1.2 REFERENCES

- A. AASHTO M 237: Standard Specification and Recommended Practice for Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.
- B. AASHTO M 247: Standard Specification for Glass Beads Used in Traffic Paint.
- C. AASHTO M 248: Standard Specification for Ready-Mixed White and Yellow Traffic Paints.
- D. AASHTO M 249: Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form).
- E. ASTM D 638: Standard Test Method for Tensile Properties of Plastics.
- F. ASTM E 303: Standard Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
- G. FS L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.
- H. Federal Standard 141: Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling, and Testing.
- I. Federal Standard 370: Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices.
- J. MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 SUBMITTALS

- A. Specifications of primer to be used for tape applications.
- B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.
- C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degree observation angle.
- D. Manufacturer's recommendation for type of epoxy to be used when installing prismatic reflectors and markers.
- E. Samples of each thermoplastic or preformed plastic Pavement markings along with a statement of how the materials will be applied.

PART 2 PRODUCTS

2.1 ALKYD RESIN PAINT

- A. White or yellow Type F (Fast dry) ready-mixed, AASHTO M 248.

2.2 THERMOPLASTIC PAINT

- A. White or yellow, AASHTO M 249.

2.3 GLASS BEADS

- A. Type 1, AASHTO M 247.

2.4 REFLECTIVE TAPE

- A. Type II white or yellow with a Class 1 (pressure-sensitive) adhesive, FS L-S-300.

2.5 REFORMED PLASTIC FILM MATERIALS

- A. Film: A retroreflective pliant polymer with white or yellow pigments selected and blended to conform to standard highway colors throughout the expected life of the film and glass beads distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top surface and composed of the following materials.

| Materials | Minimum Percent By Weight |
|------------------------|----------------------------------|
| Resin and Plasticizers | 20 |
| Pigments and Extenders | 30 |
| Graded Glass Beads | 33 |

- 1. Type 1: Subjected to high traffic volume and severe wear conditions such as repeated shear action from crossover, encroachment on edge and channelization lines, and stop, start, or turn movements.
 - a. Class 1: Without precoated adhesive, for application with epoxy cement.
 - b. Class 2: With precoated pressure sensitive adhesive.
- 2. Type 2: Subjected to lower traffic volumes and less severe wear action such as most highway edge lines, markings on rural highways, lane lines in well-channelized areas and transverse and word/symbols subjected primarily to free rolling traffic.
 - a. Class 1: Without precoated adhesive, for application with epoxy cement.
 - b. Class 2: With precoated pressure sensitive adhesive
- B. Tensile Strength: Sample 6 x 1 x 0.06 inches at a temperature between 70 deg. F. and 80 deg. F. using a jaw speed of 10 inches to 12 inches per minute tested per ASTM D 638 requirements.
 - 1. Type 1: 150 pounds per square inch of cross-section.
 - 2. Type 2: 40 pounds per square inch of cross-section.
- C. Elongation: 75 percent minimum at break when tested per ASTM D 638 requirements using a Sample 6 x 1 x 0.06 inches at a jaw speed of 10 inches to 12 inches per minute.
- D. Skid Resistance: Initial minimum skid resistance values are 35 BPN as measured by the British Portable Skid Test, ASTM E 303 requirements.
- E. Reflectance: Minimum reflectance values at 0.2 degrees and 0.5 degrees observation angles and 86.0 degrees entrance angle as measured per the testing procedures of Federal Standard 370.

| Film Type | Observation Angles | | | |
|------------------------|---------------------------|-------------|---------------|-------------|
| | White | | Yellow | |
| | 0.2o | 0.5o | 0.2o | 0.5o |
| Type 1: SL (mcd/sf/ft) | 550 | 380 | 410 | 250 |
| Type 2: SL (mcd/sf/ft) | 960 | 760 | 680 | 510 |

- 1. The photometric quantity is measured in specific luminance (SL), and expressed as millicandelas per square foot per footcandle (mcd/sf/ft).
- 2. Use a test distance 50 feet and a Sample size of 2. x 2.5 feet.
- 3. Use an angular aperture of both the photoreceptor and light projector of 6 minutes of

arc.

4. The reference center is the geometric center of the Sample, and the reference axis is taken perpendicular to the test Sample.
- F. Film Reflectivity Retention: Not more than 15 percent of the beads lost due to popout and the predominate mode of Failure is "wear down" of the beads, when subjected to 200 cycles of a Taber Abraser Simulation test using an H-18 wheel and 125 gram load.
- G. Thickness: 0.06 inch without adhesive.
- H. Effective Performance Life: The film, when applied according to the recommendations of the manufacturer, will provide a neat, durable marking that will not flow or distort due to temperature if the Pavement surface remains stable. Although reflectivity is apply wear, the pliant polymer will provide a cushioned, resilient substrate that reduces bead crushing and loss. Use a film that shows no appreciable fading, lifting, or shrinkage throughout the useful life of the marking, and shows no significant tearing, roll back, or other signs of poor adhesion.
- I. Abrasion Resistance: Use a material that when tested will not wear through to the conformable backing surface in less than 5,000 cycles when tested per Federal Standard 141, Method 6192, using a CS-17 wheel and a 1,000 gram load.
- J. Acid Resistance: Use a material that will show resistance to etching, hazing, or delamination of bead surface after exposure to a 1 percent solution of sulfuric acid.

2.6 PRISMATIC REFLECTORS

- A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated.
 1. With a cast iron housing and acrylic prismatic reflector.
 2. With an overall size not less than 9 inches long, 5 inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above the roadway.
 3. With a minimum reflective area of 1.6 square inches per face.
- B. Reflector Specific Intensity:

| Color | Intensity at 0.2 Degree Observation Angle | |
|--------|---|--------------------------|
| | 0 Degree Entrance Angle | 20 Degree Entrance Angle |
| White | 3. | 1.2 |
| Yellow | 1.8 | 0.72 |

2.7 EPOXY ADHESIVE

- A. Epoxy, AASHTO M 237 requirements and as recommended by the manufacturer of the reflector. Provide a minimum adhesion value of 1.1 pounds per inch width.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

- A. Use equipment manufactured for Pavement marking. Use workers experienced in operating such equipment.
- B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip the machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of 6 inches over that cycle.
- C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

- D. For thermoplastic paint materials, use equipment that is designed to agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

- A. Broom or flush the surface to remove dirt, loose stones, or other foreign material immediately prior to applying.
- B. Prior to applying, mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other Pavement striping locations such as stop bars, crosswalks, zebra striping, etc.
- C. Markings that adhere to asphalt concrete or Portland cement concrete by either a pressure sensitive precoated adhesive or an epoxy cement shall mold to the Pavement contours by traffic action at normal Pavement temperatures and shall be ready for traffic immediately after application.
- D. Begin Pavement painting and marking operations not later than 24 hours after receipt of written order by ENGINEER.
- E. Apply striping and markings per MUTCD requirements.
- F. Apply all materials in accordance with manufacturer's and ENGINEER's directions.

3.3 APPLICATION

- A. Apply Pavement paintings and markings only when Pavement surface is dry and air temperature is above 40 deg. F. during daylight hours.
- B. Do not apply paints and markings when rain is anticipated within 12 hours.

3.4 ALKYD RESIN PAINT STRIPING

- A. Adjust Pavement striping machine to apply paint at rate recommended by paint manufacturer.
- B. Glass Bead Application Rate: 5.9 to 6.1 pounds per gallon of paint.
- C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.5 THERMOPLASTIC PAINT STRIPING

- A. Clean off dirt, glaze, and grease before prestripping.
- B. Prestripe the application area with a binder material that will form, when sprayed, a continuous film over the Pavement surface, and will dry rapidly and mechanically adhere to the Pavement surface. Install the material in varying widths if indicated.
- C. Extrude the thermoplastic material at a temperature of 412 plus or minus 12 deg. F. from approved equipment to produce a line 1/8 inch to 3/16 inch thick, continuous and uniform in shape, and have clean and sharp dimensions.
- D. Do not use material which produce fumes that are toxic, obnoxious, or injurious to persons or property.
- E. Apply so that finished lines have well-defined edges free of waviness.
- F. Glass Beads Application Rate: 6 pounds of glass beads to every 100 square feet of marking.

3.6 TAPE STRIPING

- A. Apply Pavement marking tape as indicated or directed. ENGINEER will establish control points.
- B. Apply the tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.
- C. Maintain the line on established control points. Apply intermittent Pavement marking tape 24

inches long, spaced approximately 100 feet on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other Pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

- D. Press down the tape immediately after application until it adheres and conforms to the surface of the Pavement.
- E. Completely remove all tape on sections where tape conflicts with revised traffic lanes prior to opening new lanes to traffic.

3.7 PAVEMENT MARKING FILMS

- A. Use Pavement marking films that are capable of being applied to new, dense, and open-graded asphalt concrete wearing courses during the paving operation in accordance manufacturer's instructions, and that are capable of conforming to Pavement contours through the action of traffic at normal Pavement temperatures.
- B. Use a Pavement marking film that is capable of use for patching worn areas of the same type film.
- C. Apply before traffic is allowed on the freshly paved surface.
- D. Unless indicated otherwise, provide Type C, Class II, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.
- E. When indicated, inlay the markings in fresh asphalt surface by a compaction roller during the paving operation.
- F. Apply all markings in accordance with manufacturer's recommendations.

3.8 PRISMATIC REFLECTOR INSTALLATION

- A. Install reflectors by cutting Pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.
- B. Install marker so that housing edges are flush with Pavement and so that the angle formed by the longitudinal axis of the marker and the adjacent Pavement stripe does not exceed 5 degrees.

3.9 WORDS AND OTHER MARKINGS

- A. Wet sandblast existing or temporary Pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.
- B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.10 TEMPORARY PAVEMENT MARKINGS

- A. Renew when stripes and markings have lost 50 percent of their original visual effectiveness.

END OF SECTION

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SECTION 33 05 05

DUCTILE IRON PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ductile iron pipe, couplings, fittings, and joint materials.
- B. Related work includes but is not limited to,
 - 1. Excavation, Section 31 23 16.
 - 2. Trench backfill, Section 33 05 20 .
 - 3. Landscape restoration, Section 32 92 00 or Section 32 93 13.
 - 4. Pavement restoration, Section 33 05 25.

1.2 REFERENCES

- A. AWWA C104: American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- B. AWWA C110: American National Standard for Ductile-Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
- C. AWWA C111: American National Standard For Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
- D. AWWA C115: American National Standard for Flanged Ductile-Iron and Gray Iron Pipe with Threaded Flanges.
- E. AWWA C151: American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- F. AWWA C600: AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

- A. Buried Applications:
 - 1. Class 52 or pressure class 350 psi ductile iron pipe, AWWA C151 with push-on joints, AWWA C111.
 - 2. Cement lining for all pipe and fittings, AWWA C104.
 - 3. Class 250 fittings, AWWA C110.
 - 4. Coupler with mechanical joint fittings, AWWA C104, C110, and C111.
 - 5. Rubber gasket slip-on pipe joints, AWWA C111 with gasket lubricant.
 - 6. Bronze wedges with current capacity of 400 amps each for each joint as follows:

| Pipe Diameter | No. of Wedges |
|----------------------|----------------------|
| less than 10" | 2 |
| 10" | 3 |
| 12" | 4 |
| greater than 12" | 6 |

- B. Above Ground Applications: As buried applications, except use bolted flanged fittings, AWWA C104, C110, and C115.

2.2 COVERINGS

- A. Buried Mechanical Joints: Grease and 8 mil vinyl wrap plastic cover.
- B. Pipe Sections: 8 mil vinyl wrap plastic cover

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe per manufacturer's instructions and AWWA C600.
- B. Water distribution and transmission, Section 33 12 19.
- C. Gravity water systems, Section 33 31 00 or Section 33 41 00.
- D. Irrigation Systems, Section 32 84 23.

END OF SECTION

SECTION 33 05 06

POLYETHYLENE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyethylene pipe, couplings, fittings and joint materials.
- B. Related work includes but is not limited to,
 - 1. Excavation, Section 31 23 16.
 - 2. Trench backfill, Section 33 05 20.
 - 3. Landscape restoration, Section 32 92 00 or Section 32 93 13.
 - 4. Pavement restoration, Section 33 05 25.

1.2 REFERENCES

- A. AASHTO M 252: Standard Specification for Corrugated Polyethylene Drainage Pipe.
- B. AASHTO M-294: Standard Specification for Corrugated Polyethylene Drainage Pipe 300-1200 mm Diameter.
- C. AASHTO MP7-97: Standard specification for Corrugated Polyethylene Pipe – 1350 and 1500 mm Diameter.
- D. ASME B1.1: Unified Inch Screw Threads (UN and UNR Thread Form), Supplement.
- E. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- F. ASTM D 2239: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter.
- G. ASTM D 2321: Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- H. ASTM D 2657: Standard Recommended Practice for Heat Joining of Thermoplastic Pipe and Fittings.
- I. ASTM D 2774: Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- J. ASTM D 3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- K. ASTM D 3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- L. ASTM F 477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- M. ASTM F 1055: Standard Specification for Electofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.3 DEFINITIONS

- A. Standard Dimension Ratio (SDR): Average diameter of pipe divided by the minimum wall thickness. The diameter may be either inside or outside measurement depending upon which standard is referenced.
- B. Code Designation: A rating system by the Plastic Pipe Institute for smooth wall polyethylene pipe materials. The designation PE 3408 designates the type of plastic pipe (PE), the grade (34), and the hydrostatic design stress measured in units of 100 psi (08) at 23 deg C.

PART 2 PRODUCTS

2.1 SMOOTH WALL PIPE SYSTEMS

- A. Material: PE 3408 per ASTM D 2239 with a minimum cell classification of 345434C per

ASTM D 3350.

- B. Pipe: Smooth wall inside and out with an SDR or working pressure rating indicated or accepted by ENGINEER. Exterior markings as follows.
 - 1. ASTM Standard Number.
 - 2. Pipe Size.
 - 3. Class and profile number.
 - 4. Production code.
 - 5. Standard dimension ratio.
- C. Fittings:
 - 1. Resin same as pipe.
 - 2. Working pressure same or greater than pipe.
- D. Joints:
 - 1. Thermally welded butt fusion, ASTM D 3261.
 - 2. Flanged, ASTM D 2657.
 - 3. Ultra-high molecular weight Electofusion Tape with a Polyethylene coupler meeting ASTM F 1055 requirements.

2.2 CORRUGATED WALL PIPE SYSTEMS

- A. Material: Polyethylene, ASTM D 3350 with a cell class as required in AASHTO M 252, AASHTO M 294 or AASHTO MP7-97
- B. Pipe: Type S or D unless specified otherwise. Corrugations may be either annular or helical.

| Type | Description |
|-------------|---|
| C | Circular pipe with a corrugated surface inside and out |
| CP | Type C pipe with perforations |
| S | Circular pipe with an outer corrugated wall and a smooth inter wall |
| SP | Type S pipe with perforations |
| D | Circular pipe with a corrugated wall sandwiched between a smooth outer wall and a smooth inner wall |

- C. Fittings:
 - 1. Blow molded with cell class 335420C, ASTM D 3350.
 - 2. Rotational molded with cell class 213320C, ASTM D 3350.
 - 3. Shop or field remanufactured of the same material as the pipe
- D. Joints:
 - 1. Bell and spigot with gaskets, ASTM F 477. Foam type weather stripping not allowed.
 - 2. Split corrugated couplings with plastic or stainless steel ties and leak resistant neoprene gasket.

2.3 NUTS AND BOLTS

- A. Carbon steel machined heavy hex heads, Class 2 fit, ASTM A 307; Grade B, threads, ASME B1.1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe as per manufacturer's instructions, ASTM D 2321 or ASTM D 2774.
- B. Water distribution and transmission, Section 33 12 19.
- C. Gravity water systems, Section 33 31 00 or Section 33 41 00.
- D. Irrigation Systems, Section 32 84 23.
- E. Tape wrap steel materials for protection against corrosion after piping installation.

END OF SECTION

SECTION 33 05 07

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride pipe, couplings, fittings and joint materials.
- B. Related work includes but is not limited to,
 - 1. Excavation, Section 31 23 16.
 - 2. Trench backfill, Section 33 05 20.
 - 3. Landscape restoration, Section 32 92 00 or Section 32 93 13.
 - 4. Pavement restoration, Section 33 05 25.

1.2 REFERENCES

- A. ASTM D 1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- B. ASTM D 2241: Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).
- C. ASTM D 2321: Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- D. ASTM D 2412: Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- E. ASTM D 2564: Standard Specification for Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- F. ASTM D 2729: Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- G. ASTM D 2774: Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- H. ASTM D 2855: Standard Practice for Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- I. ASTM D 3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- J. ASTM D 3139: Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- K. ASTM D 3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- L. ASTM F 656: Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- M. ASTM F 679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- N. ASTM F 949: Standard Specification for Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.
- O. AWWA C900: AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

1.3 DEFINITIONS

- A. Standard Dimension Ratio (SDR): Outside diameter of pipe divided by wall thickness.

PART 2 PRODUCTS

2.1 GRAVITY PIPE SYSTEMS

- A. Pipe:
 - 1. Solid smooth wall, 4 to 15 inch diameter, ASTM D 3034.
 - 2. 18 to 27 inch diameter, ASTM F 679.
 - 3. 4 to 10 inches diameter corrugated wall with a smooth interior, ASTM F 949.
- B. Fittings: ASTM D 1784.
- C. Stiffness: 50 psi minimum when measured at 5 percent deflection, ASTM D 2412.
- D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.
- E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D 3212.
- F. Flattening: No visual evidence of splitting, cracking, or breaking when flattened to 60 percent deflection, ASTM D 2412.

2.2 PRESSURE PIPE SYSTEMS

- A. Pipe: Conform to AWWA C900 except use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D 2241.
- B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D 1784.
- C. Joints:
 - 1. Bell and spigot with flexible elastomeric seals, ASTM D 3139. Use non-toxic lubricant.
 - 2. Solvent weld, ASTM D 2564.

2.3 PERFORATED PIPE SYSTEMS

- A. Pipe: Refer to gravity pipe products above.
- B. Perforations: ASTM D 2729.
- C. Joints: Push-on, solvent weld or other.

2.4 SOLVENT WELDS

- A. Primer, ASTM F 656.
- B. Glue, ASTM D 2564.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe per manufacturer's instructions, ASTM D 2321 for gravity systems, AWWA C900 or ASTM D 2774 for pressure systems, And ASTM D 2855 for underground Irrigation Systems.
- B. Water distribution and transmission, Section 33 12 19.
- C. Gravity water systems, Section 33 31 00 or Section 33 41 00.
- D. Irrigation System, Section 32 84 23.

END OF SECTION

SECTION 33 05 14

UTILITY GRADE ADJUSTMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Raise, lower, or change slope of Street Fixtures.
- B. Install Cover Collars.
- C. This section is NOT APPLICABLE to raising and lowering Street Fixtures that withstand internal pressure.

1.2 DEFINITIONS

- A. Box: A structure such as a valve box, meter box, monument box, fire hydrant box, electrical pull box, cleanout box or other like structure not intended for human entry.
- B. Cover Collar: A concrete filled annular space between metal frames and the adjacent Pavement structural section.
- C. Extension Ring: A concrete or metal ring used to adjust surface elevations and surface cross slopes of Street Fixture covers. Metal rings are used between metal frames and metal covers or grates. Concrete rings are used below metal frames or in the concrete structure below.
- D. Manhole: A structure designed to permit human entry and working space inside and to confine and control the flow of pipe-conveyed fluids. These structures are collectively referred to as manholes regardless of composition, design, type or depth.
- E. Street Fixture: The top of existing structures such as but not limited to Manholes, catch basin, sumps, inlets, valve boxes, meter boxes, monument boxes, and similar structure in a thoroughfare surface.
- F. Vault: A structure intended for human entry containing electrical/telephone facilities or other like utilities.

PART 2 PRODUCTS

2.1 PAVEMENT

- A. Asphalt Concrete: AC-20-DM-1/2, Section 32 12 05.
- B. Cast-in-place Concrete: Class 4000, Section 03 30 04.

2.2 GROUT

- A. Hydraulic cement.

2.3 EXTENSION RINGS

- A. Metal: Cast iron or steel.
- B. Cast-in-place Concrete: Class 4000, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

- A. Determine condition of existing incidental structure. Any item not reported damaged prior to construction shall be considered unbroken and must be replaced by CONTRACTOR at no additional cost to OWNER.

- B. Provide invert cover over pipe in cleanout box to prevent gravel, concrete, or debris from entering pipeline.
- C. Unless indicated otherwise, arrange for utility companies to adjust their own structures.
- D. Coordinate all adjustments with requirements of affected utility company.

3.2 ADJUST STRUCTURE TO GRADE

- A. Restrict excavation around the structure to a minimum area.
- B. At the completion of the structure adjustment, backfill the void around the structure and compact before paving or landscaping.
- C. Apply mortar to inside and outside of concrete grade rings used to make adjustments.
- D. If the cone is cracked during construction, restack the Manhole with shorter Manhole sections and install a new cone at no additional cost to the OWNER.

3.3 ADJUST COVER IN PAVEMENT SURFACE

- A. Method A - Metal Extension Rings:
 - 1. Use rings that lock together.
 - 2. Set frame at desired elevation and cross-slope.
 - 3. Seal joints between Pavement and ring.
- B. Method B – Concrete Extension Rings:
 - 1. Place concrete grade rings under frame or in structure riser shaft.
 - 2. Set frame at desired elevation and cross-slope.
 - 3. Provide 100 percent concrete support under frame. Do not use wood, bricks, concrete fragments, blocks or particles as support.
 - 4. Grout seams between concrete rings and between frame and concrete rings.
- C. Method C – Place Concrete:
 - 1. Set frame at desired elevation and cross-slope.
 - 2. Place concrete and provide 100 percent concrete support under frame.
- D. Method D – Concrete Deck:
 - 1. Remove existing concrete deck.
 - 2. Reset steel rebar.
 - 3. Set frame to grade, set forms.
- E. Pour concrete. Provide complete concrete support under Street Fixture.

3.4 INSTALLING COVER COLLAR

- A. Open an annular space between pavement and Street Fixture cover. Unless indicated otherwise, provide 12 inches of annular space.
- B. Set concrete collar to 1/4 inch minimum to 1/2 inch maximum below asphalt concrete pavement surface and 1/4 inch below Portland cement concrete pavement surface.
- C. Trowel finish, Section 03 35 00.

3.5 PAVEMENT SURFACE RESTORATION

- A. In new streets or overlays, adjust Street Fixture cover after bituminous paving is complete.
- B. Pavement restoration, Section 33 05 25.

END OF SECTION

SECTION 33 05 20

BACKFILLING TRENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench backfill materials.
- B. Trench backfilling requirements.
- C. Surface restoration requirements.

1.2 DEFINITIONS

- A. Bedding: That surface of the Excavation or portion of the Pipe Zone below the pipe.
- B. Pipe Zone: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.3 SUBMITTALS

- A. Submit maximum laboratory dry density and optimum laboratory moisture content for:
 - 1. Subgrade material, and
 - 2. Each type of fill to be used.
- B. Upon ENGINEER's request, submit a written quality control Inspections and testing report describing source and field quality control activities performed by CONTRACTOR and its Suppliers.

1.4 QUALITY ASSURANCE

- A. Do not change material sources, or aggregate without ENGINEER's knowledge.
- B. Reject backfill material that does not comply with requirements specified in this section.

1.5 STORAGE AND PROTECTION

- A. Storage:
 - 1. Safely stockpile backfill materials.
 - 2. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.
- B. Protection:
 - 1. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.
 - 2. Avoid displacement of and injury to Work while compacting or operating equipment.
 - 3. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.6 SITE CONDITIONS

- A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.
- B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.
- C. Reshape and compact damaged structural section to required density.
- D. Restore any damaged structure to its original strength and condition.
- E. Replace contaminated backfill at no additional cost to OWNER.

1.7 SEQUENCING

- A. Coordinate backfilling operation with pipeline commissioning requirements in Section 33 08 00.

1.8 ACCEPTANCE

- A. General:
 - 1. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.
 - 2. For material acceptance refer to.
 - a. Common fill, Section 31 05 13.
 - b. Crushed aggregate base, Section 32 11 23.
 - c. Cement treated fill, Section 31 05 15.
- B. Trench Backfilling: One test per Lot.

| Table 1: Lot Size for Trench Backfilling Operation | | |
|--|----------------------|---|
| Material | Test Criteria | Lot size |
| Subgrade | Standard (a) | 200 lineal feet |
| Common Fill | Standard (a) | 200 lineal feet per lift 25 square feet of footing area per lift |
| Crushed Aggregate Base | Modified (a) | 200 lineal feet per lift 25 square feet of footing area per lift |
| Flowable Fill | Strength (b) | 50 cubic yards |
| NOTES (a) Proctor density, Section 33 05 05 (b) Compressive strength, Section 31 05 15 (c) Lift thickness above the pipe zone before compaction, 8 inches. | | |

1.9 WARRANTY

- A. Any settlement noted in Trench backfill or in structures built over the Trench backfill will be considered to be caused by improper compaction methods and shall be corrected at no cost to the OWNER.
- B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

- A. Common fill, Section 31 05 13.
- B. Crushed aggregate base, Section 32 11 23.
- C. Cement treated fill, Section 31 05 15.
- D. Slag or asphalt bearing material not allowed.

2.2 ACCESSORIES

- A. Water: Make arrangements for sources of water during construction and make arrangements for delivery of water to site. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

- B. Geotextile Fabric: Section 31 05 19.
- C. Identification Tape: Permanent, bright-colored, continuous-printed magnetic plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick. The tape shall read "CAUTION: BURIED INSTALLATION BELOW". Color of tape as follows.
 - 1. Red: Electric power lines, cables, conduit and lighting cables
 - 2. Yellow: Gas, oil, steam, Petroleum or gaseous materials
 - 3. Orange: Communications, alarm, signal, cables or conduits.
 - 4. Blue: Potable water
 - 5. Purple: Reclaimed Water, irrigation and slurry lines
 - 6. Green: Sewer and storm drain lines

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify backfill material meets gradation requirements, foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water, and Trench bottom is not frozen.
- B. If Subgrade is not readily compactable secure written authorization for extra excavation and backfill; Section 31 23 16.
- C. Avoid injuring and displacement of pipe and structures while compacting soil or operating equipment next to pipeline.
- D. Place geotextile fabrics; Section 31 05 19.

3.2 GENERAL BACKFILLING REQUIREMENTS

- A. Protect Subgrade from desiccation, flooding and freezing.
- B. Do not damage corrosion protection on pipe.
- C. Repair or replace damaged pipe at no additional cost to OWNER.
- D. Withdraw sheathing, Shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.
- E. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.
- F. Water settling of Trench backfill is not permitted. "Jetting" of Trench backfill is prohibited.

3.3 PIPE ZONE

- A. Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.
- B. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.
- C. Do not permit free fall of backfill material which may damage pipe, pipe finish, or pipe alignment.
- D. Except where piping must remain exposed for tests, fill Pipe Zone as soon as possible.

3.4 TRENCH ABOVE PIPE ZONE

- A. Maximum lift thickness before compaction is 8 inches.
- B. Fill unauthorized Excavations with material acceptable to ENGINEER at no additional cost to OWNER.
- C. Do not damage adjacent structures or service lines.
- D. Install continuous plastic line marker directly over buried lines 18 inches below finished grade.

3.5 MODIFIED BACKFILL LAYER METHOD

- A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions.
 - 1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
 - 2. ENGINEER, on the basis of test results, approves the system in writing.
- B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.
- C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.
- D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.6 COMPACTION

- A. Compact backfill, Section 33 05 05.
 - 1. A-1 soils: 95 percent or greater of a Modified Proctor Density.
 - 2. Other soils: 95 percent or greater of a Standard Proctor Density.

3.7 COMPRESSIVE STRENGTH

- A. Where a flowable fill is used, provide compressive strength indicated in Section 31 05 15. Use fill which flows easily and vibration is not required.

3.8 SURFACE RESTORATION

- A. Provide temporary paved surfaces where Trenches pass through roadways, Driveways or sidewalks.
- B. Restore paved surfaces; Section 33 05 25.
- C. Finish landscaped surfaces with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

3.9 CLEANING

- A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.
- B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 08 00

COMMISSIONING OF WATER UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing requirements for potable and non-potable water piping systems.
- B. Warning: DO NOT use hydrostatic pressures described in this section for air-pressure testing.

1.2 DEFINITIONS

- A. Leakage: The quantity of water required to maintain the specified hydrostatic test pressure after the pipeline has been filled with water and the air expelled.
- B. Non-rigid Pipe: Any pipe that requires Bedding and backfill material for structural support.

1.3 SUBMITTALS

- A. Pipeline Test Report: Submit.
 - 1. Type of test.
 - 2. Identification of pipe system.
 - 3. Size, type, location and length of pipe in test section.
 - 4. Test pressure and time.
 - 5. Video cassette and log of visual examination.
 - 6. Amount of Leakage versus allowable.
 - 7. Date of test approval.
 - 8. Signature of test supervisor.
 - 9. Signature of Resident Project Representative witnessing and accepting the test.

1.4 PROJECT CONDITIONS

- A. Repair pipeline system at no additional cost to OWNER until it passes specified commissioning tests.

1.5 WARRANTY

- A. At the end of the One Year Correction Period repeat any test requested by ENGINEER to verify warranty of pipeline performance.

PART 2 PRODUCTS

2.1 TESTING MATERIALS

- A. Medium: Water, air.
- B. Recording Equipment (pressure systems):
 - 1. Supply all equipment and power to perform pressure testing.
 - 2. Secure approval of pressure gages.
 - 3. Locate all gages and recording equipment away from effect of sunshine or unsuitable weather conditions.
 - 4. Place, vents, pressure taps and drains for the test. Repair pipeline at completion of test at no additional cost to OWNER.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify ENGINEER 48 hours in advance of test.
- B. Carry out tests as pipeline construction progresses to ensure construction methods are producing satisfactory results.
- C. Remove debris, sediment and other material from installed pipe prior to testing. Do not discharge or flush sand, gravel, concrete, debris or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of the existing gravity systems. Flushing into existing pressurized water systems will not be allowed.

3.2 ALIGNMENT AND GRADE TEST

- A. Do not allow line and grade of pipe to vary more than 1/2 inch in 10 feet and not more than 1 inch variance from true line at any location.
- B. Do not allow grade of pipe to vary more than 1/4 inch in 10 feet for all design grades less than or equal to 1 percent and not more than 1/2 inch total variance from true grade at any location. Also, do not allow grade of pipe to vary more than 1/2 inch in 10 feet for all design grades greater than 1 percent and not more than 1 inch total variance from true grade at any location. These tolerances shall be acceptable provided that such variation does not result in a level or reverse sloping invert.
 - 1. The variation in the invert elevation between adjoining ends of pipe due to eccentricity of joining surface and pipe interior surfaces shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

3.3 PRESSURE TEST

- A. Air Test: Per pipe manufacturer's recommendation. B. Hydrostatic test:
 - 1. Provide 225 psi test pressure for 2 hours unless specified otherwise.
 - 2. Provide air release taps at pipeline's highest elevations and expel all air before the test. Insert permanent plugs after test has been completed.
 - 3. No piping installation will be acceptable until the leakage is less than the amount allowed by industry standards for the type of pipe material being tested or if no standard prevails than the number of gallons per hour as determined by the formula:

$$Q = \frac{LD \times \text{square root of } P}{133,200}$$

Where:

- Q = allowable leakage, in gallons per hour. L = length of pipe under test in feet.
- D = nominal diameter of pipe in inches.
- P = average test pressure, in pounds per square inch (gage).
- C. Locate and repair defective joints and retest until the leakage rate is less than allowable.
- D. Repair any noticeable leakage even if total leakage is less than allowable.

3.4 OBSTRUCTION AND DEFLECTION TEST

- A. Obstructions: Maximum protuberance is 1 inch.
- B. Deflections:
 - 1. Do not use mechanical pulling equipment when pulling mandrels through pipe.
 - 2. Maximum reduction of internal diameter in any plane measured full length of

installation and not less than 30 days after installation as follows.

- a. Polyvinyl chloride pipe, 7.5 percent.
 - b. High density polyethylene pipe, 5 percent.
 - c. Ductile iron pipe, 3 percent.
 - d. Corrugated metal pipe, 7.5 percent.
3. Recommend an alternate method of measurement if mandrel testing would cause damage to internal pipe coating.

3.5 INFILTRATION TEST

- A. Maximum is 50 gallons per inch diameter per mile per 24 hours.

3.6 PIPE TESTING SCHEDULE

- A. Irrigation - Gravity System:
 1. Grade test: All circuits drain.
- B. Irrigation – Pressure System:
 1. Grade test: All circuits drain.
 2. Pressure test.
 3. Operational Testing:
 - a. Perform operational testing after hydrostatic test is complete; backfill is in place and sprinkler heads adjusted to final coverage.
 - b. Demonstrate system meets coverage requirements and automatic controls function properly.
 - c. Coverage requirements are based on operation of 1 circuit at a time.
- C. Sanitary Sewers:
 1. Alignment and grade test.
 2. Obstructions and deflection test.
 3. Infiltration test for gravity pipeline systems.
 4. Pressure test for pressure pipeline systems.
 5. Video inspection.
- D. Subdrains:
 1. Grade test: All pipelines drain.
 2. Obstructions and deflection test.
- E. Storm Drains:
 1. Alignment and grade test.
 2. Obstructions and deflection test.
 3. Infiltration test for gravity pipeline systems.
 4. Pressure test for pressure pipeline systems.
 5. Video inspection.
- F. Potable Water System:
 1. Obstruction and deflection test.
 2. Pressure test.
 3. Disinfection (Section 33 13 00).

END OF SECTION

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SECTION 33 11 00

WATER DISTRIBUTION AND TRANSMISSION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water distribution and transmission system identification, valves, boxes, service connections and accessories.
- B. This section is applicable to potable and non-potable water pressure systems.

1.2 REFERENCES

- A. ACPA: American Concrete Pipe Association.
- B. Applicable water company requirements.
- C. AWWA C600: AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- D. AWWA C605: AWWA Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- E. AWWA C800: AWWA Standard for Underground Service Line Valves and Fittings.
- F. AWWA M11: AWWA Manual for Steel Pipe - Design and Installation.
- G. CDA: Copper Development Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Depth of Cover:
 - 1. 48 inches minimum to top of pipe, service line, or as indicated in local building code. 72 inches maximum unless ENGINEER authorizes otherwise.
 - 2. If less cover, provide additional protection to withstand frost and external loads.
- B. Remove any section of pipe already placed that is found to be defective or damaged. Relay or replace without additional cost to OWNER.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions.
- B. Commissioning: Submit testing data indicated in Section 33 08 00.
- C. Record Documents: Submit documents, Section 01 78 39. Include details of underground structures, connections, thrust blocks and anchors. Show interface and spatial relationship between piping and adjacent structures.
- D. Operating and Maintenance: Submit data, Section 01 78 23. Include maintenance data, parts lists, product data, and shop drawings.

1.5 SITE CONDITIONS

- A. Minimize neighborhood traffic interruptions. Barricade stockpiles.
- B. Secure acceptance of pipeline lateral tie-in work.
- C. Repair public and private facilities damaged by CONTRACTOR.
- D. Do not turn on or turn off any valve outside of the Work prior to securing ENGINEER's or water company's permission.

PART 2 PRODUCTS

2.1 PIPES AND FITTINGS

- A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Use only NSF approved products in drinking water systems. All such products shall be appropriately stamped with the NSF logo.
- B. Where not indicated, provide proper selection as determined by installer and acceptable to ENGINEER to comply with installation requirements.
- C. Provide sizes and types of equipment connections for fittings of material that matches pipe material used in the piping system. Where more than one type of material or product Option is indicated, selection is installer's choice.
- D. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 VALVES

- A. Section 33 12 16.

2.3 VALVE BOX

- A. Buried Valves In Traffic Areas: 2 piece, cast iron, screw adjustable sleeve, 5 - 1/4 inch shaft, with a drop lid.
- B. Buried Valves in Non-traffic Areas: Slip type of height required for the installation.
- C. Markings: On cover of valve box, cast the appropriate utility lettering.

2.4 VALVE CHAMBER

- A. General: Refer to applicable design criteria requirements explained in Laws and Regulations.
- B. Basin: Class 4000 concrete floor and walls.
- C. Steps: Plastic, cast into sidewalls greater than 4 feet deep.
- D. Top: Flat slab class 4000 concrete.
- E. Frame and Cover: Scoriated asphalt coated, heavy duty ductile iron conforming to Section 05 56 00 with flat top design and appropriate utility lettering. Shape and size as indicated.

2.5 MORTAR, GROUT, AND CONCRETE

- A. Mortar: Cement, Section 04 05 16.
- B. Grout: Cement, Section 03 61 00.
- C. Concrete:
 - 1. Cast-in-place: Class 4000, Section 03 30 04.
 - 2. Precast: Class 5000, Section 03 40 00.

2.6 TAPPING SADDLES

- A. Provide bronze alloy, ductile iron, or stainless steel saddles with stainless steel double straps.
- B. Provide tapping saddles that have a minimum rated working pressure of 300 psi, neoprene Buna N gaskets, and bronze tapered threads.

2.7 SERVICE CONNECTION

- A. Type K copper pipe; Section 33 05 03 with flare type 200 psi compression fittings in accordance with AWWA C800. If materials used in main line are non-copper, provide a plastic nipple to separate the metals.

2.8 ACCESSORIES

- A. Bolts, Nuts, Washers: Steel, Section 05 05 23.
- B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
- C. Corporation Stops: All bronze with tapered threads.
- D. Hydrant and Valve: Dry barrel, Section 33 12 19.
- E. Water Meter and Valve: Section 33 12 19.
- F. Grease: Non-oxide.
- G. Polyethylene Sheet: 8 mil thick.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are as indicated.
- B. Commencing installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Excavation, Section 31 23 16. Hand trim to required elevations. Correct over excavations.
- B. Remove stones or other hard matter that could damage pipe embedment or impede backfilling or compaction.
- C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.
- D. Clearly identify and promptly set aside defective or damaged pipe. E. Use pipe cutting tool acceptable to pipe manufacturer.

3.3 LOCATING POTABLE WATER PIPE

- A. Comply with Utah Drinking Water Act. As a minimum locate potable water pipe at least 18 inches vertical and 10 feet horizontal edge to edge between water and sewer lines. Place water lines above sewer line.
- B. Where potable water pipe crosses under gravity-flow sewer lines, fully encase the sewer pipe in concrete for a distance at least 10 feet each side of the crossing.
 - 1. Do not locate any joint in the water line within 36 inches of the crossing.
 - 2. Encase water line if it is within 24 inches of a sewer force main or inverted syphon.
 - 3. Encase sewer main joints in concrete if joints are horizontally closer than 36 inches to the water line.
- C. Do not put potable water lines in the same Trench with sewer lines, storm drains or electric wires.

3.4 INSTALLATION - PIPE AND FITTING

- A. General:
 - 1. Seal each open end of pipeline at end of day's work.
 - 2. Grease all bolts and nuts then apply polyethylene sheet and tape wrap.
- B. Steel Pipe: AWWA M11.
- C. Ductile Iron Pipe: AWWA C600.
- D. Copper Tube: CDA "Copper Tube Handbook".
- E. Polyethylene Pipe: For 3 inches and smaller pipe follow AWWA C901. Install all other sizes per manufacturer's installation instructions.

- F. Polyvinyl Chloride Pipe: AWWA C605.
- G. Concrete Pipe: ACPA "Concrete Pipe Handbook".
- H. Wedges: Install metal wedges on all metal pipe systems.

3.5 INSTALLATION – CONCRETE THRUST BLOCKS

- A. Do not make hydrostatic tests of Section 33 08 00 until thrust block concrete has cured for at least 5 days.
- B. Provide thrust blocks on all plugs, caps, tees, hydrants and vertical or horizontal bends.
- C. Provide stainless steel or epoxy coated steel tie rods and clamps or shackles to restrain thrust.
- D. Unless otherwise indicated or directed by ENGINEER, place the base and bearing sides of thrust blocking directly against undisturbed earth.
- E. Sides of thrust blocking not subject to thrust may be placed against forms. Place thrust blocking so the fitting joints will be accessible for repair.

3.6 INSTALLATION - VALVES AND VALVE BOXES

- A. Valves:
 - 1. Ensure all parts are in working order.
 - 2. Set location of valves outside of sidewalk limits, Driveway Approaches and other pedestrian or vehicular interference.
 - 3. Install plumb with stems pointing up.
 - 4. Grease all exposed bolts and nuts then apply polyethylene sheet and tape wrap.
- B. Valve Boxes:
 - 1. Set over valve nut so operator's key is plumb with clearance in valve box when opening and closing the valve.
 - 2. Adjust box to finish grade.
 - 3. Clean all dirt or foreign material out of box.

3.7 INSTALLATION – TAPS

- A. Apply for and pay for applicable permits from water company for the indicated size and location of tap to water main. Comply with all connection requirements of water company.
- B. Make all service taps with a tapping machine acceptable to the water company. Use teflon tape on all taps unless indicated otherwise.
- C. The minimum distance between taps is 24 inches, with a 5 degree stagger. Do not make service taps within 24 inches of the end of pipe. Install taps at 60 degrees from vertical, or authorized by ENGINEER.
- D. Service saddles are required on all taps except, 3/4 inch or 1" taps to new ductile iron pipe
- E. Grease all exposed bolts and nuts then apply polyethylene sheet and tape wrap.

3.8 INSTALLATION – SERVICE LINES

- A. Replacing Existing Water Service Line:
 - 1. Follow AWWA C800, Utah public drinking water regulations and Utah plumbing code requirements.
 - 2. When replacing water service lines, replace non-copper pipe with type K copper pipe, Section 33 05 03.
- B. Looping Existing Water Service:
 - 1. Minimum pipe diameter 3/4 inch.
 - 2. Pinching tools used to close and open service lines may be used only if allowed by ENGINEER. When service line pinches cannot be returned to previous shape or flow,

- remove and replace damaged portion of pipe.
- 3. Soldered joints or connections not allowed.
- 4. For copper to iron connections use a brass pack joint compression coupling with joint locking device.
- 5. For copper- to- copper connections use a brass flare coupling.
- 6. Follow details shown in the Drawings.

- C. Meter Box: Install meter boxes back of the curb, outside of sidewalks and Driveway Approaches and outside of other pedestrian and vehicular interference.

3.9 INSTALLATION – WATER MAIN LOOP (SYPHON)

- A. Existing water mains may not match standard size. Excavate to obtain actual pipe diameter and match size.
- B. Do not shutdown pipeline until couplings and fittings are on site. Coordinate shutdown with water company.
- C. Connections to steel or transite pipe requires transition couplings or sleeves with transition gaskets.
- D. Grease all exposed bolts and nuts then apply polyethylene sheet and tape wrap
- E. Provide thrust blocks except where joints are welded. Follow details shown on the Drawings.

3.10 DISINFECTION

- A. Section 33 13 00.
- B. After disinfection, legally dispose of disinfection water.

3.11 BACKFILLING

- A. Prior to Backfilling:
 - 1. Secure ENGINEER's acceptance of brass wedge installations and concrete thrust block installations.
 - 2. For pressure pipe testing follow Section 33 08 00 requirements and for disinfection follow Section 33 13 00 requirements.
- B. Trenches: Section 33 05 20.
- C. Landscapes: Section 31 23 23.

3.12 SURFACING RESTORATION

- A. Roadway Trenches and Patches: Section 33 05 25.
- B. Landscapes: Section 32 92 00 or Section 32 93 13 as applicable.

END OF SECTION

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SECTION 33 12 16

WATER VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gate, butterfly, plug, check, pressure reducing, pressure relief, control valves and their installation.
- B. Related work includes but is not limited to,
 - 1. Excavation, Section 31 23 16.
 - 2. Trench backfill, Section 33 05 20.
 - 3. Landscape restoration, Section 32 92 00 or Section 32 93 13.
 - 4. Pavement restoration, Section 33 05 25.

1.2 REFERENCES

- A. AWWA C111: American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
- B. AWWA C504: AWWA Standard for Rubber-Seated Butterfly Valves.
- C. AWWA C508: AWWA Standard for Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS.
- D. AWWA C509: AWWA Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems.
- E. AWWA C550: AWWA Standard for Protective Interior Coatings for Valves and Hydrants.
- F. AWWA C600: AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 SUBMITTALS

- A. Provide technical information as required for evaluating the quality of the valve. As a minimum include dimensions, weights, materials lists and operation charts.

PART 2 PRODUCTS

2.1 VALVES - GENERAL

- A. Underground:
 - 1. Less than 3 inches: Screwed ends.
 - 2. 3 inches and larger: Flanged or mechanical joint ends as specified. Non-rising stem. Two inches square operating nut. Low alloy steel bolts, AWWA C111.
- B. Submerged or Above Sewage or Water:
 - 1. Valve body bolts per manufacturer's recommendations.
 - 2. For joining valve to piping system use stainless steel nuts and bolts, Section 05 05 23.
- C. Below an Operating Deck: Provide shaft extension from the valve to deck level.
- D. Above Ground: Non-rising stems equipped with a hand wheel.
- E. Manually Operated Valves Over 6 feet Above Operating Level: Provide chain operated handles.
- F. Clearance: Install so that handles clear all obstruction when moved from opened to closed.
- G. Rated Working Pressure: 150 psi unless indicated.
- H. Coating: Interior, AWWA C550. Exterior per manufacturer's recommendation.

2.2 GATE VALVES

- A. Material: Cast iron body, bronze mounted. Furnish valves 3 inches through 48 inches that conform to the requirements of AWWA C509, non-rising stem design with "O" ring seals.
- B. Operating Direction: Open counterclockwise.
- C. Buried Valves: Flanged, mechanical joint, or as indicated.

2.3 BUTTERFLY VALVES

- A. Material: Cast iron body, bronze mounted. Furnish valves 3 inches through 48 inches that conform to the requirements of AWWA C504.
- B. Body Type: Short body or long body at CONTRACTOR's option or short body valves only where the disc will not interfere with adjacent fittings.
- C. Wafer Valves: Subject to approval.

2.4 ECCENTRIC PLUG VALVES

- A. Material: Cast iron body, bronze mounted, non-lubricated, eccentric, quarter-turn type with resilient face plugs, ductile iron discs with upper and lower shafts integral.
- B. Markings: Indicate open and close position.
- C. Port Areas: At least 82 percent of full pipe area.
- D. Resilient Seat Seals: Buna N, field replaceable.

2.5 CHECK VALVES

- A. Material: AWWA C508.
- B. Valves 2-1/2 inches in Size and Smaller: 200 psi working pressure Y-pattern, bronze, regrinding, swing check valve with screwed ends.
- C. Valves 3 inches in Size and Larger: Iron body, bronze mounted, flanged end, swing valves with stainless steel hinge pins.
- D. Outside Weight and Lever: Required.

2.6 PRESSURE REDUCING VALVES - SERVICE LINE

- A. Operation: Capable of reducing a varying higher upstream pressure to an adjustable constant lower downstream pressure.
- B. Spring and nylon reinforced diaphragm type construction.
- C. Equip with Y-strainer upstream of valve.

2.7 PRESSURE REDUCING VALVES - MAIN LINE

- A. Operation: Capable of maintaining an adjustable constant downstream pressure regardless of upstream pressure.
- B. Type: Hydraulically operated using a direct-acting, spring-loaded, normally open, pilot valve controlled diaphragm.
- C. Provide a single removable seat and a resilient disc. No "O" ring type discs permitted. No external packing glands permitted. No pistons operating the main valve or pilot controls permitted.
- D. Equip with Y-strainers on the pilot controls, variable closing and opening speed controls and a valve position indicator.
- E. Rating: 250 psi working pressure with flanged connections.
- F. Include an upstream and downstream pressure gage capable of accurately measuring system pressures.

2.8 PRESSURE RELIEF VALVES

- A. Operation: Maintain a constant upstream pressure by passing or relieving excess pressure.
- B. Closed Valves: Drip-tight.
- C. Type: Hydraulically operated, pilot control using a diaphragm with a single removable seat and resilient disc.
- D. Pilot Controls: Direct acting, adjustable between 20 and 200 psi, spring-loaded diaphragm valve.
- E. Rating: 250 psi working pressure with flanged connections.

2.9 CONTROL VALVE

- A. Types: Diaphragm actuated, single seated, composition disc, hydraulically operated globe valve.
- B. Pilot Controls: Externally mounted, four-way, solenoid pilot valve with self-cleaning strainers and diaphragm type check valves.
- C. Equip with a limit switch for pump control.
- D. Equip with a built-in lift check valve to prevent flow reversal.
- E. Rating: 250 psi working pressure with flanged connections.
- F. Solenoids and the Limit Switch: Supplied with operating voltage as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Flush all lines before valve installation.
- B. In ductile iron water mains install valves, AWWA C600.
- C. Install butterfly valve shafts vertical in Vault boxes and horizontal otherwise.

END OF SECTION

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SECTION 33 12 19

HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dry-barrel fire hydrants, valves, piping and accessories.

1.2 REFERENCES

- A. AWWA C110: American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
- B. AWWA C111: American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
- C. AWWA C209: AWWA Standard for Cold-Applied Tape Coatings for the Exterior of Special Section, Connections, and Fittings for Steel Water Pipelines.
- D. AWWA C210: AWWA Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- E. AWWA C213: AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel water Pipelines.
- F. AWWA C214: AWWA Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.
- G. AWWA C502: AWWA Standard for Dry-Barrel Fire Hydrants.
- H. AWWA M17: AWWA Manual for Installation, Operation, and Maintenance of Fire Hydrants.

1.3 PRODUCT HANDLING

- A. Package fire hydrants, gate valves, and valve boxes for protection against dirt and damage during shipment and storage.
- B. Do not plug drain hole.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's technical product data and installation instructions.
- B. Shop Drawings: Show interface and spatial relationship between piping and adjacent structures.
- C. Field Quality Control Reports: For system commissioning.

1.5 JOB CONDITIONS

- A. Notify appropriate fire department as soon as hydrant is removed or placed in service.

PART 2 PRODUCTS

2.1 DRY-BARREL FIRE HYDRANT

- A. Cast iron compression type, AWWA C502, opening against pressure and closing with pressure, base valve design, 150 psi working pressure, with 1/4 inch diameter minimum tapping and bronze plug in standpipe.
 - 1. Size: 5-1/4 inch valve opening.
 - 2. Direction to Open Hydrant: Counterclockwise.
 - 3. Size and Shape of Operating and Cap Nuts: Pentagon. 1-1/2 inch point to flat.
 - 4. Hose Nozzles: Two 2-1/2 inch National Standard Thread, cap, gasket and chain.

5. Pumper Nozzle: One 4-1/2 inch National Standard Thread, cap, gasket and chain.
6. Depth of Burial: 48 inches or consistent with main depth.
7. Connection to Main: 6 inches flanges or mechanical joint.
8. Pressure: 150 psi working pressure and 300 psi hydrostatic pressure.
9. Inlet Bottom Connection: 6 inches mechanical joint or flanged in accordance with AWWA C110 and AWWA C111, designed to allow separation at the sidewalk level when hydrant is sheared off.
10. Automatic Drain: Opens as the hydrant is closed.

2.2 PIPE AND FITTINGS

- A. Ductile iron, Section 33 05 05. Standard drilling, AWWA C110.
- B. PVC, Section 33 05 07.
- C. Steel, Section 33 05 09. Standard drilling, 150 lb.
- D. Spool, Schedule 40 steel, epoxy lined, exterior wrapped with minimum 60 mil thick tape wrap, AWWA C210 or C213 and C209 or C214 with two welded in place 150 lb. steel ANSI B 16.5 slip on flanges.

2.3 VALVES

- A. Gate valve. Section 33 12 19.
- B. If indicated, furnish an auxiliary 6 inch diameter valve with end connections as required.

2.4 ACCESSORIES

- A. Bolts, Nuts, Washers: Stainless steel, Section 05 05 23.
- B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
- C. Thrust Blocks: Cast-in-place concrete, Class 2000 minimum, Section 03 30 04.
- D. Valve Box, Valve Chamber: Section 33 12 19.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavation, Section 31 23 16.

3.2 INSTALLATION

- A. Install hydrants, valves, and valve boxes as indicated and located in accordance with AWWA M17. Hydrants shall not be connected to or located within 10 feet of a sanitary sewer or storm drain.
- B. Install so bottom of hydrant base flange is even with or less than 4 inches above grade.
- C. Point 4-1/2" pumper nozzle to face the street.
- D. Drain holes at base of hydrant to remain clear with a minimum of 1 cubic yard of clean Sewer Rock (Section 32 11 23) placed around hydrant base and drain. Place sheet plastic over gravel to prevent silting.
- E. Coal tar and tape wrap steel pipe.
- F. Grease all buried nuts and bolts and wrap with 8 mil polyethylene sheet and tape.
- G. Install thrust blocks, Section 33 12 19.

3.3 BACKFILLING

- A. Secure water company permission to commence backfilling operation.
- B. Trenches, Section 33 05 20.

- C. Structures and landscaping, Section 31 23 23.
- D. Pavements, Section 32 05 10.

3.4 PAINT

- A. Paint buried portion of hydrant with two coats of coal tar enamel or asphalt.
- B. Paint hydrant barrel and caps with one coat primer and final coat per water company paint standards.

3.5 FIELD QUALITY CONTROL

- A. Commissioning, Section 33 08 00.
- B. Disinfection, Section 33 13 00.

END OF SECTION

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SECTION 33 12 33

WATER METER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water meters, service connections, materials.
- B. Related work includes but is not limited to,
 - 1. Excavation, Section 31 23 16.
 - 2. Trench backfill, Section 33 05 20.
 - 3. Landscape restoration, Section 32 92 00 or Section 32 93 13.
 - 4. Pavement restoration, Section 33 05 25.

1.2 REFERENCES

- A. AWWA C704: AWWA Standard for Cold-Water Meters – Propeller Type for Main Line Applications.
- B. AWWA C800: AWWA Standard for Underground Service Line Valves and Fittings.

1.3 SUBMITTALS

- A. A. Manufacturer's test records on the range and accuracy of the meter being furnished.
- B. B. Equipment material diagram and parts schematic.

PART 2 PRODUCTS

2.1 METERS FOR SYSTEM PIPING

- A. Materials and Construction: AWWA C704
 - 1. Cast iron bodies with 175 psi working pressure flanged connections.
 - 2. Built-in straightening vanes.
 - 3. Working pressure 150 psi.
 - 4. Polyethylene plastic propeller.
 - 5. Stainless steel shaft with stainless steel ball bearings, lubricated by means of a single pressure fitting.
- B. Accuracy: Plus or minus 2 percent of scale for velocities over 1 foot per second.
- C. Totalizer: Six digits reading in units indicated.

2.2 METERS FOR SERVICE PIPING

- A. Provided by OWNER unless indicated otherwise.

2.3 SERVICE LINE, VALVES, AND FITTINGS

- A. Service Pipe: Provide copper pipe, Section 33 05 03 or polyethylene pipe, (Section 33 05 06). The service pipe between the main and the meter and to a point not less than 1 foot from the public way side of the property line cannot exceed the meter size.
- B. Service Valves and Fittings: AWWA C800.
- C. Meter Setters: Brass, with angle fittings, saddle nuts and gaskets.
- D. Corporation Stops and Angle Valves: Invert key design.
- E. Bypasses: Not allowed on any service installation without approval of ENGINEER.

2.4 METER BOXES

- A. Meters to 1" Service: Plastic or asphalt-dipped corrugated metal. Fiber meter boxes are not acceptable. Provide a meter box with frame and cover of sufficient strength to withstand loadings in vehicular traffic areas without breaking.
- B. Meters 1-1/2" and Larger: Reinforced concrete with a minimum clearance of 12" from each side of meter plumbing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install meter box, meter setters, valves, etc. at indicated locations. If not indicated, install in street right-of-way parking strip or at a location approved by ENGINEER.
- B. Install meter setters level and horizontal. Provide suitable pipe lengths to prevent stress.
- C. Do not operate any of the utility agency's main line valves. Contact agency if valves are to be operated. If required by water utility agency notifies affected water users, Section 01 31 13.
- D. OWNER Supplied Meters: Installed by CONTRACTOR unless indicated otherwise.

END OF SECTION

SECTION 33 13 00

DISINFECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water system.
- B. Test and report results.

1.2 REFERENCES

- A. AWWA A100: AWWA Standard for Water Wells.
- B. AWWA B300: AWWA Standard for Hypochlorites.
- C. AWWA B301: AWWA Standard for Liquid Chlorine.
- D. AWWA C651: AWWA Standard for Disinfecting Water Mains.
- E. AWWA C652: AWWA Standard for Disinfection of Water-Storage Facilities.
- F. State of Utah: Public Drinking Water Regulations, Part 2, Section 12.

1.3 DEFINITIONS

- A. Disinfectant Residual: The quantity of disinfectant in treated water.
- B. PPM: Parts per million.

1.4 SUBMITTALS

- A. CONTRACTOR's evidence of experience in disinfection.
- B. Bacteriological laboratory's evidence of certification if laboratory is not OWNER's laboratory.
- C. Disinfection Report: 3 copies containing:
 - 1. Date issued.
 - 2. Project name and location.
 - 3. Treatment contractor's name, address and phone number.
 - 4. Type and form of disinfectant used.
 - 5. Time and date of disinfectant injection started.
 - 6. Time and date of disinfectant injection completed.
 - 7. Test locations.
 - 8. Initial and follow-up disinfectant residuals in ppm for each outlet tested.
 - 9. Time and date of flushing start.
 - 10. Time and date of flushing completion.
 - 11. Disinfectant residual after flushing in ppm for each outlet tested.
 - 12. Flush water disposal location and acceptance by local agency.
- D. Bacteriological Report: 3 copies including:
 - 1. Date issued.
 - 2. Project name and location.
 - 3. Laboratory's name, certification number, address, and phone number.
 - 4. Time and date of water Sample collection.
 - 5. Name of person collecting Samples.
 - 6. Test locations.
 - 7. Time and date of laboratory test start.
 - 8. Coliform bacteria test results for each outlet tested.
 - 9. Certification that water conforms or fails to conform to bacterial standards of State of Utah public drinking water regulations.
 - 10. Bacteriologist's signature.

1.5 QUALITY ASSURANCE

- A. Bacteriological Laboratory: Certified by State of Utah if laboratory is other than OWNER's laboratory.

1.6 PRODUCT HANDLING

- A. Store and protect disinfectant in accordance with manufacturer's recommendations to protect against damage or contamination. Do not use unsuitable disinfectant.
- B. Follow all instruction labeling for safe handling and storage of disinfectant materials.

1.7 REGULATORY REQUIREMENTS

- A. Conform to State of Utah public drinking water regulations.

PART 2 PRODUCTS

2.1 DISINFECTANT

- A. Liquid Chlorine: AWWA B301 with chlorine 99.5 percent pure by volume.
- B. Sodium Hypochlorite: AWWA B300 with not less than 100 grams per liter available chlorine.
- C. Calcium Hypochlorite: AWWA B300 with 65 to 70 percent available chlorine by weight in granular form.
- D. Powder, tablet, or gas according to manufacturer's specification.

2.2 ALKALI

- A. Caustic Soda or Soda Ash.

2.3 ACID

- A. Hydrochloric (Muriatic) type.

PART 3 EXECUTION

3.1 PREPARATION

- A. Provide necessary signs, barricades, and notices to prevent accidental exposure to disinfecting materials, consuming disinfecting water, or disturbing the system being disinfected.
- B. Make sure the potable water system is complete, clean, and that the system to be disinfected is not connected to the existing system.

3.2 DISINFECTION OF WATER LINES

- A. Use one method defined under AWWA C651 that is acceptable to ENGINEER.
- B. After pressure testing per Section 33 08 00, flush system through hydrants or if a hydrant does not exist, install a tap of sufficient size to provide 2.5 feet per second flushing velocity in the line.
- C. Starting at outlet closest to water source, bleed water from each outlet until chlorine residual reaches outlet. Repeat process at each outlet throughout system.
- D. Collect a bacteriological water sample at end of line to be tested. If sample fails bacteriological test, flush system and retest. Continue flushing and retesting until a good

sample is obtained.

- E. If flushing does not produce a passing bacteriological test disperse disinfectant throughout system to obtain 10 to 25 ppm of free chlorine residual.

- F. Flush the chlorinated water from the main until chlorine measurements show the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.
- G. After a negative bacteriological sample is obtained, let the system relax for 24 hours. Flush and collect a subsequent bacteriological sample for testing. If the subsequent test is negative then water line is acceptable.

3.3 DISINFECTION OF CULINARY WELLS

- A. Use one method defined under AWWA A100 that is acceptable to ENGINEER.
- B. Do not start disinfection until well is thoroughly cleaned.
- C. Use a disinfecting solution containing a minimum of 50 ppm residual chlorine.
- D. Flush system after disinfection.

3.4 DISINFECTION OF WATER STORAGE RESERVOIRS

- A. Use one method defined under AWWA C652 that is acceptable to the ENGINEER.
- B. Do not start disinfection until water storage tank is thoroughly cleaned.
- C. Provide and use necessary safety equipment for workers in contact with disinfectant or gasses.
- D. Flush system after disinfection.

3.5 FIELD QUALITY CONTROL

- A. Bacteriological Test:
 - 1. Collect Samples for testing no sooner than 16 hours after system flushing.
 - 2. Analyze water samples per State of Utah requirements.
 - 3. If bacteriological test proves water quality to be unacceptable, repeat system treatment.
 - 4. Do not place water systems into service until a negative bacteriological test is made. Provide a copy of the negative bacteriological test to ENGINEER.
- B. Disposal of Disinfectant:
 - 1. Legally dispose of disinfecting water and ensure no chlorine buildup or damage to the environment.

END OF SECTION

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SECTION 33 31 00

SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gravity sanitary sewerage systems.
- B. Pressure systems are indicated in Section 33 11 00.

1.2 REFERENCES

- A. ASTM C 478: Standard Specification for Precast Reinforced Concrete Manhole Section.
- B. ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
- C. ASTM C 923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 PERFORMANCE REQUIREMENTS

- A. Vertical Cover: Unless indicated otherwise, 2 feet minimum for laterals and 4 feet when subjected to light construction equipment loads.
- B. Remove any section of pipe already placed that is found to be out of alignment tolerance indicated, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.4 PROJECT CONDITIONS

- A. Minimize neighborhood traffic interruptions. Barricade stockpiles.
- B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.
- C. Repair public and private facilities damaged by CONTRACTOR.
- D. Prior to Backfilling: Commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.

1.5 ACCEPTANCE

- A. Each sanitary sewer system component must pass applicable requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

- A. Provide piping materials and factory fabricated piping products of sizes, types, and classes indicated.
- B. Where not indicated, provide proper selection acceptable to ENGINEER to comply with installation requirements.
- C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 MORTAR, GROUT AND CONCRETE

- A. Mortar: Cement, Section 04 05 16.
- B. Grout: Cement, Section 03 61 00.

- C. Concrete:
 - 1. Cast-in-place: Class 4000, Section 03 30 04.
 - 2. Precast: Class 5000, Section 03 40 00.

2.3 MANHOLES

- A. Basin: Precast concrete, ASTM C 478.
- B. Steps: None.
- C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.
- D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron; Section 05 56 00 with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as indicated.
- E. Pipe Connectors: Resilient, ASTM C 923. Sand mortar grout pipe connections.
- F. Joints in Sections: Bituminous mastic gasket-type sealant unless indicated otherwise.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are as indicated.
- B. Hand trim Excavations to required elevations. Backfill over excavations and compact, Section 33 23 26.
- C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.
- D. Clearly identify and promptly set aside defective or damaged pipe.
- E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 INSTALLATION - PIPE AND FITTINGS

- A. Place bell or groove end facing upstream.
- B. Install gaskets per manufacturer's recommendations.
- C. Plug leak-proof such pipeline branches, stubs or other open ends which are not to be immediately connected.
- D. Clean interior of pipe of dirt and debris as work progresses.
- E. Meet line and grade tolerance specified in Section 33 08 00.

3.3 INSTALLATION – MANHOLES

- A. Form bottom of Excavation clean and smooth to correct elevation.
- B. Place structures in location indicated.
- C. Install precast units, ASTM C 891.
- D. Provide elevations and pipe inverts for inlets and outlets indicated.
- E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface, elsewhere set 3 inches above finished grade. Provide a concrete Cover Collar between the frame and asphalt Pavement.

3.4 ABANDONED UTILITIES

- A. Plug and cap with concrete all open ends of abandoned underground utilities which are to remain in place.
- B. Provide closure to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.

3.5 TAP CONNECTIONS - 6 INCHES AND SMALLER

- A. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.
- B. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.
- C. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus 6 inches overlap, with not less than 6 inches of concrete.
- D. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.6 TAP CONNECTIONS - LARGER THAN 6 INCHES

- A. Not allowed. Provide a Manhole structure.

3.7 JOINTS

- A. Join pipe per manufacturer's recommendation or as indicated.
- B. Joining Pipe of Different Sizes: At Manholes only.
- C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.8 BACKFILLING

- A. Prior to Backfilling: Commission pipeline, Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.
- B. Trenches: Section 33 05 20.
- C. Structures or Landscapes: Section 31 23 23.

3.9 CLEANING

- A. Remove debris, concrete, or other extraneous material which accumulates in existing pipes or structures. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping system.

3.10 SURFACE RESTORATIONS

- A. Provide temporary paved surfaces where Trenches pass through roadways, Driveways, or sidewalks.
- B. Restore paved surfaces, Section 33 05 25.
- C. Finish landscaped surfaces:
 - 1. With grass, Section 32 92 00 or
 - 2. Other ground cover, Section 32 93 13.

END OF SECTION

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SECTION 33 41 00

STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gravity systems such as irrigation, sub-drains, and storm drains.
- B. Pressure systems are indicated in Section 33 12 19.

1.2 REFERENCES

- A. ASTM C 478: Standard Specification for Precast Reinforced Concrete Manhole Section.
- B. ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
- C. ASTM C 923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 PERFORMANCE REQUIREMENTS

- A. Vertical Cover: 2 feet minimum or as indicated.
- B. Remove any section of pipe already placed that is found to be out of alignment tolerance indicated, defective, or damaged. Relay or replace without additional cost to OWNER.

1.4 PROJECT CONDITIONS

- A. Minimize neighborhood traffic interruptions. Barricade stockpiles.
- B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.
- C. Repair public and private facilities damaged by CONTRACTOR.
- D. Prior to Backfilling: Commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.

1.5 ACCEPTANCE

- A. Each storm drain system component must pass applicable requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

- A. Provide piping materials and factory fabricated piping products of sizes, types, and classes indicated.
- B. Where not indicated, provide proper selection acceptable to ENGINEER to comply with installation requirements.
- C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 IN-PLANE WALL DRAINAGE

- A. Drainage Core: Manufacturer's standard three-dimensional non-bio- degradable, plastic designed to effectively conduct water to foundation drainage system.

- B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 SUB DRAIN FILL MATERIALS

- A. Sewer Rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 MORTAR, GROUT AND CONCRETE

- A. Mortar: Cement, Section 04 05 16.
- B. Grout: Cement, Section 03 61 00.
- C. Concrete:
 - 1. Cast-in-place: Class 4000, Section 03 30 04.
 - 2. Precast: Class 5000, Section 03 40 00.

2.5 CLEANOUTS AND MANHOLES

- A. Basin: Concrete floor with cast in place concrete walls or ASTM C478 precast requirements.
- B. Steps: None.
- C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.
- D. Frame and Cover: Asphalt coated, heavy duty, ductile iron; Section 05 56 00 with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as indicated.
- E. Pipe Connectors:
 - 1. Precast Bases: Resilient, ASTM C 923. Sand mortar grout pipe connections.
 - 2. Cast in Place or Connections to Existing Manhole with Plastic Pipe: Use rubber Manhole adapter gasket for precast sections. Grout; Section 03 61 00 for cast in place sections.
- F. Joints in Sections: Bituminous mastic coating unless indicated otherwise.

2.6 INLETS AND CATCH BASINS

- A. Basin: Concrete floor and walls.
- B. Frame and Grate:
 - 1. Asphalt coated, heavy duty, cast iron: Section 05 56 00. Shape and size as indicated.
 - 2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10. Shape and size as indicated.
- C. Pipe Connectors: Resilient, ASTM C 923. Sand mortar grout.

2.7 OUTFALLS

- A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide riprap, Section 31 37 00, if indicated.

2.8 DRAIN PIPE JOINT SCREENS

- A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.
- B. Plastic or corrosion resistant metal bands.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are as indicated.
- B. Hand-trim Excavations to required elevations. Backfill over excavations and compact, Section 33 05 05.
- C. Remove stones larger than 2 inches or other hard matter that could damage pipe or impede backfilling or compaction.
- D. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.
- E. Clearly identify and promptly set aside defective or damaged pipe. F. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 INSTALLATION - PIPE AND FITTINGS

- A. Place bell or groove end facing upstream.
- B. Install gaskets per manufacturer's recommendations.
- C. Plug pipeline branches, stubs or other open ends which are not to be immediately connected.
- D. Clean interior of pipe of dirt and debris as work progresses.
- E. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.
- F. Meet line and grade tolerance specified in Section 33 08 00.

3.3 INSTALLATION - CLEANOUTS AND MANHOLES

- A. Form bottom of Excavation clean and smooth to correct elevation.
- B. Place structures in location indicated.
- C. Install precast units, ASTM C 891.
- D. Provide elevations and pipe inverts for inlets and outlets indicated.
- E. Where structures occur in Pavements, mount frame and cover 1/2 inch below finished surface, elsewhere set 3 inches above finished grade. Provide a concrete Cover Collar between the frame and asphalt Pavement.

3.4 INSTALLATION - INLETS OR CATCH BASINS

- A. Form bottom of Excavation clean and smooth to correct elevation.
- B. Construct with all connecting piping and appurtenances in their final position.
- C. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.5 INSTALLATION - SUB DRAIN SYSTEMS

- A. Install pipe and fittings per manufacturer's instruction.
- B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe circumference, centered over joint.
- C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.
- D. Place drainage pipe on bed of Sewer Rock, Section 31 05 13.

3.6 ABANDONED UTILITIES

- A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.
- B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.7 TAP CONNECTIONS

- A. Not allowed. Provide a cleanout or Manhole structure.

3.8 BACKFILLING

- A. Prior to Backfilling: Commission pipeline, Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.
- B. Trenches: Section 33 05 20.
- C. Structures or Landscapes: Section 31 23 23.

3.9 CLEANING

- A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.
- B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping system.

3.10 SURFACE RESTORATION

- A. Provide temporary paved surfaces where Trenches pass through roadways, Driveways, or sidewalks.
- B. Restore paved surfaces, Section 33 05 25.
- C. Finish landscaped surfaces as applicable.
 - 1. With grass; Section 32 92 00 or
 - 2. Other ground cover; Section 32 93 13.

END OF SECTION