

CITY OF JACKSON, MISSOURI

STANDARD TECHNICAL SPECIFICATION

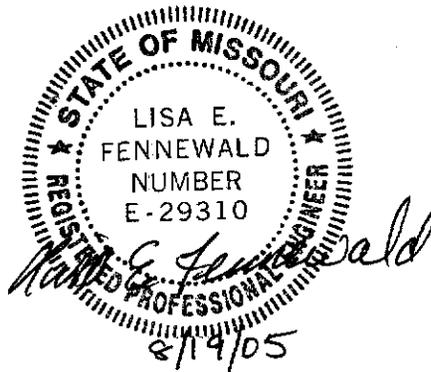
FOR

WATER MAIN EXTENSIONS / DEVELOPER INSTALLATIONS

OCTOBER 25, 2001

REVISED

August 19, 2005



Prepared by:

**HORNER &
SHIFRIN, INC.**
ENGINEERS ■ ARCHITECTS ■ PLANNERS

5200 Oakland Ave.
St. Louis, MO 63110

CITY OF JACKSON, MISSOURI
STANDARD TECHNICAL SPECIFICATIONS

FOR

WATER MAIN EXTENSIONS / DEVELOPER INSTALLATIONS

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NOTE: Specifications originally prepared by Burns & McDonnell (November 25, 2001), and updated by Horner & Shifrin on August 19, 2005 to meet MDNR 2003 design requirements.

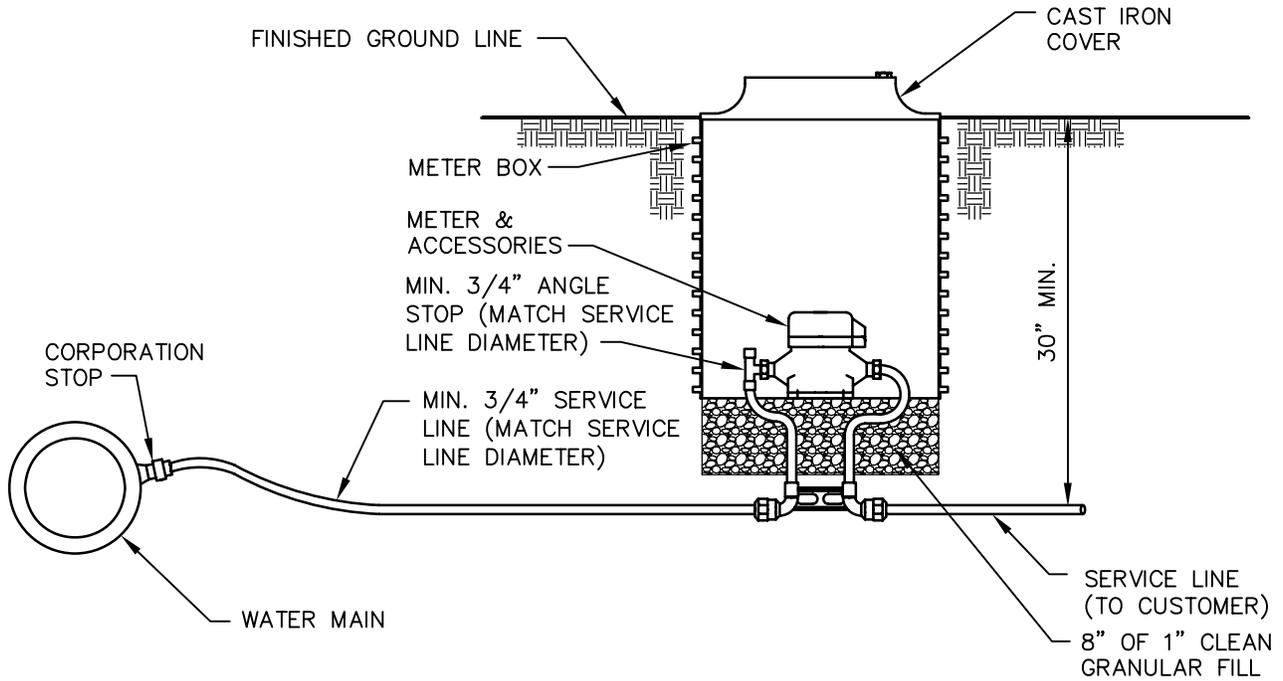
Lisa E. Fennewald, P. E.

APPENDIX A

DIMSCALE: 1

DATE: 09-28-05

DWG: N:\05003\05\CAD\STD DWG SPECS\STD-SPEC1.DWG



WATER METER DETAIL

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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION

WATER METER DETAIL

DIMSCALE: 1

DATE: 08-22-05

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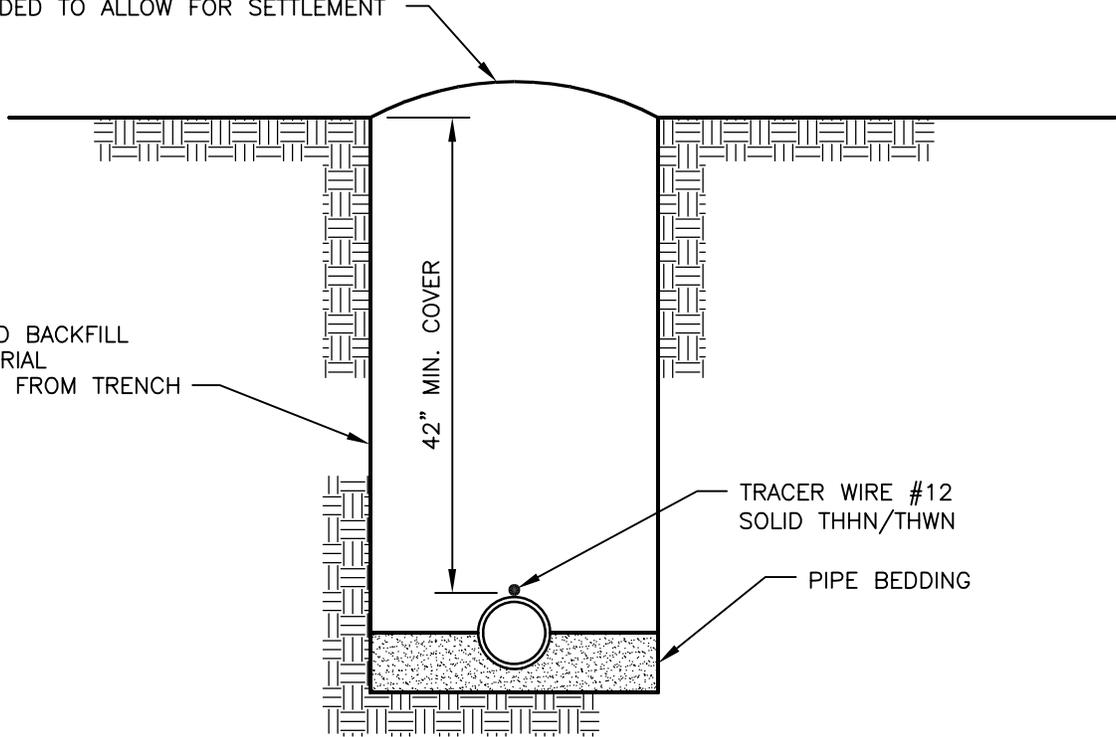
WHERE EARTH BACKFILL IS USED THE TRENCH SHALL BE LEFT SLIGHTLY MOUNDED TO ALLOW FOR SETTLEMENT

COMPACTED BACKFILL WITH MATERIAL EXCAVATED FROM TRENCH

42" MIN. COVER

TRACER WIRE #12 SOLID THHN/THWN

PIPE BEDDING



TRENCH DETAIL NON-ROADWAY AREAS

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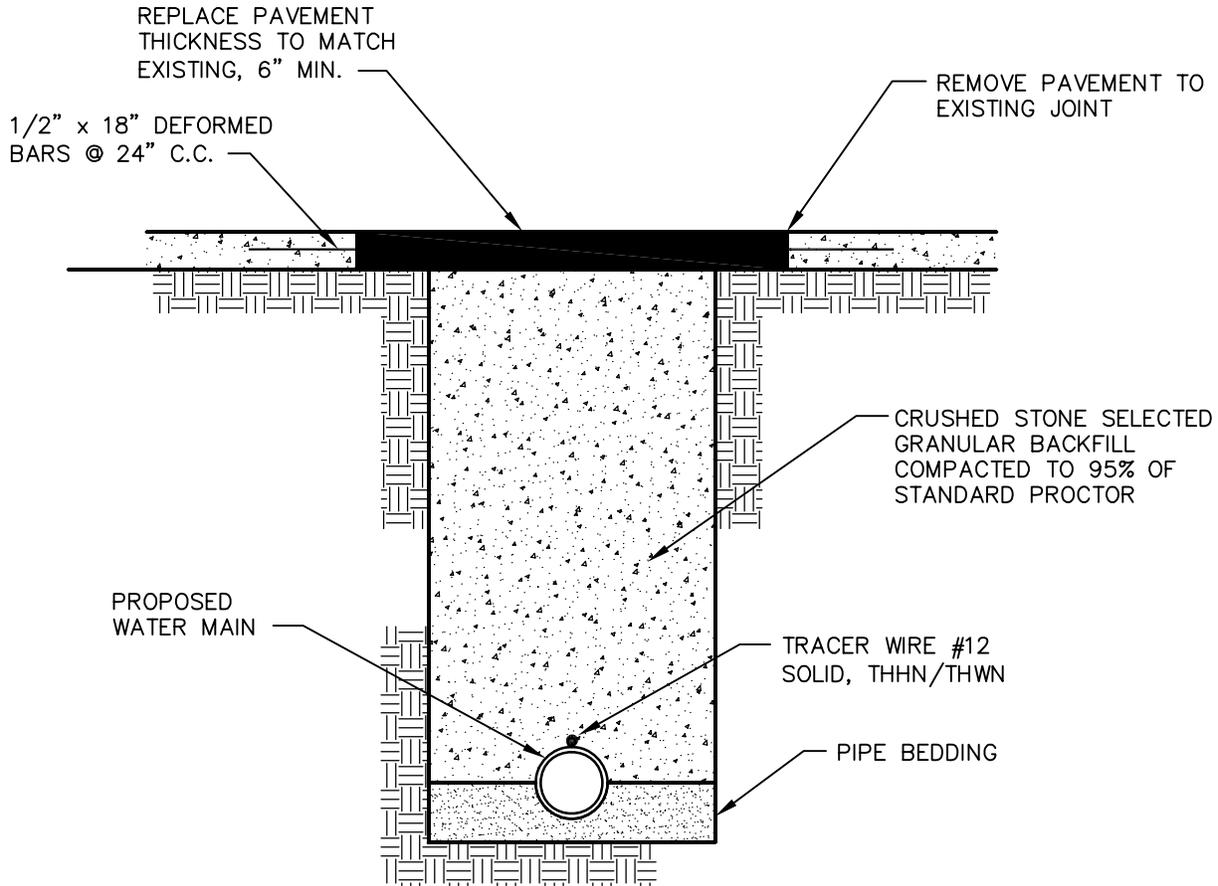
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TRENCH DETAIL
 NON-ROADWAY AREAS

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TRENCH DETAIL
ROADWAY AREAS

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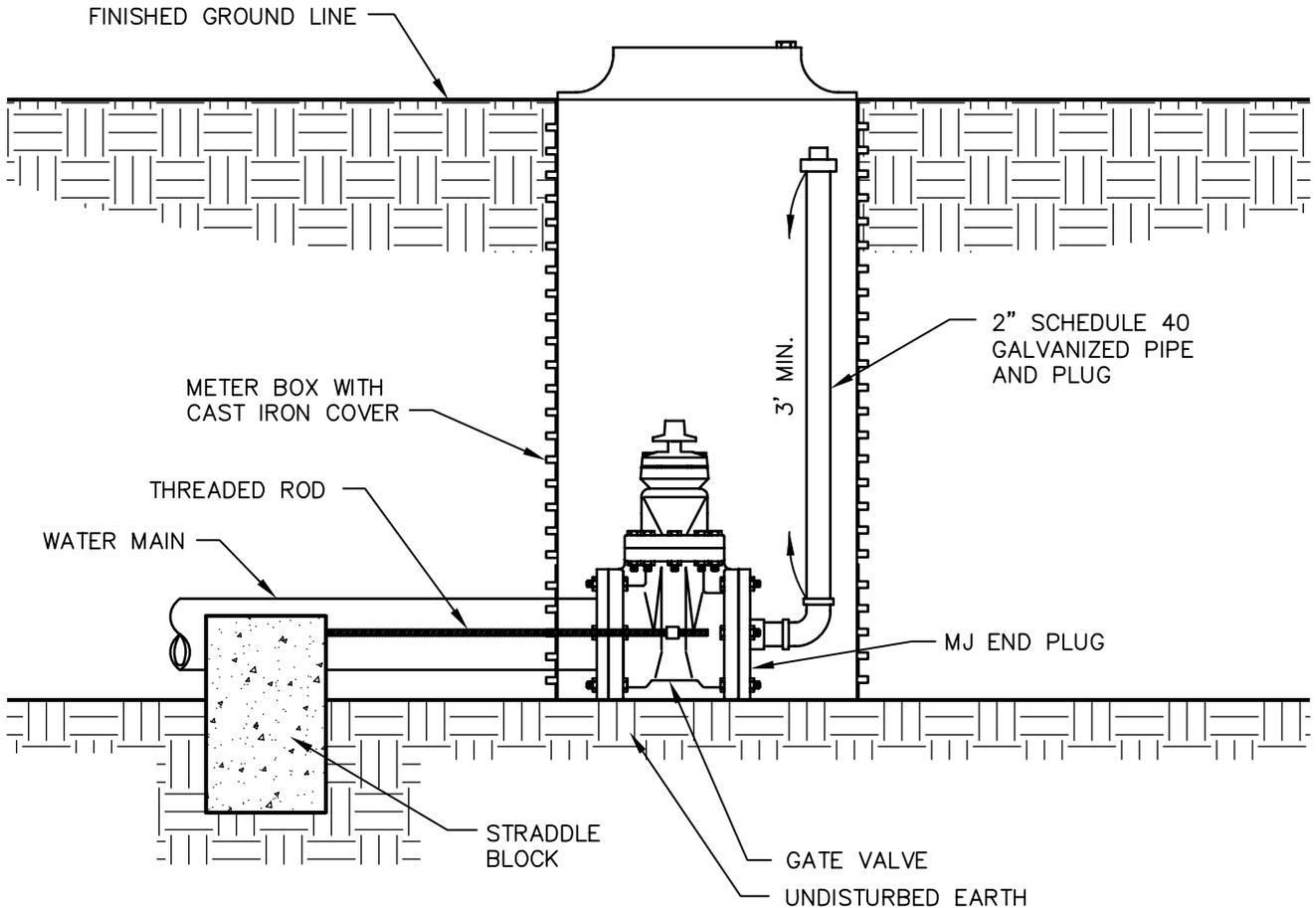
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TRENCH DETAIL
ROADWAY AREAS

DIMSCALE: 1

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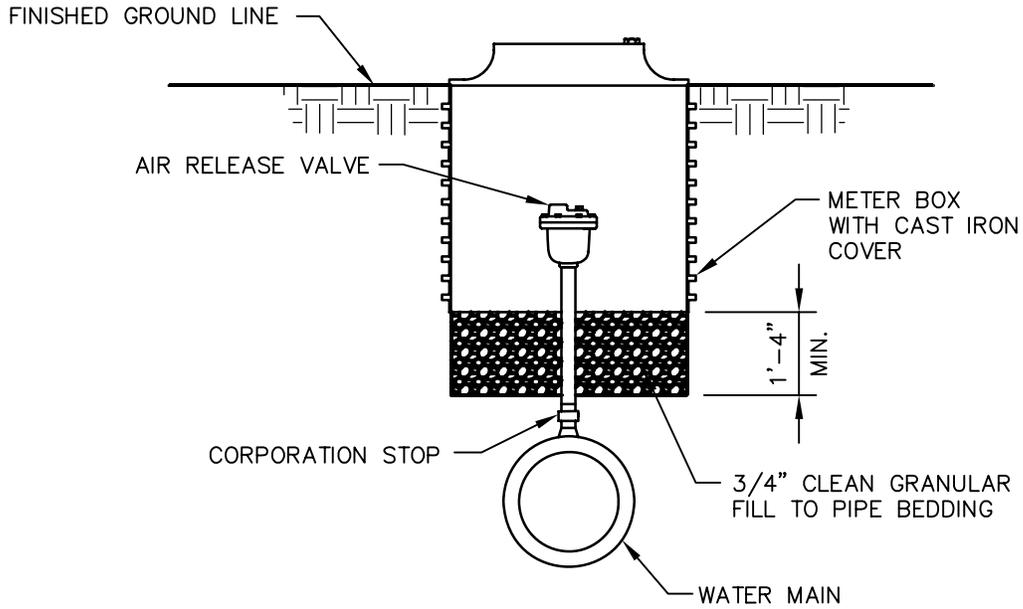
2" END FLUSH DEVICE

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2" END FLUSH DEVICE



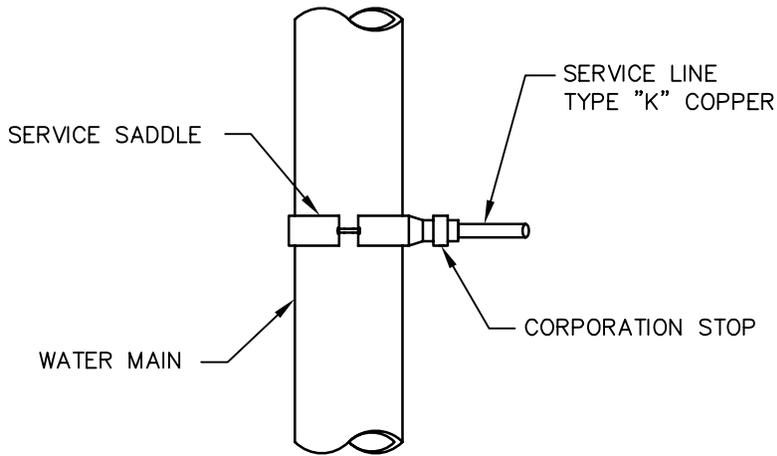
AIR RELEASE VALVE

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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION

AIR RELEASE VALVE



NOTE:
 A MINIMUM DISTANCE OF 2'-0" IS REQUIRED FROM THE END OF THE WATER MAIN FOR SERVICE CONNECTIONS AND A MINIMUM DISTANCE OF 2'-0" IS REQUIRED BETWEEN SERVICE CONNECTIONS.

SERVICE CONNECTION

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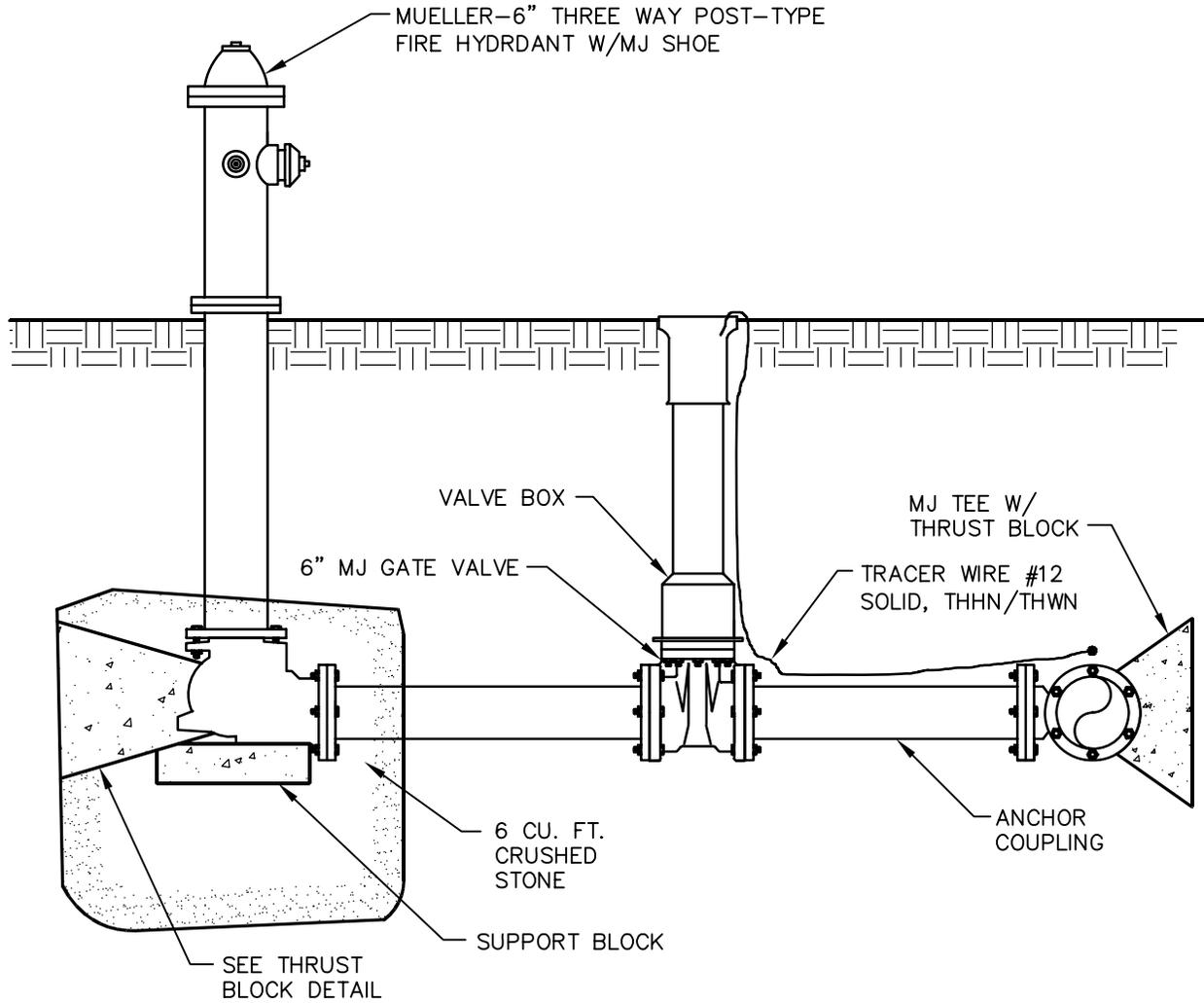
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SERVICE CONNECTION

DIMSCALE: 1

DATE: 08-22-05

DWG: N:\05003\05\CAD\STD_DWG_SPECS\STD-SPEC7.DWG



FIRE HYDRANT ASSEMBLY

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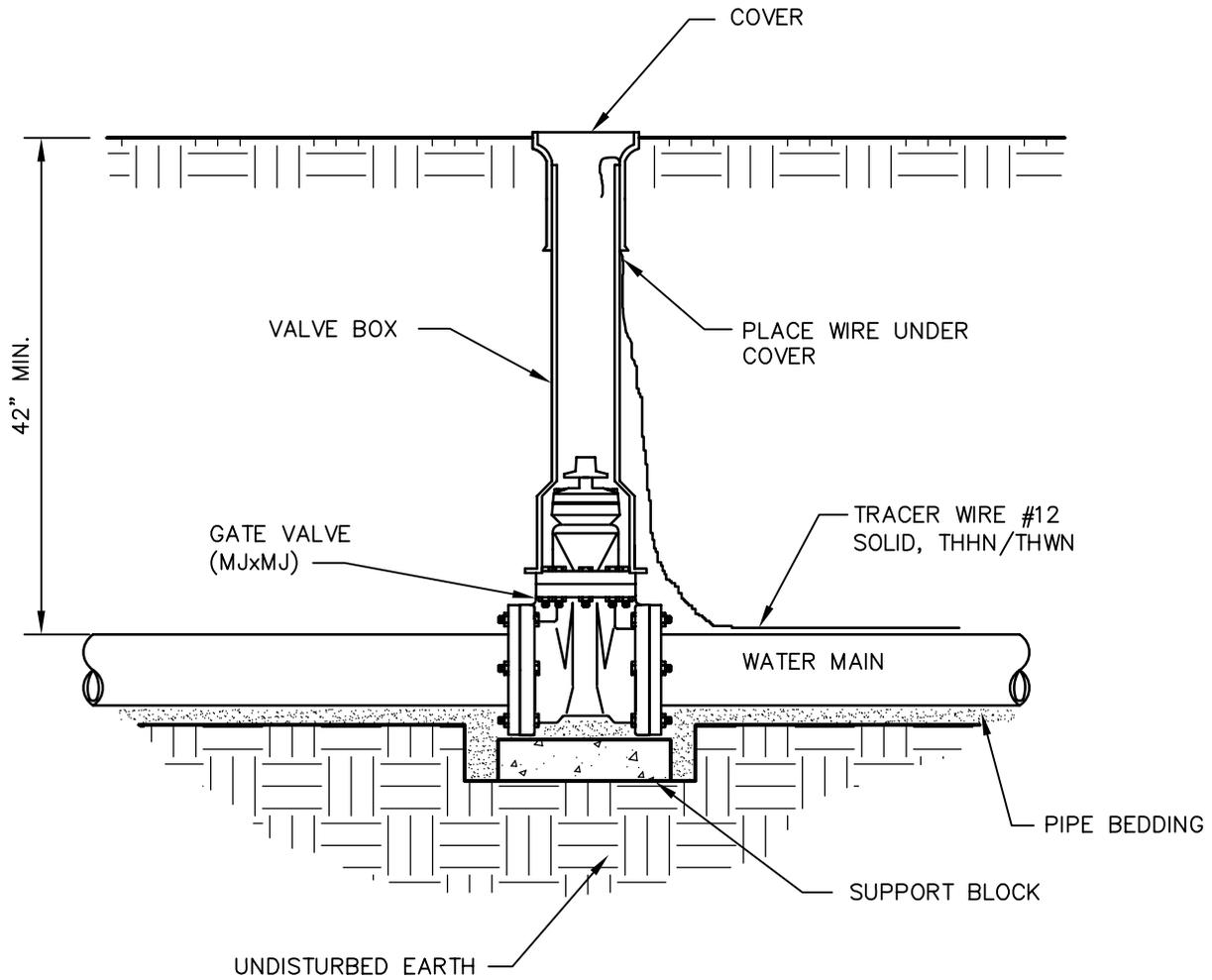
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FIRE HYDRANT ASSEMBLY

DIMSCALE: 1

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VALVE AND VALVE BOX

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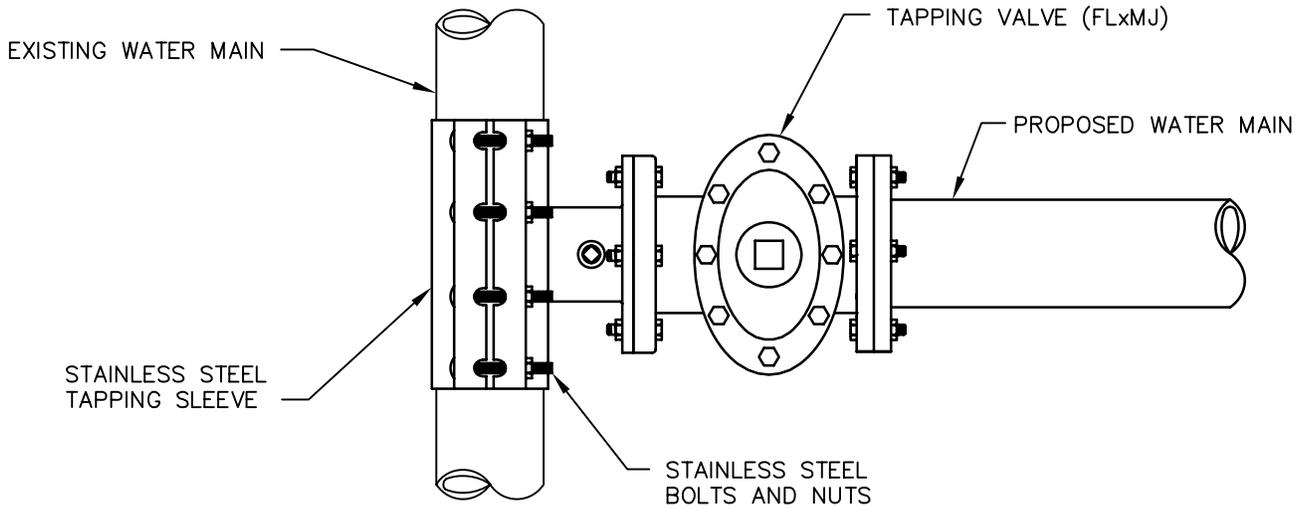
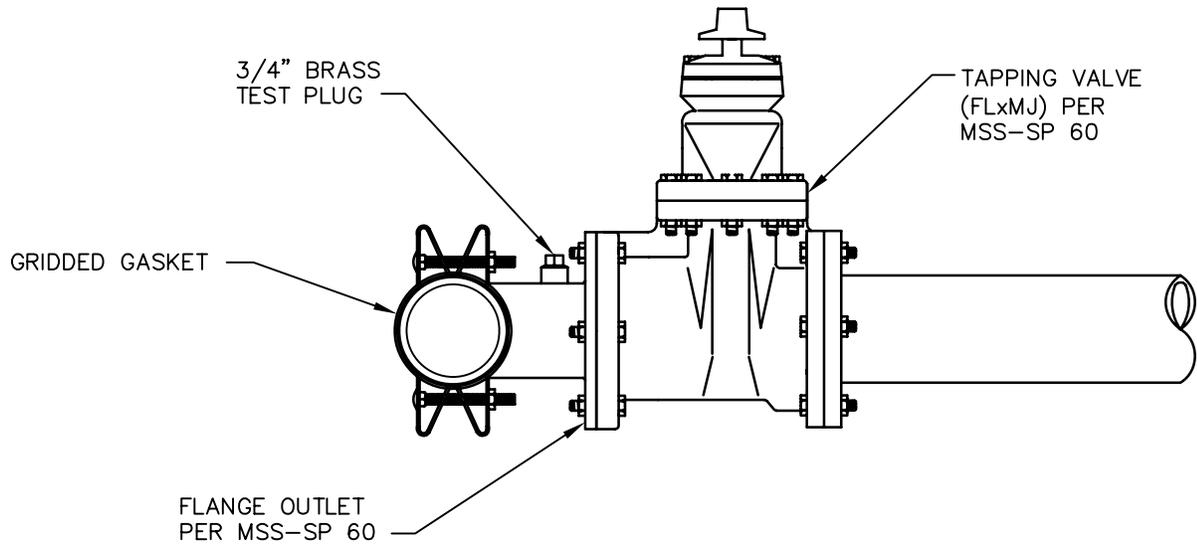
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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION

VALVE AND VALVE BOX

DIMSCALE: 1

DATE: 08-22-05

DWG: N:\05003\05\CAD\STD DWG SPECS\STD-SPEC9.DWG



TAP UNDER PRESSURE

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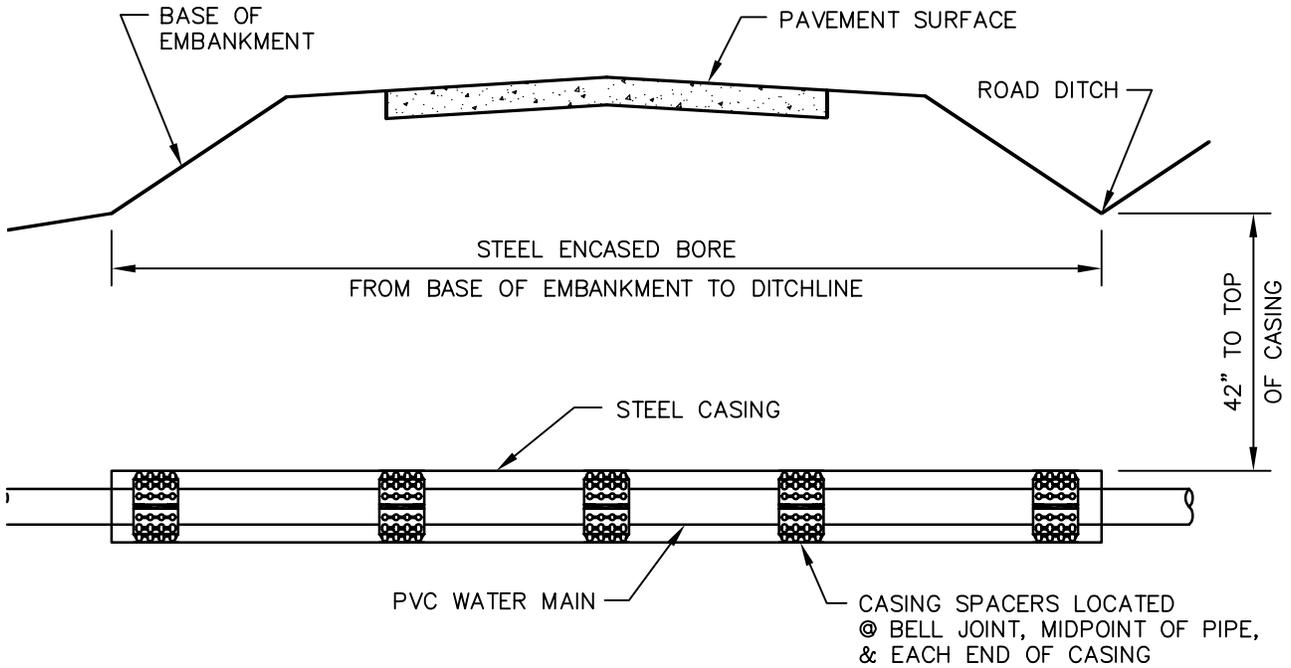
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ROAD BORE DETAIL

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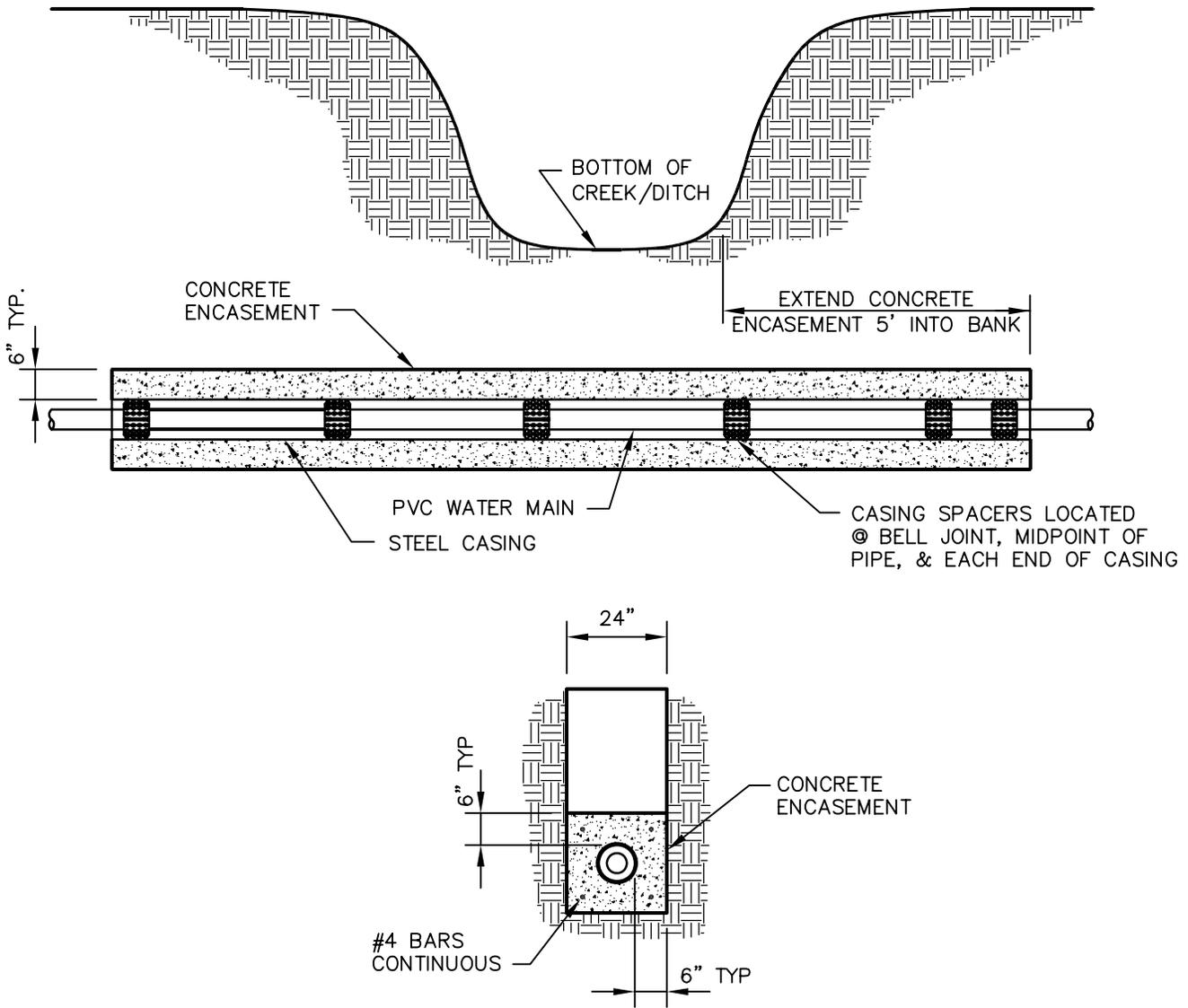
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ROAD BORE DETAIL

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DWG: N:\05003\05\CAD\STD DWG SPECS\STD-SPEC11.DWG



CREEK/DITCH CROSSING - STEEL CASING

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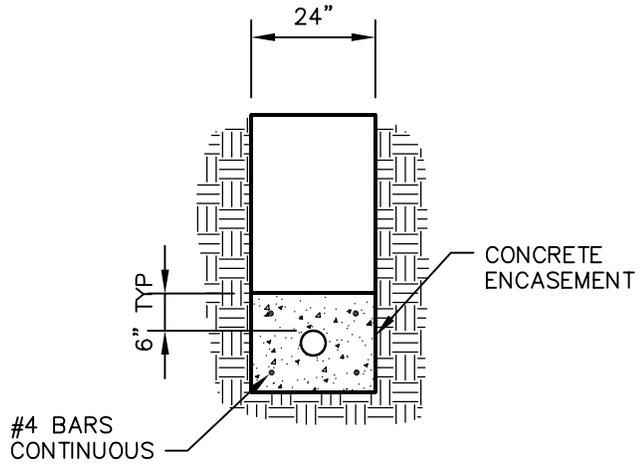
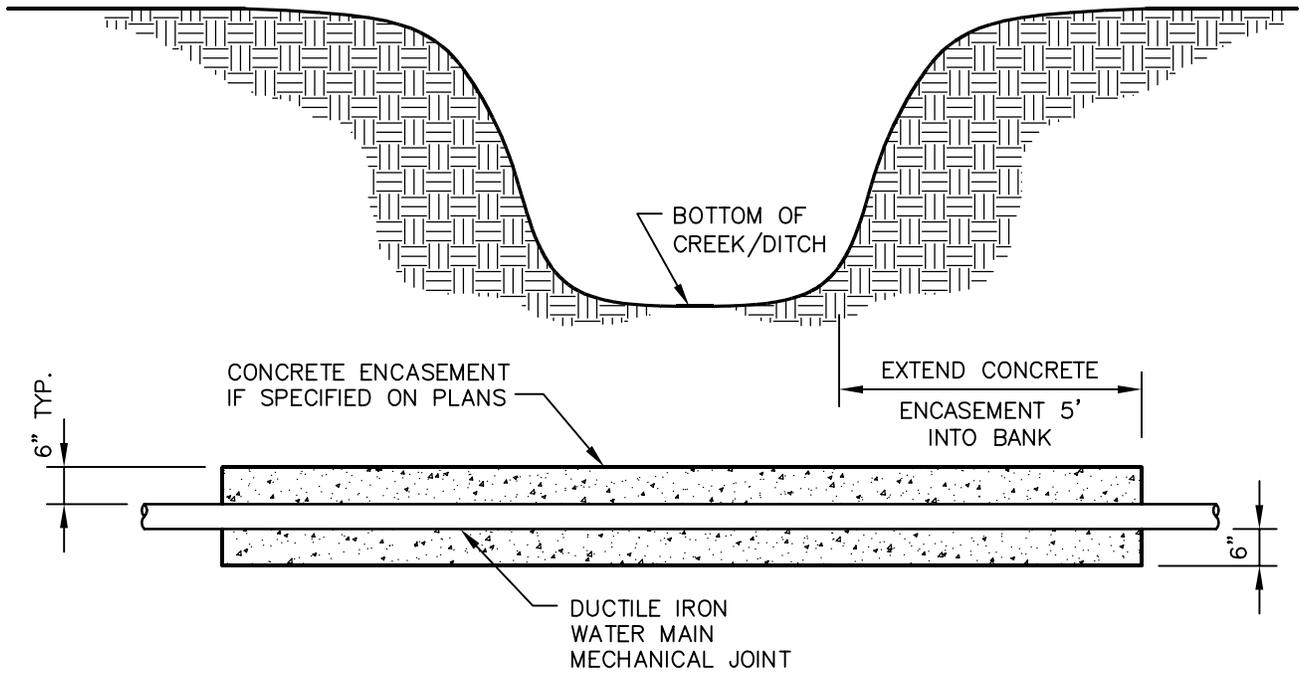
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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION
 CREEK/DITCH CROSSING - STEEL CASING

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DATE: 08-18-05

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CREEK/DITCH CROSSING - DUCTILE IRON

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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION

CREEK/DITCH CROSSING - DUCTILE IRON

THRUST BLOCK DEMINSIONS

90° BEND							
SIZE	2'	4'	6'	8'	10'	12'	18'
A	16"	16"	26"	33"	40"	50"	70"
B	16"	16"	24"	33"	40"	50"	70"
C	9"	9"	12"	12"	15"	16"	22"
D	8"	8"	12"	16"	20"	25"	24"

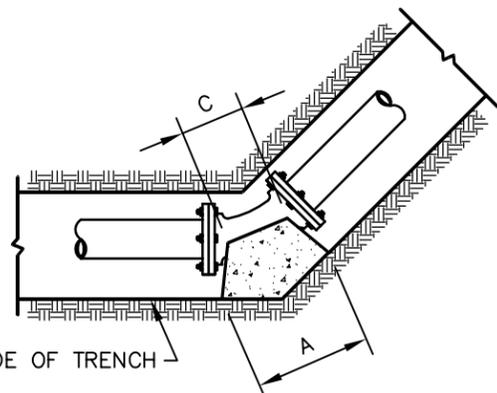
45° BEND							
SIZE	2'	4'	6'	8'	10'	12'	18'
A	12"	12"	18"	24"	31"	37"	52"
B	12"	12"	18"	24"	31"	37"	52"
C	8"	8"	10"	12"	14"	16"	14"
D	6"	6"	9"	12"	15"	18"	18"

22 1/2° BEND							
SIZE	2'	4'	6'	8'	10'	12'	18'
A	9"	9"	13"	18"	23"	26"	40"
B	9"	9"	13"	18"	23"	26"	40"
C	8"	8"	10"	12"	14"	16"	15"
D	4"	4"	6"	9"	11"	13"	16"

11 1/4° BEND							
SIZE	2'	4'	6'	8'	10'	12'	18'
A	9"	9"	11"	13"	16"	18"	30"
B	9"	9"	11"	13"	16"	18"	30"
C	8"	8"	10"	12"	14"	16"	15"
D	4"	4"	5"	6"	8"	9"	16"

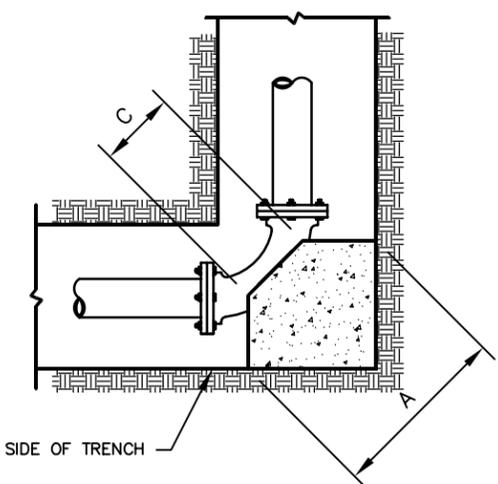
TEE							
MAIN	2'-6"	8'-12"	8'-10"	12'	12'	12'	18'
BRANCH	2'-6"	2'-6"	8'-10"	2'-6"	8'-10"	12'	16'-18'
A	26"	26"	43"	26"	43"	52"	70"
B	26"	26"	43"	26"	43"	52"	70"
C	12"	12"	12"	12"	12"	12"	30"
D	13"	13"	21"	13"	21"	26"	24"

PLUG							
SIZE	2'	4'	6'	8'	10'	12'	18'
A	26"	26"	26"	34"	43"	52"	70"
B	26"	26"	26"	34"	43"	52"	70"
C	12"	12"	12"	12"	12"	12"	30"
D	11"	11"	11"	15"	22"	32"	32"



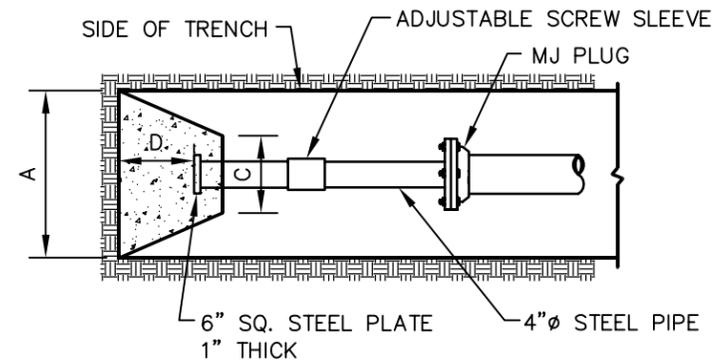
SIDE OF TRENCH

THRUST BLOCK 45° BEND

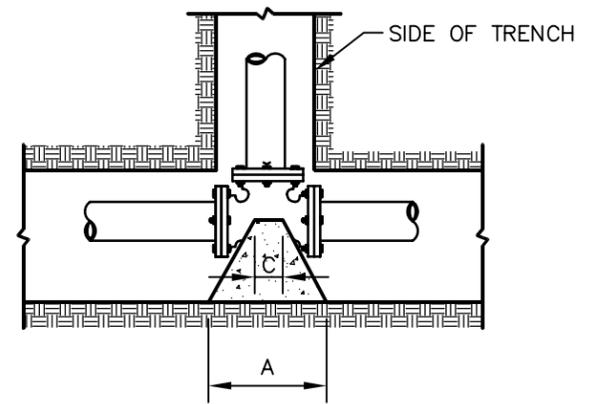


SIDE OF TRENCH

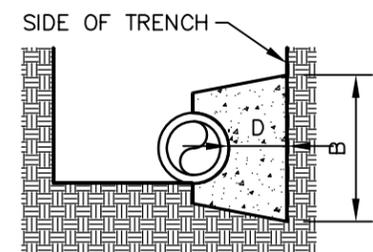
THRUST BLOCK 90° BEND



THRUST BLOCK PLUG



THRUST BLOCK TEE



THRUST BLOCK SECTION

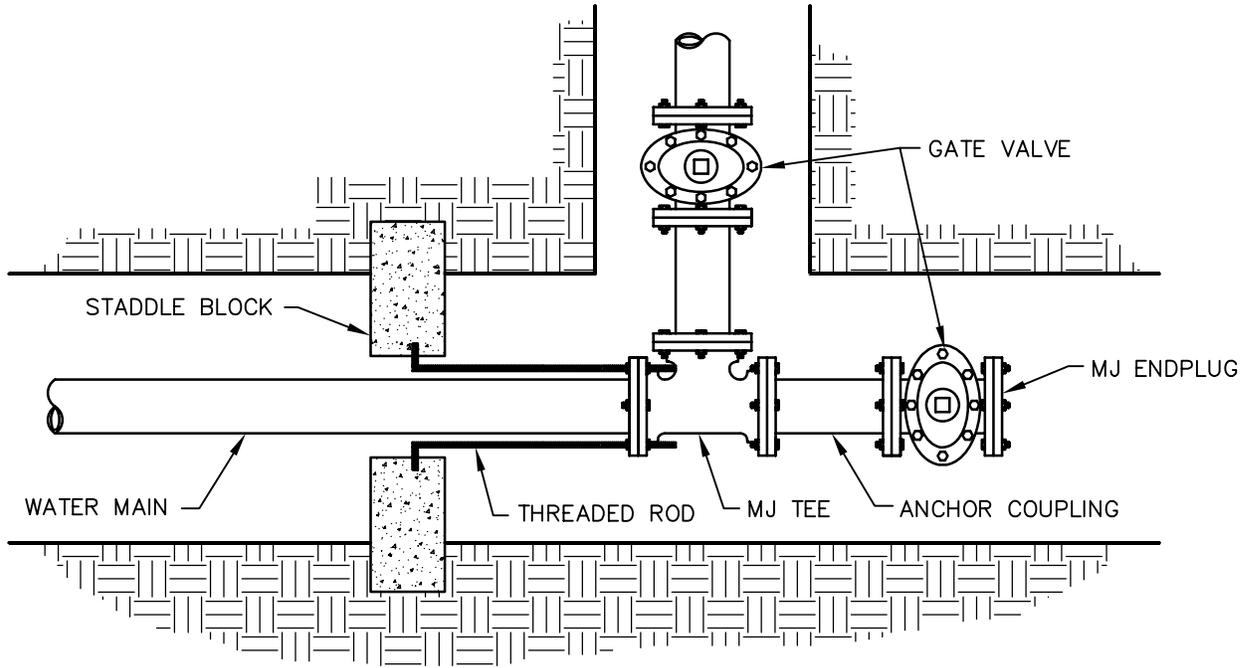
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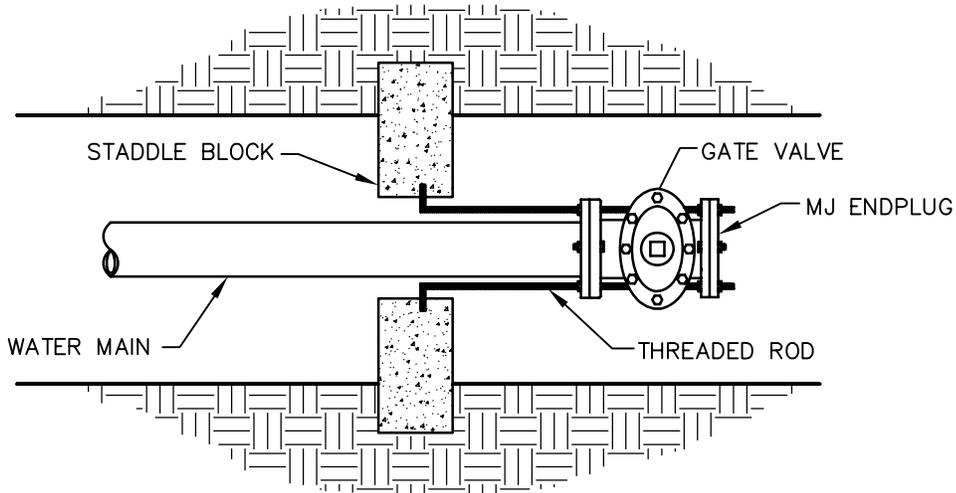
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 STANDARD SPECIFICATIONS FOR
 WATERLINE CONSTRUCTION
THRUST BLOCK DETAILS

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STRADDLE THRUST BLOCK - TEE



STRADDLE THRUST BLOCK - VALVE

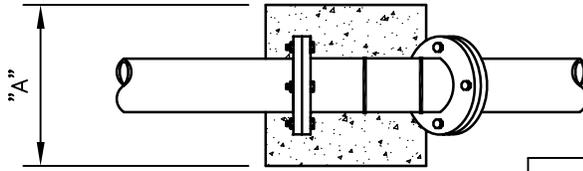
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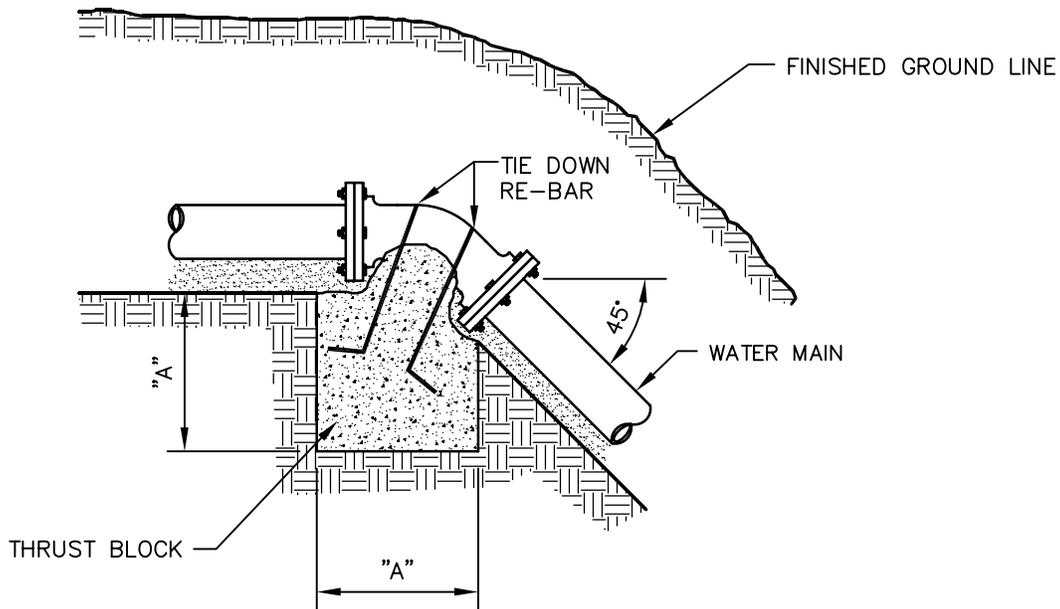
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 WATERLINE CONSTRUCTION

THRUST BLOCK DETAILS



THRUST BLOCK TO BE
POURED AGAINST
UNDISTURBED EARTH
TIE DOWNS
6"-10" #4 REBAR
12"-18" #5 REBAR

DIMENSIONS "A"				
DIA	BEND	45°	90°	TEE
6"		18"	20"	22"
8"		20"	30"	30"
10"		30"	45"	45"
12"		36"	59"	59"
18"		52"	70"	70"



VERTICAL BEND THRUST BLOCK

DIVISION 2 - SITE CONSTRUCTION

SECTION 02300 - SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes Site preparation activities and certain items of earthwork common to other related Work.
- B. Related Work Specified Elsewhere:
 - 1. Trenching and Backfilling for Utilities: SECTION 02322.

1.02 REFERENCES:

- A. Missouri Standard Specifications for Highway Construction, 1996, or latest revision thereto.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.

PART 2 - PRODUCTS

2.01 RIPRAP:

- A. Riprap material shall conform to the Missouri Standard Specifications for Highway Construction – SECTION 611.30 ROCK BLANKET.

PART 3 - EXECUTION

3.01 SITE PREPARATION:

- A. Clearing and Grubbing:
 - 1. Perform clearing and grubbing as indicated or as necessary to perform excavation, trenching, embankment, borrow, and other Work required, and where desired by Contractor for subsidiary purposes subject to approval:
 - a. Clearing:
 - (1) Includes felling and disposal of trees, brush, and other vegetation.
 - (2) Conduct Work in a manner to prevent damage to property and to provide for the safety of employees and others.
 - (3) Keep operations within property lines as indicated.
 - b. Grubbing:
 - (1) Includes removal and disposal of tree stumps and roots larger than 3-inches in diameter.
 - (2) Remove to a depth of at least 18-inches below existing grade elevation.
 - (3) Backfill all excavated depressions with approved material and grade to drain.
- B. Protection of Trees:
 - 1. Protect tops, trunks, and roots of existing trees on Project Site which are to remain, as follows:
 - a. Box, fence around, or otherwise protect trees before any construction Work is started.
 - b. Do not permit heavy equipment or stockpiles within branch spread.

- c. Trim or prune to obtain working space in lieu of complete removal when possible. Conduct operation as follows:
 - (1) With experienced personnel.
 - (2) Conform with good horticultural practice.
 - (3) Preserve natural shape and character.
 - (4) Protect cuts with approved tree paint.
 - d. Grade around trees as follows:
 - (1) Trenching: Where trenching is required around trees which are to remain, avoid cutting the tree roots by careful hand tunneling under or around the roots. Avoid injury to or prolonged exposure of roots.
 - e. Remove when damage occurs and survival is doubtful.
 - f. Replace with similar item when damaged through carelessness and so requested.
- C. Debris:
- 1. Dispose of debris from clearing, grubbing, stripping, and demolition at a location off the Site as arranged for by Contractor or by burying on the Site with approval.
 - 2. Place debris buried on the Site a minimum of 5 feet below finished grade in areas acceptable to Owner. Indicate locations of buried debris on Contractor-furnished construction records.
 - 3. Contractor may claim and salvage any timber which Contractor may consider of value, but shall not delay in any manner either this Contract or other Work with salvaging operations.

3.02 EARTHWORK:

A. Excavation:

- 1. Perform excavation as indicated or as required to complete the Work.
- 2. Normal materials to be excavated are earth and other materials which can be removed by power shovel, bulldozer, or other normal equipment, but not requiring the use of explosives or drills:
 - a. If rock is encountered within the limits of the excavation, notify Owner immediately. Do not proceed further until so instructed and measurements are made for establishing the volume of rock excavation. Rock will only be measured for removal within the boundaries of the required utility trench.
 - b. Strip rock for measurement before excavating. No rock excavated or loosened before measurement will be allowed or paid for as rock.
 - c. The Bid price shall include rock excavation throughout the length of restrained joint pipe depicted at each creek crossing. All other rock excavation shall be paid for at the Unit Price stipulated in the Agreement.
 - d. "Rock" as pertaining to "rock excavation" referenced in these Documents shall include any material in original beds, or well defined ledges such as solid limestone, hard sandstone, or hard shales. Also, any material where each piece is more than one cubic yard in volume such as large boulders, detached pieces of limestone, hard limestone, or mass concrete.
- 3. Blasting:
 - a. Blasting shall be performed only by persons who are qualified, competent, and thoroughly experienced in the use of explosives for rock excavation and when no other means of removal is possible. Only with the approval of the City of Jackson.
 - b. Locate charge holes properly and drill to correct depth for charges used.
 - c. Limit charges in size to minimum required for reasonable removal of material by excavating equipment.

- d. Avoid excessive overbreak or damage to adjacent structures, equipment, utilities, or buried pipeline and conduit as follows:
 - (1) With properly designed pattern.
 - (2) By use of approved explosion mats.
 - e. Blasting near utilities shall be subject to approval of owning agency.
 - f. Contractor shall perform baseline measurements in order to determine and quantify any effects of the blasting on nearby structures.
 - g. Before delivery of any explosives to Site, Contractor must have obtained a blasting endorsement on his public liability and property damage insurance policy.
4. Waste Materials:
- a. Waste materials as described for purposes of this Contract within this Section consist of deleterious soils, rock, and other materials considered unacceptable for compaction or placement fill, and which are not environmentally contaminated. Waste materials shall not include environmental pollutants, hazardous substances, contaminated products, by-products, samples, or waste materials of any kind that are regulated under environmental laws.
 - b. Remove waste materials from Work area as excavated.
 - c. Deposit such materials in locations and within areas designated by Owner and as indicated.
 - d. Material shall become property of Contractor and shall be disposed of off Site at locations arranged for by Contractor.
 - e. Place excavated rock in the interior of waste area fills so that it will not be exposed to view.
 - f. Grade waste areas and leave them free draining and with an orderly and neat appearance.
- B. Topsoiling:
- 1. Includes placement of topsoil on all areas not specified to receive paving or other surface treatment (including borrow or waste areas).
 - 2. Materials:
 - a. Those obtained from excavation which are most suitable and stockpiles for such purpose:
 - (1) Topsoil shall be a fertile, friable, and loamy soil of uniform quality, free from materials such as hard clods, stiff clay, stone with any dimension greater than 1-inch, and similar impurities. Relatively free from grass, roots, weeds, and other objectionable plant material.
 - b. Borrow when required.
 - 3. Subgrade Treatment:
 - a. Clear Site of vegetation heavy enough to interfere with proper grading and tillage operations.
 - b. Clear surfaces of all stones or other objects larger than 3-inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.
 - c. Loosen subgrade by discing or scarifying to a depth of 2-inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the subgrade.
 - 4. Placement of Topsoil:
 - a. Distribute over required areas without compaction in upper 1 foot, other than that obtained with spreading equipment.
 - b. To extent material is available within following limits:
 - (1) Not less than 4-inches in depth.
 - (2) Do not exceed 2 feet in depth.

- (3) Shape cuts, fills, and embankments to contours indicated.
 - (4) Grade to match contours of adjacent areas and permit good, natural drainage. Provide gentle mound over trenches.
 - 5. Maintenance:
 - a. After topsoil has been spread, clear surface of stones or other objects larger than 1-inch in thickness or diameter and all other objects that might interfere with planting and maintenance operations.
 - b. Protect topsoiled areas from the elements until grass is established and repair eroded areas as required.
 - c. Keep paved areas clean. Promptly remove topsoil or other dirt dropped upon surfacing.
- 3.03 RIPRAP:
 - A. Riprap materials and placement shall conform to the Missouri Standard Specifications for Highway Construction – SECTION 611.30 ROCK BLANKET.
- 3.04 FIELD QUALITY CONTROL:
 - A. Subgrades:
 - 1. Owner will inspect all subgrades to determine conformance with indicated lines and grades.
 - 2. Subgrades for roadways, drives, parking areas, and railroads shall have a maximum deviation of not more than ½ inch in any 10 feet when tested with a 10-foot straightedge applied parallel with and right angles to the centerlines of subgrade areas, except that subgrades to receive aggregate-type surfacing shall have a maximum deviation of not more than 1 inch in any 10 feet.
- 3.05 PROTECTION OF THE WORK:
 - A. Maintenance:
 - 1. Protect newly graded and topsoiled areas from actions of the elements.
 - 2. Fill and repair settling or erosion occurring prior to landscaping and reestablish grades to the required elevations and slopes.
 - B. Correction of Backfill Settlement:
 - 1. Under provisions of the guarantee, Contractor is responsible for correcting any settlement of backfill and damages created thereby within 1 year after acceptance of the Work.
 - 2. Make repairs within 10 days from and after due notification by Owner of backfill settlement and resulting damage.
 - 3. Make own arrangements for access to the Site for purposes of repair.

END OF SECTION 02300

SECTION 02322 - TRENCHING AND BACKFILLING FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes:
 - 1. Excavation, sheeting, bracing, and all operations necessary for the preparation of trenches for bedding of pipes and pipe appurtenances, conduit, and buried cable.
 - 2. Pipe embedments and encasements.
 - 3. Backfilling of trenches.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M147 - Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 - b. T99 - The Moisture-Density Relations of Soils Using a 5.5-Pound Rammer and a 12-Inch Drop.
 - c. T104 - Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
 - 2. American Society for Testing and Materials (ASTM):
 - a. D4253 - Test Method for Maximum Index Density of Soils Using a Vibratory Table.
 - b. D4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 3. Occupational Safety and Health Administration (OSHA):
 - a. Part 1926 - Safety and Health Regulations for Construction.
 - 4. State of Missouri Standard Specifications for Highway Construction.

1.03 SUBMITTALS:

- A. Submit as specified.
- B. Includes, but not limited to, the following:
 - 1. Steel reinforcement for concrete encasement.
 - 2. Steel reinforcement for concrete cradle.
 - 3. Concrete Submittals as specified.
- C. Where selecting an option for excavation, trenching, and shoring in compliance with local, state, or federal safety regulations such as "OSHA Part 1926" or successor regulations, which require design by a registered professional engineer, submit (for information only and not for Owner approval) the following:
 - 1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located.
 - 2. Documents provided with evidence of registered professional engineer's seal, signature, and date in accordance with appropriate state licensing requirements.

PART 2 - PRODUCTS

2.01 GRANULAR PIPE EMBEDMENT:

- A. Material:
 - 1. Gravel or crushed stone which shall not have a loss of more than 15% after five cycles when tested for soundness with sodium sulfate as described in AASHTO T104.

B. Gradation:

<u>Percent Passing</u>	<u>Standard Square-Mesh Sieve</u> <u>U.S. Size or No.</u>
100	3/4-inch
60-100	1/2-inch
0-5	No. 4

2.02 TRENCH STABILIZATION MATERIAL:

- A. Material shall be one of the following:
1. As specified in this PART 2 Granular Pipe Embedment.
 2. Conform to AASHTO M147, Gradation A or B.

2.03 CONCRETE:

- A. Concrete and reinforcing steel shall conform to applicable requirements.

2.04 TRENCH BACKFILL MATERIALS:

- A. Obtain from the following:
1. Trenches and other excavations included in this Contract
 2. Borrow from location off Site.
 3. As specified for pipe embedment.
 4. Combination of above.
- B. Free from organic matter, refuse, ashes, cinders, frozen, or other unsuitable material.
- C. Gravel, rock, or shale particle size limited as follows:
1. Not to exceed 3/4 inches in greatest dimension within 12 inches of pipe or conduit and upper 18 inches of trench.
 2. Gravel, rock, or shale not allowed within 12 inches of buried cable.
 3. Maximum dimension one-half the depth of layer to be compacted in other areas.
- D. Contain sufficient fine materials to provide a dense mass free of voids and capable of satisfactory compaction.
- E. Have moisture content enabling satisfactory placement and compaction.
- F. Use granular material as specified for pipe embedment and backfill under pavements, shoulders, driveways, and median strips.

PART 3 - EXECUTION

3.01 TRENCHING:

- A. Equipment and Methods:
1. Types of Equipment and methods may be at Contractor's option, where structures or other facilities are not endangered.
 2. Equipment and methods shall be subject to approval of jurisdictional agency where stability or usefulness of other facilities may be impaired.
 3. Perform by hand methods when required to save or protect trees, culverts, utilities, or other structures above or below ground.
 4. Maximum length of open trench shall be limited to 30 feet in advance and to 20 feet behind pipe installation, except as approved.
 5. It is the responsibility of the Contractor to maintain all work in compliance with current Occupational Safety and Health Act (OSHA) standards. In the event of any possible hazardous or unstable trenching conditions, suitable bracing or shoring is the responsibility of the Contractor.

- B. Side Walls:
 - 1. Make vertical or slope within specified trench-width limitations below a horizontal plane 12 inches above top of pipe.
 - 2. Vertical or sloped (stepped) as required for stability, above a horizontal plane 12 inches above top of pipe.
 - 3. Sheet and brace where necessary. Excavate without undercutting.
- C. Trench Depth:
 - 1. Depth shall be sufficient to provide the minimum bedding requirements for the pipe being placed.
 - 2. Do not exceed the indicated depth where conditions of bottom are satisfactory.
 - 3. Increase depth as necessary to remove unsuitable supporting materials.
- D. Trench Bottom:
 - 1. Protect and maintain when suitable natural materials are encountered.
 - 2. Remove rock fragments and materials disturbed during excavation or raveled from trench walls.
 - 3. Restore to proper subgrade with trench-stabilization material when overexcavated:
 - a. Correct, at no additional cost to Owner, when trench is overexcavated without authority or to stabilize bottom rendered unsuitable through negligence or improper operations.
 - b. Placement of Trench Stabilization Material:
 - (1) Compact in lifts not exceeding 6-inch loose thickness:
 - (a) With pneumatic or vibratory equipment.
 - (b) To density specified for granular pipe embedment.
- E. Trench Width:
 - 1. Excavate trench to a width which will permit satisfactory jointing of the pipe and thorough tamping of the bedding.
 - 2. Minimum Trench Width: 12 inches greater than the outside diameter of the pipe.
 - 3. Maximum Trench Width:
 - a. Below a plane 12 inches above top of pipe (or as defined by top of pipe embedment).

<u>Nominal Pipe Size</u>	<u>Depth of Cover</u>	<u>Maximum Trench Width</u>
4"	42"	30"
6"	42"	30"
8"	42"	30"
10"	42"	30"
12"	42"	30"

- b. Above plane defined in (a), no maximum limit.
 - c. Maximum trench-width limitations shall apply beginning 3 feet from manhole or structure walls.
 - d. Maximum width shall be as near the minimum specified as can be controlled by construction equipment and methods used.
 - e. Correct when overexcavated at no additional cost to Owner:
 - (1) Use stronger pipe or higher class embedment.
 - (2) Obtain approval of Owner before proceeding.
- F. Trenching in Fill Areas: Perform trenching in fill areas only after compacted fill has reached an elevation of not less than 1 foot above the top of the pipe.

- G. Test Pits:
1. Excavate test pits sufficiently in advance of trenching to enable adequate planning of construction procedure.
 2. Locate as follows:
 - a. Where unstable material is suspected that may require special protective measures.
 - b. Where groundwater may require special handling methods.
 - c. Where advisable to assess adequacy of blasting pattern.
 - d. Where indicated or otherwise approved.
 - e. Where interference or conflict with other utilities or structures could affect alignment of pipe.
 3. With lateral dimension not less than minimum trench width specified for location excavated.
 4. To depth required to obtain information desired.

3.02 ROCK EXCAVATION:

- A. Definition:
1. Rock excavation shall be defined as material that cannot be excavated without drilling and blasting, sledging, or barring. All stone boulders less than eight cubic feet in volume will be classified as "earth" and all larger boulders shall be paid for as rock. Wherever a ledge of solid rock other than flint rock or limestone is encountered with earth below it, or where alternate layers of solid rock and earth occur, the earth shall be included in the allowance for rock when the layer of earth does not exceed twelve inches.
 2. Any flint rock or limestone encountered shall not be classified as rock excavation if it consists of solid layers of rock less than eight cubic feet in volume which are separated from other layers by natural cracks and seams filled with clay or other substances.
- B. Trench Width and Depth:
1. Any trench of rock excavation shall be at least twelve (12) inches wider than the outside diameter of the pipe and six (6) inches deeper than the average depth of the trench as required by existing topography or these specifications.
 2. In the event of any required undercut, the trench subgrade shall be restored to proper grade by filling and compacting, with an approved material, so as to insure a uniform bed along the full length of the pipe barrel. Approved materials are clean, finely divided soil, sand, and crushed stone aggregate (95% passing a ½ inch screen but not more than 10% passing A #200 sieve).

3.03 PIPE EMBEDMENTS AND ENCASEMENTS:

- A. Granular or Earthen Pipe Embedment:
1. Place granular or earthen embedment as follows:
 - a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length.
 - b. Form depression under each joint so that no part of bell or coupling is in contact with trench when pipe is placed in position.
 - c. Add second layer simultaneously to both sides of the pipe with care to avoid displacement.
 - d. Complete promptly after completion of jointing operations and approval to proceed.
 - e. Substitute for any part of earth backfill to within 2 feet of final grade at Contractor's option.
 - f. Granular embedment is required in areas of rock excavation.
 2. Compact granular or earthen bedding as follows:
 - a. In lifts not exceeding 12 inches in compacted depth.

- b. Rod, spade, or use pneumatic or vibratory equipment:
 - (1) Granular as required to obtain not less than 80% relative density as determined by ASTM Method D4253 and D4254, earthen as required to obtain not less than 90% proctor density.
 - (2) Throughout depth of embedment.
- B. Arch and Total Concrete Encasement:
 - 1. Include in locations indicated or where approved by Owner to correct overwidth trench condition.
 - 2. Form to dimensions indicated or construct full width of trench.
 - 3. Start and terminate encasement at a pipe joint:
 - a. Exclude joints from encasement:
 - (1) Applies only to joints at either end of encasement.
 - 4. Install keyed construction joints coincident with pipe joints at 30- to 36-foot intervals. Provide separation of at least 75% of cross-section area at construction joints. Do not run horizontal steel through joint.
 - 5. Suitably support and block pipe to maintain position and prevent flotation.
 - 6. Place arch encasement promptly after installation of granular embedment.
 - 7. Protect against damage from heavy equipment with layer of earth. Use hand methods to a horizontal plane 12 inches above top of encasement.
- C. Concrete Cradle:
 - 1. Include in locations indicated and where designated by Owner to reinforce unstable trench bottom.
 - 2. Place on undisturbed trench bottom or on stabilized subbase.
 - 3. Form to dimensions indicated or construct full width of trench.
 - 4. Start and terminate concrete cradle at a pipe joint:
 - a. Exclude joints from cradle:
 - (1) Applies only to joints at either end of cradle.
 - 5. Place without horizontal construction joints other than indicated.
 - 6. Suitably support and block pipe to maintain position and prevent flotation.
 - 7. Provide anchorage where indicated.

3.04 BACKFILLING:

- A. Placement:
 - 1. Complete promptly after approval to proceed:
 - a. Upon completion of pipe embedment.
 - b. Only after concrete encasement has obtained 70% of design strength. Determination of design-strength percentage obtained shall be as specified.
 - 2. Use hand methods to a horizontal plane 12 inches above top of pipe conduit or duct banks.
 - 3. Use approved mechanical methods where hand backfill is not required.
 - 4. Place in layers of thickness within compacting ability of equipment used.
 - 5. Until compacted depth over conduit exceeds 3 feet, do not drop fill material 5 feet. Then distance may be increased 2 feet for each additional 1 foot of cover. Backfill conduit trenches in layers of 4 to 8 inches.
- B. Compaction:
 - 1. Perform at moisture content necessary to achieve required results with equipment used.
 - 2. Perform with spreading equipment supplemented by hand-operated equipment and rollers as required to obtain density specified.
 - 3. Accomplish without inundation or flooding.
 - 4. Achieve following densities as specified by AASHTO T99.
 - a. Unless otherwise specified, adequate to prevent significant future settlement.

- b. Under pavements and shoulders: 95% of optimum dry density, as determined by the Moisture Density Standard (Proctor) Test – ASTM D698. The field density test shall be run on accordance with ASTM D2167.
- 5. Backfill failing to meet required densities shall be removed or scarified and recompactd as necessary to achieve specified results.

3.05 CHANNEL EXCAVATION:

- A. Maintain area drainage during construction.
- B. Complete channel protection expeditiously following excavation.

3.06 FIELD QUALITY CONTROL:

- A. Compaction: Contractor shall, through services of an independent laboratory, test all trench-stabilization material, granular pipe embedment, earth-pipe embedment, clay cut-off walls, and trench backfill to determine conformance with specified moisture- density relationships:
 - 1. Method of test will be as specified.
- B. Concrete: Contractor shall test all concrete for use in encasements, cradles, and concrete cut-off walls to determine conformance with Specifications. Method of test shall be as specified.

END OF SECTION 02322

SECTION 02445 - UTILITY CASINGS

PART 1 - GENERAL

1.01 SUMMARY: This Section includes casing pipe, installed by boring and jacking, carrier pipe alignment skids, (sand fill,) and end seals where indicated or where constructed at Contractor's option. Use when required to pass other utilities, streets, highways, railroads or obstructions without open excavation.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Petroleum Institute (API):
 - a. API RP1102 - Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways.
 - b. API 1104 - Standard for Welding Pipelines and Related Facilities.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A36 - Structural Steel.
 - b. A570 - Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
 - c. C32 - Sewer and Manhole Brick (Made from Clay or Shale).
 - d. C270 - Mortar for Unit Masonry.
 - 3. American Water Works Association (AWWA):
 - a. C200 - Steel Water Pipe 6 Inches and Larger.
 - b. C206 - Field Welding of Steel Water Pipe.
 - 4. Steel Structures Painting Council (SSPC):
 - a. SP-3 - Power Tool Cleaning.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Submit the following for acceptance prior to shipment:
 - 1. Pipe alignment guides.
 - 2. Guide spacer bands.
- C. Affidavits:
 - 1. Furnish for acceptance prior to shipment to jobsite.
 - 2. Certify compliance with applicable standards for the following:
 - a. Casing material.
 - b. Casing paint coating/lining system.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Casing Pipe: New, smooth wall, welded steel pipe fabricated from ASTM A36 plate or ASTM A570 sheet with a minimum yield point of 36,000 psi, conforming to AWWA C200. Furnish pipe with minimum wall thickness as follows:

1. Minimum Casing Thicknesses:

<u>Casing Diameter</u>	<u>Wall Thickness</u>	
	<u>Under</u>	<u>Under</u>
	<u>Highways</u>	<u>Railroads</u>
<u>in.</u>	<u>in.</u>	<u>in.</u>
Under 14	0.1880	0.2500
14 and 16	0.2500	0.3125
18	0.2500	0.3125
20	0.3125	0.3750
22	0.3125	0.3750
24	0.3125	0.4375
26	0.3125	0.4375
28	0.3125	0.4375
30	0.3125	0.5000
32	0.4375	0.5000
34	0.4375	0.5000
36	0.4375	0.5625
38, 40, and 42	0.4375	0.5625

2. Minimum casing inside diameter shall exceed outside diameter of carrier pipe joints or couplings by 4 inches.
- B. Coatings and Linings:
 1. Coat exterior and line interior of all casing pipe with iron oxide primer applied at 1.5 mils minimum thickness.
 2. Hold coatings back from end joints to be welded at least 2 inches each side of joint.
- C. Joints:
 1. All joints in steel pipe casings shall be field welded to conform to API 1104 or AWWA C206.
 2. Clean to SSPC-SP3 and apply iron oxide field coating to all exterior joints after field welding.
 3. Clean to SSPC-SP3 and apply iron oxide field coating to all interior joints on casings 24-inch diameter and larger after field welding.

PART 3 - EXECUTION

3.01 **INSTALLATION:**

- A. All Work shall, as a minimum, meet the requirements of API RP1102 and the highway, railroad, or utility having jurisdiction, and shall be subject to their inspection and approval.
- B. Install Casing Pipes:
 1. By boring with continuous flight auger, pneumatic or hydraulic jacking, or other acceptable method. Reinforce leading end of casing with jacking band.
 2. Including measures for maintaining indicated line and grade for casings less than 24-inch diameter within a plus or minus tolerance of 0.5%. Maintain indicated line and grade for casings 24-inch and larger within a plus or minus tolerance of 3-inches over length of casing.
 3. With working pits of adequate size to provide safe working conditions. Install sheeting and bracing to conform to DIVISION 2.
 4. In such a manner as not to disrupt traffic or damage the roadway grade or surface.
 5. Casings rejected due to misalignment or other failures to conform to Specifications shall be abandoned in place and filled with concrete grout. Casing pipe shall not be recovered for reuse.

3.02 PIPE ALIGNMENT SKIDS:

- A. Furnish skids for pipe alignment guides as indicated for all carrier pipe to be installed in casing.
 - 1. Minimum spacing of skids shall be 10 feet or every pipe joint, whichever is the lesser.
 - 2. Size to fit outside diameter of carrier pipe and inside diameter of casing pipe.
 - 3. Skids to be sized slightly larger than carrier pipe's outside joint diameter.
- B. Provide either of the following:
 - 1. Hardwood timber skids notched for steel bands. Permanently attach each pair of skids with two 3/4-inch wide stainless steel bands. Wiring is not permitted.
 - 2. Stainless steel casing spacers with plastic runners, Cascade Waterworks Style CCS or Owner-approved equal.

3.03 SAND FILL AND END SEALS:

- A. Construct end seals (and fill annular space between carrier pipe and casing with dry sand) as indicated and as follows:
 - 1. After inside of casing has been thoroughly cleaned and approved by Owner.
 - 2. After carrier pipe has been permanently placed inside casing, tested, and approved.
 - 3. Place dry sand by Owner-approved method and equipment.
 - 4. Brick end seals shall conform to ASTM C32, Grade MS. Mortar shall conform to ASTM C270, Type M, with Type II portland cement and Type S lime.

END OF SECTION 02445

SECTION 02510 - PRESSURE PIPE

1.01 SUMMARY:

- A. This Section includes all pressure pipe, fittings, specials, and appurtenances.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Installation: SECTION 02535.
 - 2. Valves and Accessories: SECTION 02515.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO).
 - 2. American Water Works Association (AWWA):
 - a. C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water and Other Liquids.
 - c. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. C150 - Thickness Design of Ductile-Iron Pipe.
 - f. C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 - g. C153 - Ductile-Iron Compact Fittings, 3 In. Through 24 In. and 54 In. Through 64 In. for Water Service.
 - h. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch, for Water Distribution.
 - i. C905 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 Inch Through 36 Inch.
 - j. C907 - Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 Inch through 8 Inch.
 - k. M23 - PVC Pipe-Design and Installation.
 - 3. American National Standards Institute (ANSI):
 - a. B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
 - b. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 - 4. American Society for Testing and Materials (ASTM):
 - a. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - b. D1248 - Polyethylene Plastics Molding and Extrusion Materials.
 - c. F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Submit the following for acceptance prior to fabrication:
 - 1. Pipe and joint details.
 - 2. Special, fitting, and coupling details.
 - 3. Laying and installation schedule.
- C. Certificates and Affidavits: Furnish the Following Prior to Shipment:
 - 1. Affidavit of compliance with applicable standard.
 - 2. Test certificates.

1.04 QUALITY ASSURANCE:

- A. Manufacturers shall be experienced in the design and manufacture of pipe, fittings, specials, or appurtenances for a minimum period of 5 years.

- B. All pipe manufactured to AWWA C-200 series specifications shall be furnished by a manufacturer certified by the Steel Plate Fabricators Association (SPAA) for steel pipe fabrication.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Handle in a manner to ensure installation in sound and undamaged condition.
 - 1. Do not drop or bump.
 - 2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings, and coatings.
- B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
- C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.
- D. PVC pipe fittings and accessories – If stored for an extended period of time, they shall be protected from direct sunlight and shall be laid so as not to become deformed or bent.
- E. Pipe Gaskets shall be protected from direct sunlight, and shall not be allowed to come in contact with petroleum products.

PART 2 - PRODUCTS

2.01 PIPE REQUIREMENTS:

- A. Furnish pipe of materials, joint types, and sizes as indicated or specified.
- B. Pipe shall be designed to withstand all stresses resulting from external loads and internal pressures listed in the following table plus applicable allowance for surge unless otherwise specified:

<u>Location</u>	<u>Nominal Pipe Size</u>	<u>Design Cover Depth</u>	<u>Live Load</u>	<u>Design Internal Working Pressure</u>	<u>Maximum Test Pressure</u>
Buried Pipe	6" through 12"	42-inch	H-20	150 psi	250 psi

- C. Pipe Marking: All pipe and fittings shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.

2.02 DUCTILE-IRON PIPE:

- A. Design and Manufacture of Pipe:
 - 1. Ductile-iron pipe shall conform to AWWA C115, C150 and C151 except as otherwise specified.
- B. Dimensions: The minimum thickness as defined by pressure class for mechanical or push-on-type joint ductile-iron pipe shall be (as indicated) as follows:

<u>Location</u>	<u>Nominal Pipe Size</u>	<u>Minimum Pressure Class</u>
All Pipe	6", 8", 10", 12"	350

- 1. Minimum thickness for ductile-iron pipe threaded for screw-on flanges shall be in accordance with AWWA C115.
- 2. Pipe with grooved barrel for any type of restrained joint shall have wall thickness increased to provide a minimum wall thickness conforming to AWWA C606.

- C. Joints:
 - 1. Mechanical and Push-On Type:
 - a. Provide mechanical or push-on-type joints for all buried pipe less than 30 inches in diameter unless otherwise specified or indicated. Provide push-on-type joints for sizes 30 inches in diameter and greater.
 - b. Joints shall conform to AWWA C111.
 - 2. Restrained:
 - a. Furnish where joint restraint is required to offset internal pipeline forces.
 - b. Provide restrained joints of following approved types:
 - (1) Restrained mechanical joint.
 - (2) Cut grooved type for rigid joint conforming to AWWA C606.
 - (3) Restrained push-on joint.
 - (4) Boltless (or bolted) ball and socket joint.
 - (5) Anchored couplings.
 - c. Mechanical joint retainer glands shall not be used where joint restraint is required unless indicated. When indicated, retainer glands shall be Megalug manufactured by EBAA Iron, Inc. (or equal).
- D. Fittings:
 - 1. Fittings shall conform to AWWA C110 (or C153) and shall have a pressure rating of not less than that specified for pipe.
 - 2. Fittings shall be ductile iron.
 - 3. Fittings for pipe with mechanical joint shall have mechanical joints.
 - 4. Fittings for pipe with push-on joints shall be mechanical joint.
- E. Lining:
 - 1. All pipe and fittings shall be cement-mortar lined in accordance with AWWA C104.
- F. Coating:
 - 1. All iron pipe and fittings shall be coated with manufacturer's standard bituminous paint coating.
 - 2. Flange faces shall be coated in accordance with AWWA C115.
 - 3. Polyethylene encasement shall be required for use of ductile iron pipe.

2.03 PVC PIPE:

- A. Materials:
 - 1. Materials shall conform to AWWA C900 or C905.
 - 2. Gaskets shall conform to ASTM F477 and be synthetic rubber.
- B. Design of Pipe: Design shall conform to AWWA C900, C905 and as specified:
 - 1. Internal Loading:
 - a. Internal pressure specified plus allowance for surge pressure conforming to AWWA C900 or C905.
 - b. Hydrostatic test pressure as specified.
 - 2. External Loading:
 - a. Earth dead load cover at 120 pcf plus AASHTO H-20 live loads.
 - b. 5% deflection limit.
 - c. Bedding condition as indicated.
 - 3. Use E' of 700 and bedding angle of 90°.
- C. Dimensions: The minimum pressure class for PVC pipe shall be as follows:

<u>Location</u>	<u>Nominal Pipe Size</u>	<u>Minimum Pressure Class</u>
All Pipe	All sizes	AWWA C900, Class 200

- D. Diameters: PVC pressure pipe shall have Cast-Iron-Pipe-Equivalent (CI) outside diameters.
- E. Joints: Pipe shall be furnished with integral bell-type pipe ends designed for joint assembly using elastomeric gaskets.
- F. Fittings:
 - 1. Fittings shall conform to AWWA C110 or C153 and be ductile iron. Fittings shall be mechanical joint.
- G. Marking: Identification markings on pipe shall conform to AWWA C900 or C905.

2.04 GASKETS AND BOLTING MATERIALS:

- A. Provide all gaskets, bolts, lubricant, and other accessories required to install pipe, fittings, and specials complete and ready for service.
- B. Gaskets for flanged joints shall conform to ANSI B16.21, 1/8-inch thick full-face synthetic rubber gasket (American Cast Iron Pipe Company Toruseal 1/8-inch thick full face gasket or equal). Provide full-face gaskets for all pump and equipment connections.
- C. Gaskets for ductile iron flanged pipe and fittings 12-inch and smaller shall have "nominal" inside diameters, not the larger inside diameters per ANSI B16.21.
- D. Bolts for flanged joints shall conform to ASTM A307, Grade B. Nut and bolt heads shall be hexagonal.
- E. Gaskets and bolts for other than flanged joints shall be as otherwise specified for pipe and pipe joints.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Specified in SECTION 02535.

3.02 FIELD TESTING:

- A. Specified in SECTION 02535.

END OF SECTION 02510

SECTION 02515 - UTILITY VALVES AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes all valves and accessories.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Installation: SECTION 02535.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - b. A276 - Stainless and Heat Resisting Steel Bars and Shapes.
 - c. A536 - Ductile Iron Castings.
 - d. A564 - Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat Resisting Steel Bars and Shapes.
 - 2. American Water Works Association (AWWA):
 - a. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C500 - Metal-Seated Gate Valves for Water Supply Service.
 - c. C502 - Dry-Barrel Fire Hydrants.
 - d. C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - e. C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - f. C540 - Power-Actuating Devices for Valves and Sluice Gates.
 - g. C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
 - h. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - i. C606 - Grooved and Shouldered Joints.
 - 3. National Fire Protection Association (NFPA):
 - a. 1963 - Screw Threads and Gaskets, Fire Hose Connections.

1.03 SUBMITTALS:

- A. Submit as specified.
- B. Include, but not limited to, the following:
 - 1. Catalog data or illustrations showing principal dimensions, parts, and materials.
 - 2. Spare parts list referenced to illustration of parts.
 - 3. Assembly and disassembly or repair instructions.
 - 4. Dimensions of the clearance required for butterfly valve discs.
- C. Certificates and Affidavits: Furnish prior to shipment. Include the following:
 - 1. Test certificates.
 - 2. Affidavit of compliance with applicable AWWA Standard.

1.04 QUALITY ASSURANCE:

- A. Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.
- B. Protect valve threads, flanges, stems, and operators from damage.
- C. Ship valves 2-1/2-inch and larger to the Project Site tagged with the valve number shown on the Drawings. Tag smaller valves to show the piping system in which it is to be used.

1.06 RESPONSIBILITY:

- A. Actuators, their controls, and accessories shall be the responsibility of the valve manufacturer for sizing, assembly, certification, field testing, and any adjustments necessary to operate the valve as specified.

PART 2 - PRODUCTS

2.01 RESILIENT-SEATED GATE VALVE:

- A. Acceptable Manufacturers:
 - 1. Mueller Company: A-2360
 - 2. CLOW Company
 - 3. Owner approved equal.
- B. Design:
 - 1. Conform to AWWA C509 and as specified.
 - 2. 2" square operating nut, open counterclockwise, MJ X MJ.
 - 3. Wedge rubber shall be molded and bonded in place to the wedge and shall not be mechanically attached with screws, rivets, or similar fasteners.
 - 4. Wedge shall seat so the seating is equally effective regardless of direction of pressure unbalanced across the wedge.
 - 5. Waterway shall be full diameter, smooth and shall have no depressions or cavities in the seat area where foreign material can lodge and hinder closure or sealing.
 - 6. The valve body and bonnet shall be fusion bonded epoxy coated, inside and out, per AWWA C550 and the valve shall be provided with stainless steel bonnet and packing bolts.
 - 7. "T" bolts for the MJ fittings shall be NSS Cor-ten, Cor-Blue or equal.
- C. Testing:
 - 1. Testing shall be performed conforming to AWWA C509.
 - 2. Furnish affidavit of compliance.

2.02 TAPPING VALVE:

- A. Acceptable Manufacturers:
 - 1. Mueller Company: T-2360.
 - 2. Owner approved equal.
- B. Design:
 - 1. Same as gate valve above except that is shall be equipped with a raised lip constructed in accordance with MSS-SP 60 to provide for centering of the valve on the tapping saddle.

2.03 TAPPING SLEEVE:

- A. Acceptable Manufacturers:
 - 1. Ford FAST.
 - 2. ROMACSST
 - 3. JCM #432
 - 4. Rockwell #663
- B. Design:
 - 1. Manufactured from all stainless steel group 18-8, material 304 including sleeve, outlet neck, outlet flange, and all bolts and nuts.
 - 2. Seal to be full circumferential gridded and approved for potable water.
 - 3. Flanged outlets shall be indexed per MSS-SP 60 to accept tapping valves with an ANSI 150 lb. drilling IAW AWWA C207.
 - 4. Neck to accept full size cutter.

2.04 AIR VALVES:

- A. Acceptable Manufacturers:
 - 1. GA Industries, Inc.
 - 2. Owner approved equal.
- B. Design: Conform to AWWA C512 and as specified.
 - 1. Valve shall be heavy-duty combination air release, water style.
 - 2. Body and cover shall be cast or ductile iron.
 - 3. Float shall be stainless steel.
 - 4. All internal parts shall be stainless steel or bronze with provisions to avoid galvanic action.
- C. Operation:
 - 1. Release air when filling line.
 - 2. Admit air when emptying line.
 - 3. Release accumulated air while pipeline is full and operating under pressure.
- D. Connection:
 - 1. Connect air valves 2 inches and smaller to pipeline through corporation stops.
 - 2. Connect air valves 3 inches and larger through tapped bosses or flanged outlets.
 - 3. Connecting fittings and pipe shall be bronze, brass, or copper rated for 250 psi service.

2.05 FIRE HYDRANTS:

- A. Acceptable Manufacturers:
 - 1. Mueller Company, Super Centurion Model A-423.
 - 2. CLOW Medallion.
 - 3. Owner approved equal.
- B. Design:
 - 1. Conform to AWWA C502 and as specified.
 - 2. Provide compression type main valve designed to open against pressure. Valve facings shall be of nontoxic materials suitable for potable water service.
 - 3. Provide internal main valve seat opening of not less than 5 inches diameter.
 - 4. Design to open counterclockwise.
 - 5. Provide dry-type bonnet with lubricant reservoir protected by O- or Quad-ring seals.
 - 6. Provide mechanical joint bell on shoe.
 - 7. Furnish for minimum bury depth of 4 feet. Include extensions as required for blow-offs.
 - 8. Furnish with two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper nozzle with NFPA 1963 standard threads. The inlet connection shall be a minimum of 6-inches. Nozzle caps shall be chained to hydrant.
 - 9. Provide traffic break-off joint located above and near ground surface designed to minimize accident repairs.
 - 10. All pipe from the main line to the hydrant shall be 6-inches.
- C. Shop Painting:
 - 1. Shop paint exterior of hydrants red.
 - 2. Interior Coating:
 - a. Conform to AWWA C550.
 - b. Apply to exposed interior ferrous metal surfaces.

2.06 VALVE BOXES:

- A. Acceptable Manufacturers:
 - 1. Mueller Company.
 - 2. Owner approved equal.
- B. Provide for all buried valves.

C. Design:

1. Boxes shall be three-piece cast-iron screw type with 5-1/4-inch shaft.
2. Provide extension stem to bring operating nut within 2 feet of valve box top.
3. Drop cover shall be marked "WATER."

2.07 CORPORATION STOP:

- A. Corporation stops shall be a minimum diameter of 3/4 inch and shall be sized according to the service line diameter if the service line diameter is larger than 3/4 inch.
- B. Corporation stops shall be ground key AWWA taper "CC" thread by copper compression.
- C. 3/4 inch and one-inch corporation stops shall include dielectric nylon insulators, shall be Mueller N-35008 along with Mueller H-15528 eighth bend union. 1 1/2 and 2 inch corporation stops shall be Mueller H-10045, with H-15428 compression connection. Inlet shall be AWWA taper.

2.08 SERVICE SADDLE:

- A. Service saddles shall be brass body with double flattened silicone bronze straps. Saddles shall be Ford 202B, Mueller BR2B, or McDonald 3825.

2.09 CURB STOP VALVE:

- A. Curb stop valves shall be compress type.

2.10 PRESSURE REDUCING VALVES ION TYPE.

- A. Pressure reducing valves installed on service lines shall be bronze body construction with sealed spring cage suitable for valve installation in waterworks pit. Valve shall be constructed with 10% glass filled renewable NORYL seat and high temperature resistant Buna-N nylon insert diaphragm for hot or cold water service. Valve shall be equipped with an integral stainless steel strainer and union inlet connection and shall be fully serviceable in-line. Valve shall be equipped with provision to permit bypass flow of water around the valve back into the main when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main. Valves shall be rated for 300 psi inlet (supply) pressure and shall have an adjustable outlet pressure range of 25 psi to 75 psi, factory set at 50 psi no-flow pressure. Valve shall be Watts Model 25AUB or Approved Equal.

2.11 SERVICE LINE COUPLING:

- A. Service line couplings shall connect to both new and existing copper service lines using compression connections only.

2.12 SHOP PAINTING:

- A. Prepare surfaces and paint or coat all valves, fire hydrants, floor stands, valve boxes, corporation stops, and all related accessories standard of the manufacturer unless otherwise specified herein.
- B. Paint and coatings shall be suitable for the service intended.
- C. Submit type of paint or coating proposed with drawings and data for Owner approval prior to fabrication.

2.13 ANCHORS, INSERTS, REINFORCEMENTS:

- A. All threaded rods shall be 5/8" or 3/4" stainless steel group 18-8, material 304 minimum yield of 70 ksi, minimum tensile 100 ksi. Nuts shall be hex head, 5/8" or 3/4" stainless steel, group 18-8, material 304.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Comply with provisions of AWWA C600 and as specified.
- B. Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.
- C. Set fire hydrants with lowest nozzle 18 inches above finished grade. Check and fill stem bonnet lubricant reservoir.
- D. Corporation stop shall be installed only after the water main has been installed and has been placed in service. $\frac{3}{4}$ and 1-inch corporation stops shall be installed on the water main at 10 o'clock or two o'clock positions on the water main diameter. $\frac{3}{4}$ through 2-inch diameter corporation stops shall be attached to the water main with service saddles.
- E. Pressure reducing valves shall be installed on all service lines within the building served or in an additional meter pit on the building side of the water meter, as dictated by the latest version of City of Jackson Ordinance.
- F. Each service connection shall be individually metered.

3.02 FIELD TESTING:

- A. Perform on piping and valves as specified in SECTION 02535 and for the following:
 1. Gate valves.
 2. Air and air/vacuum valves.
 3. Fire hydrants.

END OF SECTION 02515

SECTION 02535 - PIPE INSTALLATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes handling, installation and testing of pipe, fittings, specials, and appurtenances as indicated or specified.
- B. Related Work Specified Elsewhere:
 - 1. Utility Structures: SECTION 02532.
 - 2. Pressure Pipe: SECTION 02510.
 - 3. Utility Valves and Accessories: SECTION 02515.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Water Works Association (AWWA):
 - a. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - b. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - c. C651- Disinfecting Water Mains.
 - d. M23 - PVC Pipe - Design and Installation.
 - 2. Federal Specifications (FS):
 - a. SS-S-00210 - Sealing Compound, Preformed Plastic, For Expansion Joints and Pipe Joints.

1.03 DELIVERY, STORAGE AND HANDLING:

- A. Handle in a manner to ensure installation in sound and undamaged condition.
 - 1. Do not drop or bump.
 - 2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings, and coatings.
- B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
- C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.
- D. PVC pipe, fittings and accessories – If stored for an extended period of time, they shall be protected from direct sunlight and shall be laid so as not to become deformed or bent.
- E. Pipe gaskets shall be protected from direct sunlight, and shall not be allowed to come in contact with petroleum products.

PART 2 - PRODUCTS

2.01 CONCRETE FOR THUST BLOCKS:

- A. See Section 02532 – Utility Structures and Division 3 of these specifications.

2.02 POLYETHYLENE ENCASEMENT:

- A. Polyethylene material shall conform to C105, Class C (Block).
- B. Adhesive tape shall be as follows:
 - 1. Approximately 2-inches wide and plastic backed.
 - 2. Capable of bonding securely to metal surfaces and/or polyethylene material.
 - 3. Polyken No. 900, Scotchrap No. 50, or Owner-approved equal.

2.03 LOCATOR WIRE:

- A. Locator wire shall be used with all PVC pipe. The PVC locator wire shall be No. 12 and insulated copper wire.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL:

- A. Use equipment, methods, and materials ensuring installation to lines and grades indicated.
1. Maintain within tolerances specified or acceptable laying schedule.
 - a. Alignment: ± 1 inch per 100 feet in open cut or tunnel.
 - b. Grade: ± 1 inch per 100 feet.
 2. Do not lay on blocks unless pipe is to receive total concrete encasement.
 3. Accomplish horizontal and vertical curve alignments with bends, bevels, and joint deflections.
 - a. Limit joint deflection with ductile-iron pipe to conform to AWWA C600.
 - b. Deflection may, with approval, exceed standard deflections by using machined bells.
 4. Obtain acceptance of method proposed for transfer of line and grade from control to the Work.
- B. Install pipe of size, materials, strength class, and joint type with embedment indicated for plan location.
- C. Place pipe, valves, hydrants, and fittings in accordance with the plans. All pipe shall have a minimum of 42 inches of cover over the top of the pipe unless otherwise approved by the Owner.
- D. Insofar as possible, install pipe with bell ends in direction of laying. Obtain Owner approval for deviations therefrom.
- E. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during installation and at discontinuance of installation.
1. Close open ends of pipe with snug-fitting closures.
 2. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate.
 3. Remove water, sand, mud, and other undesirable materials from trench before removal of end cap.
- F. Brace or anchor as required to prevent displacement after establishing final position.
1. Thrust reinforcement shall be provided at all fittings, either in the form of approved manufactured restraint, stainless steel rods, or a properly designed thrust block of concrete. Blocking shall be poured against undisturbed earth and constructed so that the pipe and fitting joints will be accessible for repair.
 2. All plugs, caps, tees, end valves, fire hydrant valves, and bends, unless otherwise indicated on approved plans, shall be anchored to prevent movement by providing suitable reaction backing in the form of concrete thrust blocks or approved manufactured restraints. Pre-cast concrete blocks not allowed.
- G. Perform only when weather and trench conditions are suitable. Do not lay in water.
- H. Observe extra precaution when hazardous atmospheres might be encountered.
- I. Trenching and backfilling shall be accomplished in accordance with SECTION 02322.
- J. Dead end main shall have a fire hydrant, flushing hydrant, or approved flush assembly for flushing purposes. Flush assemblies shall be a minimum 2" for 6" and 8" mains, a minimum 4" for 10" and 12" mains, and a fire hydrant assembly for 16" mains. Larger mains shall utilize a flushing assembly that provides a minimum of 4fps water velocity within the pipe at flushing. No flushing device shall be directly connected to a sewer.
- K. At noon, at night, or any time that work is delayed, the open-end of the line must be covered.

- L. All valves shall be protected by a valve box of six inches minimum diameter; the top of which shall be to the same grade as the existing terrain.
- M. Fire hydrants shall be set on a concrete pad, have thrust blocking, and sufficient granular backfill to provide a positive drain for the hydrant barrel. Hydrants shall not be connected to or located within ten feet of sanitary sewers.

3.02 JOINTING:

A. General Requirements:

- 1. Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks, and structures.
 - a. Not more than 8-inches from structure wall, or
 - b. As indicated.
- 2. Perform conforming to manufacturer's recommendations.
- 3. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
- 4. Use methods and equipment capable of fully seating or making up joints without damage.
- 5. Check joint opening and deflection for specification limits.

B. Special Provisions for Jointing Ductile-Iron Pipe:

- 1. Conform to AWWA C600.
- 2. Visually examine while suspended and before lowering into trench.
 - a. Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.
 - b. Remove turpentine and cement by washing when test is satisfactorily completed.

C. Special Provisions for Jointing PVC Pipe.

- 1. Conform to ASTM D2321. (Pressure pipe installation shall also conform to AWWA M23.)
- 2. Excavate bell holes at each joint or coupling to provide full length barrel support of the pipe and to prevent point loading at the bells or couplings.
- 3. Connect pipe to new or existing rigid structures or manhole tie-ins with manhole couplings.

3.03 ELECTRICAL BONDING AND INSULATION:

- A. Electrically bond adjacent lengths of pipe and fittings unless otherwise indicated.
- B. Use materials specified in SECTION 02510 applied to conform to manufacturer's instructions.
- C. Install insulated joints of dielectric materials.
 - 1. Where indicated.
 - 2. Between dissimilar materials which could cause galvanic action.
 - 3. Conform to manufacturer's instructions.

3.04 CUTTING:

- A. Cut in neat manner without damage to pipe.
- B. Observe Specifications regarding joint locations.
- C. Cut cast-iron, ductile-iron, and steel pipe with carborundum saw or other acceptable method per manufacturer's instructions.
 - 1. Smooth cut by power grinding to remove burrs and sharp edges.
 - 2. Repair lining as required and approved.

3.05 CLOSURE PIECES:

- A. Connect two segments of pipeline or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.

- B. Observe Specifications regarding location of joints, type of joints, and pipe materials and strength classifications.
- C. Field-fabricated closures, where required, shall be concrete encased between adjacent flexible joints.
- D. May be accomplished with sleeve coupling:
 1. Of length such that gaskets are not less than 3-inches from pipe ends.
 2. Wrap exterior of buried steel couplings with polyethylene encasement conforming to AWWA C105.

3.06 POLYETHYLENE ENCASEMENT:

- A. Encase all ductile iron pipe, fittings, valves, and other appurtenances with polyethylene film as specified.
- B. Installation:
 1. Perform to conform to AWWA C105.
 2. Use adhesive tape to fasten polyethylene film in place.
 3. Minimize exposure of polyethylene film to sunlight.
 4. Wrap pipe, valves, fittings, and couplings per AWWA C105 installation standards.

LOCATOR WIRE INSTALLATION

- A. Locator wire shall be installed continuously along all PVC pipe.
- B. Locator wire shall be taped to the top of the PVC pipe.

3.07 SEPARATION OF WATER MAINS AND SEWERS:

- A. Horizontal Separation:
 1. A water main shall be laid at least ten (10) feet horizontally from any existing or proposed storm or sanitary sewer line. The distance shall be measured edge to edge.
 2. Should local conditions prevent a lateral separation of ten (10) feet, water main may be laid closer than ten (10) feet to a storm or sanitary sewer line provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer line and at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer line.
 3. When it is impossible to obtain vertical or horizontal separation, the sewer line must be relaid and constructed with ductile iron pipe.
 4. Backfill shall be of compacted clay to a minimum of eighteen (18) inches over/under the water main.
 5. In no case shall the water main and the sewer main share the same granular fill bed.
- B. Vertical Separation:
 1. Where water mains must cross over storm drains or sanitary sewers, the water main must be laid at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer, and a full length of water main pipe must be centered over the sewer to be crossed so both of the joints will be equally distant from the sewer and as remote therefrom as possible.
 2. This vertical separation must be maintained for that portion of the water main located with ten (10) feet to be measured as the shortest distance from the water main to the sewer at that point.
 3. Backfill shall be of compacted clay to a minimum of eighteen (18) inches above and below the outside dimension of the water main and for a horizontal distance of ten (10) feet from the sewer being crossed.
 4. In no case shall the water main and the sewer share the same granular fill bed.

C. Unusual Conditions:

1. Where conditions prevent the minimum vertical separation as set forth above from being maintained or where it is necessary for the water main to pass under a sewer line, the water main must be backfilled with compacted clay to a minimum of eighteen (18) inches above and below the outside dimension of the water main and for a horizontal distance of ten (10) feet from the sewer being crossed.
2. In no case shall the water main and the sewer share the same granular fill bed.
3. A full length of pipe must be centered over or under the sewer to be crossed so that the joints will be equally distant from the sewer and as remote therefrom as possible.
4. The sewer line must also be constructed with ductile iron pipe until the shortest distance from the sewer to the water main is at least ten (10) feet.
5. Where a water main must cross under a sewer, a vertical separation of at least eighteen (18) inches between the bottom of the sewer line and the top of the water main must be maintained with adequate support for the larger size sewer lines to prevent them from settling.
6. When the recommended separations between water mains and sewer mains cannot be obtained when crossing mains, either the waterline or the sewer main shall be constructed of mechanical joint pipe or cased in continuous casing that extends no less than ten feet on both sides of the crossing.
7. Where these conditions cannot be met, the Missouri Department of Natural Resources shall be consulted as to the precautions to be taken to protect the public water supply.

D. Force Main Separation:

1. There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches.
2. In areas where these separations cannot be obtained, the waterline shall be cased in concrete until the ten-foot separation is achieved.

E. Sewer Manhole: No waterline shall be located closer than ten (10) feet to any part of a sanitary or combined sewer manhole.

F. Disposal facility: No watermain shall be located closer than twenty five (25) feet to any on-site wastewater disposal facility, agricultural waste disposal facility or landfill.

3.08 BACKFLOW PROTECTION:

A. Backflow protection shall be provided in accordance with Missouri Department of Natural Resources regulation 10 CSR 60-11.010.

3.09 FIELD TESTING:

B. Acceptance Tests for Pressure Pipelines:

1. Perform hydrostatic pressure and leakage tests.
 - a. Conform to AWWA C600 procedures.
 - (1) As modified herein.
 - (2) Shall apply to all pipe materials specified.
 - b. Perform after backfilling.
2. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
 - a. Select test segments such that adjustable seated valves are isolated for individual checking.
 - b. Contractor shall furnish and install test plugs.
 - (1) Including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs.
 - (2) Be responsible for any damage to public or private property caused by failure of plugs.

3. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 0.05 to 1 fps.
4. Owner shall make water for testing available to Contractor at nearest source.
5. Pressure and Leakage Test:
 - a. Be at least 2-hour duration. Maintain pressure throughout test ± 5 psi of test pressure.
 - b. Leakage test shall be conducted concurrently with the pressure test.
 - c. Acceptable when leakage does not exceed that determined by the following formula:
 - (1) In English units:
 $L = 0.0000075 SD(P)^{1/2}$, in which
 L = allowable leakage, in gallons per hour
 S = length of pipe tested, in feet
 D = nominal diameter of the pipe, in inches
 P = average actual leakage test pressure in psig
 - d. These formulas are based on an allowable leakage of 11.65 gpd/mile/in of nominal diameter at a pressure of 150 psi.
 - e. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.
 - f. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
 - g. Repeat test as necessary.
 - (1) After location of leaks and repair or replacement of defective joints, pipe, fittings, valves or hydrants. All visible leaks are to be repaired regardless of the amount of leakage.
 - (2) Until satisfactory performance of test.
 - h. Owner will witness pressure and leakage test.
- C. Deflection Testing:
 1. All joint deflections must be within the pipe manufacturer's recommendation. PVC pipe may be deflected around curves so long as deflection is in the joint only. No strain shall be placed on the pipe for the purpose of deflection.
- D. Soil Corrosion Testing:
 1. Perform electrical conductivity test on bonded pipe segments.
 2. Perform pipe-to-soil potential surveys.
 3. Submit 3 copies of test and survey reports to Owner.

3.10 DISINFECTION:

- A. Disinfection of Pipelines for Conveying Potable Water:
 1. Contractor shall place hypochlorite granules or tablets in the water main during construction as specified in AWWA C 651, and approved by the owner.
 2. Owner will perform all flushing, chlorination, sampling, laboratory testing, and final flushing per AWWA C651 and the following:
 - a. Flushing.
 - (1) Minimum preliminary flushing rates to produce 0.76 m/s (2.5 fps) velocity in main shall be as follows:

<u>Pipe Size</u>	<u>Flow Rate</u>	<u>Hydrant Outlets</u> <u>No. of 2-1/2-inch</u>
4"	100 gpm	1
6"	200 gpm	1
8"	400 gpm	1
10"	600 gpm	1
12"	900 gpm	1
16"	1600 gpm	2
(2)	Valve hydrant outlet to control flow. With a (40 psi pressure in the main with the hydrant flowing to atmosphere, a 2-1/2-inch hydrant outlet will discharge approximately 1,000 gpm and a 4-1/2-inch hydrant outlet will discharge approximately 2,500 gpm.	
(3)	Dispose of preliminary flushing water without damage to public or private property.	
b.	At minimum initial dosage of 50 mg/L (ppm) in all portions.	
(1)	Allow to stand for 24 hours.	
(2)	Minimum residual shall be at least 10 mg/L (ppm).	
(3)	Flush pipeline before use for potable water supply purposes. Dispose of final flushing water without damage to public or private property.	
c.	Repeat disinfection procedure should initial treatment fail to yield satisfactory results.	
d.	Water from the new main shall remain isolated from other waters of the city system, and shall not be made available for consumption until bacteriological testing indicates that the water meets drinking water standards of the Missouri Department of Natural Resources.	

END OF SECTION 02535

SECTION 02920 – LAWNS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following areas of Work:
 - 1. Preparation of lawn areas.
 - 2. Seeding.
 - 3. Mulching.
 - 4. Fertilizing of lawn areas.
 - 5. Maintenance.
- B. Related Work Specified Elsewhere:
 - 1. Earthwork and Site Preparation: SECTION 02300.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM) - Equivalent AASHTO standards may be substituted as approved:
 - a. D977 - Emulsified Asphalt.
- B. Missouri Standard Specifications for Highway Construction, 1996.

1.03 SUBMITTALS:

- A. Certificates:
 - 1. Seed and fertilizer shall be accompanied by certificate from vendors certifying they meet requirements of these Specifications, stating botanical name, percentage by weight, percentage of purity, germination, and weed seed for each grass seed species.

PART 2 - PRODUCTS

2.01 TOPSOIL: Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 804 – TOPSOIL.

2.02 GRASS SEED:

- A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America and as required below.
- B. Be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested:
 - 1. Seed Mixture:
 - a. Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 805 – SEEDING.
 - 2. Moldy seed or seed that has been damaged in storage shall not be used.

2.03 FERTILIZER:

- A. Reference Missouri Standard Specifications for Highway construction, 1996; SECTION 801 – FERTILIZING.
- B. Deliver to site in labeled bags or containers.

2.04 MULCH:

- A. Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 802 – MULCHING.

PART 3 - EXECUTION

3.01 SOIL PREPARATION:

- A. Dispose of any growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.
- B. Thoroughly loosen and pulverize topsoil to a depth of at least 4-inches.
- C. Grade lawn areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting of lawns. Do not create a muddy soil condition.
- E. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- F. Spread planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement.
- G. Preparation of Unchanged Grades:
 - 1. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:
 - a. Till to a depth of not less than 6 inches.
 - b. Apply soil amendments and initial fertilizers.
 - c. Remove high areas and fill in depressions.
 - d. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.

3.02 LIME FERTILIZING:

- A. Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 801-FERTILIZING.

3.03 SEEDING NEW LAWNS:

- A. Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 805 – SEEDING.

3.04 MULCHING:

- A. Apply a mulch covering to all seeded areas.
- B. Reference Missouri Standard Specifications for Highway Construction, 1996; SECTION 802 – MULCHING.
- C. Apply wood-cellulose fiber mulch hydraulically at the rate of 1,000 pounds per acre.:
 - 1. Mulch and seed may be applied in a single operation.
 - 2. Apply mulch to achieve a uniform coverage of the soil area.

3.05 RECONDITIONING LAWNS:

- A. Recondition lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required. Recondition other existing lawn areas where indicated.
- B. Provide fertilizer, seed, and soil amendments as specified for new lawns and as required to provide satisfactorily reconditioned lawn. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good, deep planting bed.

- D. Remove diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
- E. Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

3.06 PROTECTION:

- A. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricade throughout maintenance period until lawn is established.

3.07 MAINTENANCE:

- A. Mow grass to a height of 2-inches as soon as there is enough top growth to cut with mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted.
- B. Remove weeds by pulling or chemical treatment.
- C. Perform maintenance until the date of final acceptance.
- D. Seeded Areas:
 - 1. Water as required by good practice and as necessary to obtain a flourishing cover.
 - 2. Repair any portion of the seeded surface which becomes gullied or otherwise damaged, or the seeding becomes damaged or destroyed.
 - 3. Thoroughly water daily for a period of 15 days after placing.
 - 4. Maintain sod in good live condition. Replace any sod not in good growing condition with fresh live sod.
 - 5. Water thoroughly whenever sod evidences excessive drying.
- E. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer which will provide not less than a pound of actual nitrogen per 1,000 square feet of lawn area.

3.08 ACCEPTANCE OF LAWNS:

- A. When lawn Work is Substantially Complete, including maintenance, Owner will, upon request, make an inspection to determine acceptability:
 - 1. Lawn Work may be inspected for acceptance in parts agreeable to Owner, provided Work offered for inspection is complete, including maintenance.
- B. Replant rejected Work and continue specified maintenance until reinspected by Owner and found to be acceptable.
- C. Seeded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, uniform, close stand of specified grass is established free of weeds, bare spots, and surface irregularities.

3.09 CLEANUP:

- A. Promptly remove soil and debris created by lawn Work from paved areas. Clean wheels of vehicles prior to leaving Site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

3.10 MEASUREMENT AND PAYMENT:

- A. Time of Completion: Completion time for seeding shall not apply to provisions for liquidated damages with respect to Contract completion time. Payment for seeding will be withheld until such Work is accepted.

END OF SECTION 02920

SECTION 02930 - TREES AND SHRUBS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Furnishing trees and shrubs.
 - 2. Preparation of planting pits and beds, including excavation, backfilling, and disposal of surplus and unsuitable excavated material.
 - 3. Planting of trees and shrubs, including fertilizing, mulching, trimming, guying, and wrapping.
 - 4. Maintenance of trees and shrubs.
- B. Related Work Specified Elsewhere:
 - 1. Seeding and Sodding: SECTION 02920.
 - 2. Ground Cover and Plants: SECTION 02932.

1.02 REFERENCE:

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI):
 - a. Z60.1 - Nursery Stock.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A48 - Gray Iron Castings.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Include, but not limited to, the following:
 - 1. Product Certification: Certificate of inspection as may be required by governing authorities. For standard products, submit manufacturer's certified analysis. For other materials, submit analysis by a recognized laboratory made in accordance with methods established by Association of Official Agricultural Chemists, wherever applicable.
 - 2. Plant list, sizes, and quantities.
 - 3. Planting Schedule: Proposed planting schedule indicating anticipated dates and locations for each type of planting.
 - 4. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of landscape Work.

1.04 QUALITY ASSURANCES:

- A. Employ only experienced personnel familiar with required Work.
- B. Do not make substitutions of tree and shrub materials. If required landscape materials are not obtainable, submit proof of non-availability and proposed equivalent material.
- C. Provide the quantity, size, genus, species, and variety of trees and shrubs indicated and scheduled and complying with applicable requirements of ANSI Z60.1.
- D. Purchase of trees and shrubs is included in the cash allowance stated in the Contract Documents.
- E. Measurements: Measure trees and shrubs with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6-inches above ground for trees up to 4-inch caliper size, and 12-inches above ground for larger sizes. Measure main body of tree or shrub for height and spread dimensions, do not measure from branch or root tip-to-tip.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Provide freshly dug trees and shrubs. Do not prune prior to delivery. Provide adequate protection of root systems and balls from drying winds and sun. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
- B. Deliver trees and shrubs after preparations for planting have been completed, and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist as follows:
 - 1. Heel-in bare root stock. Soak roots in water for 2 hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust or other acceptable material.
 - 3. Do not remove container-grown stock from containers until planting time.
 - 4. Periodically water root systems of trees and shrubs stored on site using a fine mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.06 JOB CONDITIONS:

- A. Timing:
 - 1. Plant trees and shrubs during normal seasons for such Work in the location of the Project.
 - 2. Plant frost-tender trees and shrubs only after danger of frost is past or sufficiently before frost season to allow for establishment before first frost. Do not plant in frozen ground.
 - 3. Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Owner. If planting of trees and shrubs occur after lawn Work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.07 SPECIAL PROJECT WARRANTY:

- A. Warrant trees and shrubs for a period of 1 year after Substantial Completion.
- B. Replace trees and shrubs that are dying, dead, or in an unhealthy condition, with plants of same size and variety as the original planting at no additional cost. Exclude defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the landscape installer's control.
- C. Make replacements during growth season following end of warranty period.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Provide nursery-grown trees and shrubs, grown in a recognized nursery in accordance with good horticultural practice, with healthy root systems developed by transplanting or root pruning. Provide only healthy, vigorous stock grown under climatic conditions similar to conditions in the locality of the Project and free of disease, insects, eggs, larva, and defects such as knots, sun scald, injuries, abrasions, or disfigurement.
- B. Provide trees and shrubs of the sizes indicated in planting list and in accordance with dimensional requirements of ANSI Z60.1 for kind and size of trees and shrubs required. Trees and shrubs of larger size than indicated may be used if acceptable to Owner.
- C. Label each tree and shrub with a securely attached waterproof tag bearing legible designation of botanical and common name.
- D. Reference Missouri Standard Specifications; Section 808 – Planting Trees, Shrubs, and Other Plants.

2.02 MISCELLANEOUS MATERIALS:

- A. Mulch: Peat moss of fibrous type and approximately neutral pH. Do not use finely divided or granular type.
- B. Antidesiccant: Emulsion type, film-forming agent designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.
- C. Wrapping: Tree-wrap tape not less than 4-inches wide, designed to prevent sun scald, bore damage and winter freezing.
- D. Stakes and Guys: Stakes and deadmen of sound new hardwood, Redwood, or treated softwood, free of knotholes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized wire not lighter than 12 gage with zinc-coated turnbuckles. Provide rubber or plastic garden hose not less than 1/2-inch in diameter, cut to required lengths to protect tree trunks from damage by wires:
 - 1. Provide warning flaps for each guy wire of surveyors flagging tape, or wood not less than 2-inches wide x (1/2-inch thick x 12-inches long and painted with alternate diagonal black and white stripes or luminescent white paint.
- E. Wood Edging:
 - 1. Provide wood headers and edging of sizes shown and of following wood species:
 - a. (All heart Redwood) (Tidewater Red Cypress, all heartwood) (Western Red Cedar, all heart).
 - b. Provide wood stakes of same species, 2-inches x 2-inches x 24-inches) long and galvanized nails for anchoring headers and edging.
- F. Steel Edging: Commercial steel edging of size indicated, fabricated in sections with loops pressed from or welded to face of sections to receive stakes. Provide tapered steel stakes 16-inches long. Finish edging sections and stakes with manufacturer's standard green-black paint.
- G. Aluminum Edging: Commercial aluminum edging of size and finish indicated, fabricated in sections with stake loop pressed into face of edging. Provide commercial aluminum locking stakes in same finish as edging.
- H. Decorative Gravel:
 - 1. Water-worn, hard, durable gravel washed free of loam, sand, clay, and other foreign substances, of following size range and color:
 - a. Size Range: 1-1/2-inch maximum, 3/4-inch minimum. 3/8-inch maximum, 1/8-inch minimum - pea gravel).
 - b. Color: (Uniform tan-beige color range) (Readily available natural gravel color range).
- I. Plastic Sheet: Black, weather-resistant polyethylene sheeting 8 mils thick.
- J. Nonwoven Fabric: Nonwoven polypropylene fabric.
- K. Tree Grates: Gray cast-iron segments, ASTM A48, Class 30, of shape, pattern, and size indicated.

2.03 PLANT LIST:

- A. Included at end of this Section.

PART 3 - EXECUTION

3.01 INSTALLATION OF PLANT MATERIALS:

- A. Reference Missouri Standard Specifications; Section 808 – Planting Trees, Shrubs, and Other Plants.

3.02 PREPARATION OF PLANTING SOIL:

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix soil amendments and fertilizers with topsoil. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. For pit- or trench-type backfill, mix planting soil prior to backfilling and stockpile at site.
- D. Setting and Backfilling:
 - 1. Reference Missouri Standard Specifications; Section 808 – Planting Trees, Shrubs, and Other Plants.

3.03 INSTALLATION OF MISCELLANEOUS MATERIALS:

- A. Install wood headers and edgings where indicated. Anchor with wood stakes spaced not more than (3 feet) oc, and driven at least 1-inch below top elevation of header or edging. Use two galvanized nails per stake to fasten headers and edging; length as needed to penetrate both members and provide 1/2-inch clinch at point. Predrill stakes to avoid splitting.
- B. Install steel edging where indicated. Anchor with steel stakes spaced not more than 1 meter (3 feet) oc, and driven at least 1-inch below top elevation of edging.
- C. Install aluminum edging where indicated. Anchor with manufacturer's interlocking stakes at not more than 2-feet and drive stakes to below top edge of edging until stake is in locked position.
- D. Place gravel beds where indicated. Compact soil subgrade before placing gravel. Fill or remove excess soil as necessary to bring indicated thickness of bed to required elevation. (Place polyethylene plastic sheet over compacted subgrade prior to placing gravel.)
- E. Planters: Place not less than 4-inch layer of gravel in bottom of planters and fill with planting soil mixture. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing for natural settlement.
- F. Tree Grates: Set grate segments flush with adjoining surfaces. Shim up from supporting substrate with soil-resistant plastic. Provide 3-inch minimum growth radius around base of plant; break away units of casting, if necessary, in accordance with manufacturer's instructions.

3.04 MAINTENANCE:

- A. Maintain trees and shrubs after planting until acceptance has been made by the Owner.
- B. During the maintenance period, prune, water, cultivate, and weed, as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades of vertical position as required. Restore or replace damaged wrappings. Spray, as required, to keep trees and shrubs free of insects and disease.
- C. Remove and replace trees and shrubs found to be dying, dead, or in unhealthy condition during the warranty period. Make replacements during the growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period.

END OF SECTION 02930

SAMPLE PLANT LIST

PLANT LIST:

<u>Description</u>	<u>Size</u>	<u>Quantity</u>
D. Trees:		
1. Acer Platanoides (Norway Maple)	75 mm-125 mm (3"-5") B&B	9
2. Ginkgo Biloba (Ginkgo)	63 mm-75 mm (2-1/2"-3") B&B	15
E. Flowering Trees:		
1. Cornus Florida (Flowering Dogwood)	2.4 m-3.0 m (8'-10') B&B	1
F. Evergreens:		
1. Juniperus H. Plumosa (Andorra Juniper)	600 mm (24") B&B	90
2. Pinus Nigra (Austrian Pine)	1.8 m-2.4 m (6'-8') B&B	10
3. Pinus Strobus (White Pine)	1.2 m-1.5 m (4'-5') B&B	2
G. Shrubs:		
1. Ligustrum Regelianum (Regel Privet)	0.6 m-0.9 m (2'-3')	100

REFERENCE INFORMATION

TREES AND SHRUBS

Tree and shrub quality, as specified in this Section is based on ANSI Z60.1 "American Standard for Nursery Stock" sponsored by the American Association of Nurserymen and available from them or ANSI. The text includes choices and options for various types of trees and shrubs based on nursery-grown stock only.

Purchase of all trees and shrubs under a cost allowance may be required if extent of the planting is partially or completely undecided at the time of bidding. Contractors must know name, size, and quantity of all trees and shrubs required in order to submit Bids which will result in satisfactory Work.

ANSI Z60.1 provides for balled and burlapped (B&B) or bare-rooted deciduous trees and shrubs, and text includes options for all stock to be either "B&B" or bare rooted, or for a mixture. In the latter case, "B&B" stock must be so designated on drawings or in schedules and all other stock is specified to be bare root.

Container grown stock should be considered an alternate form of balled stock applicable to smaller trees and shrubs. Text provides options to Contractor for container grown stock in lieu of B&B within the ANSI Z60.1 limitations. Bare rooted evergreen stock is not recommended and is not included in the text of this Section.

The terms "deciduous" and "evergreen" can be confusing. Deciduous refers to plants which shed all their leaves at end of the growing season and remain leafless during winter, or dormant period. Evergreens maintain green foliage as coniferous and broadleaf. However, not all conifers (plants bearing seeds in a cone) are evergreen; larches and bald cypress lose their foliage. Broadleaf evergreens comprise a wide range of plants which have broad leaves rather than needle-like leaves and which retain green leaves during winter.

Text (and ANSI Z60.1) does not include requirements for tropical trees and plants such as palms and bananas. Requirements for such items must be inserted in text.

Refer to Masterspec Basic section "Landscaping" for discussion of fertilizer and soil amendment requirements.

Check local Soil Conservation Service (SCS) or standard state transportation department specifications for soil testing, fertilizer, and soil amendment requirements.

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SECTION 02950 - PAVEMENT REMOVAL AND REPLACEMENT FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. Remove existing pavements where required for construction of pipeline in open excavation and replace with new construction following completion of pipe Work. Also includes restoration of surface on other roads, drives, sidewalks, curbs, gutters, and similar items, as indicated or where disturbed by the Contractor's operations.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A82 - Steel Wire, Plain, for Concrete Reinforcement.
 - b. A185 - Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
 - c. A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. State of Missouri Standard Specifications for Highway Construction, 1996.

PART 2 - PRODUCTS

2.01 AGGREGATE BASE COURSE:

- A. Conform to State of Missouri Standard Specifications for Highway Construction – SECTION 304 – AGGREGATE BASE COURSE
- B. Equal in thickness to existing base but not less than:
 - 1. 6 inches for portland cement concrete pavement or pavements with asphaltic concrete surfaces.
- C. Seal with prime coat conforming to State of Missouri Standard Specification for Highway Construction
- D. Materials:
 - 1. Aggregate: Type 5
 - 2. Bituminous Material: Liquid Asphalt MC-30

2.02 ASPHALTIC CONCRETE PAVEMENT (HOT-MIX):

- A. Conform to State of Missouri Standard Specification for Highway Construction.
- B. Equal to thickness of existing surface but not less than:
 - 1. 4 inches over aggregate base course.
- C. Materials:
 - 1. Aggregate: Asphaltic Concrete : Type I-C

2.03 PORTLAND CEMENT CONCRETE PAVEMENT:

- A. Conform to State of Missouri Standard Specification for Highway Construction, SECTIONS 501 – CONCRETE and 502 – PORTLAND CEMENT CONCRETE PAVEMENT
- B. Equal in thickness to existing pavement but not less than 6 inches.
- C. Concrete:
 - 1. Concrete shall be “Pavement Concrete” meeting the requirements of SECTION 501.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL:

- A. Lay out area to be removed in neat, straight lines parallel to longitudinal centerline of trench:

1. Minimum of 12 inches beyond limit of anticipated excavation for pipe, structures, and appurtenances.
 2. Extend area to existing pavement joints or edge of pavement where cut would result in the remaining pavement strip being less than 3 feet in width.
- B. Cut pavements to obtain straight cuts with vertical edges to depth required to establish breakline:
1. Prior to breaking.
 2. Use approved power-driven saw on portland cement and asphaltic concrete pavements.
 3. Repeat after backfill of trench as required to remove undermined, heaved, or otherwise damaged surfaces or edges.
- C. Remove materials with conventional methods.
- 3.02 PAVEMENT REPLACEMENT:
- A. Replace pavements and surfacings of highways, streets, roads, drives, and sidewalks with like materials.
 - B. Complete within 2 weeks' time of pipe installation, weather permitting.
 - C. Include replacing base materials to original grade and density prior to placing surface course.
 - D. Restore pavement to condition equal to or better than condition before start of Work.
 - E. Restore to satisfaction of authority having jurisdiction.
- 3.03 SIDEWALK REPLACEMENT:
- A. Replace sidewalks with like materials.
 - B. Match existing construction and restore to condition equal to or better than condition before start of Work.
 - C. Equal existing width and thickness but not less than 4 feet wide nor 4 inches thick.
 - D. Score contraction joints at 4-foot intervals and place expansion strip where new sidewalks abut existing walks, drives, curbs, or similar structures.
- 3.04 PERMITS TO OPEN SURFACES:
- A. Obtain permits to open surface from federal, state, county, and city agencies having jurisdiction, as required.
 - B. Post bond and pay any fees or license as required.
 - C. Obtain prior to cutting pavement or surface.

END OF SECTION 02950

DIVISION 3 – CONCRETE

SECTION 03050 - CONCRETE, FORMS, AND REINFORCEMENT

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes concrete, forms, and steel reinforcement.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Concrete Institute (ACI):
 - a. 304R - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 - b. 305R - Committee Report on Hot-Weather Concreting.
 - c. 306R - Committee Report on Cold-Weather Concreting.
 - d. 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - e. 318 - Building Code Requirements for Reinforced Concrete.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A82 - Steel Wire, Plain, for Concrete Reinforcement.
 - b. A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - c. A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - d. C31 – Practice for Making and Curing Concrete Test Specimens in the Field.
 - e. C33 - Concrete Aggregates.
 - f. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - g. C94 - Ready-Mixed Concrete.
 - h. C143 – Test Method for Slump of Hydraulic Cement Concrete.
 - i. C150 - Portland Cement.
 - j. C172 – Practice for Sampling Freshly Mixed Concrete.
 - k. C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - l. C494 - Chemical Admixtures for Concrete.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Include, but not limited to, the following:
 - 1. Complete reinforcing-bar schedule, reinforcing-bar details, and erection drawings to conform to ACI 315.
 - 2. Each type of reinforcing bar marked with identification corresponding to identification tag on bar.
 - 3. Erection drawings clear, easily legible, and to a minimum scale of:
 - a. 1/4 inch = 1 foot.
 - b. 1/8 inch = 1 foot if bars in each face are shown in separate views.
 - 4. Size and location of all openings.
- C. Concrete Mix:
 - 1. Submit proposed concrete-mix proportions to Owner prior to placing concrete. Mix proportions shall be selected preferably on the basis of field experience.
 - 2. Submit fine- and coarse-aggregate gradation data to Owner prior to placing concrete.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS:

- A. Cement: Conform to ASTM C150. Portland cement Type I.
- B. Water: Clean and free from injurious amounts of oil, acids, alkalies, or other deleterious substances. Any potable drinking water will be acceptable.
- C. Fine Aggregates: Clean natural sand. Manufactured sand may be used upon written approval of Owner. Conform to ASTM C33.
- D. Coarse Aggregates: Clean crushed stone or processed gravel, not containing organic materials. Conform to ASTM C33.
- E. Air Entrainment: 5% air shall be used in all concrete that is to be exposed to the weather.
- F. Water-Reducing Admixture: Conform to ASTM C494, Type A.

2.02 CONCRETE MIX PROPORTIONS:

- A. 4,000 psi (with the following proportions and limitations;)(MCIB mix No. WA530-1-4.)
 - 1. Minimum Compressive Strength: 4,000 psi at 28 days.
 - 2. Minimum Cement 5-1/2 sacks per cubic yard.
 - 3. Maximum Water: 5-1/2 gallons per sack of cement.
 - 4. Slump: 3 inches, +/- 1 inch.
- B. Ready-Mixed Concrete:
 - 1. Concrete shall meet requirements of ASTM C94 and of materials and proportions specified.
 - 2. Ready-mixed concrete plant shall be subject to approval of Owner.

2.03 FORMS:

- A. Form Materials:
 - 1. Use one of the following:
 - a. Exterior Grade Plywood: 5/8-inch-thick (use only plywood or steel for all exposed concrete Work).
 - b. Steel.
 - c. Approved wood fiberboard.
 - d. Dressed lumber free of loose knots.
 - 2. Form Ties: Approved break-back type.

2.04 STEEL REINFORCEMENT:

- A. Reinforcement Bars: Conform to ASTM A615, Grade 60 for all bars No. 4 or larger.
- B. Tie, and all No. 3 Bars: Conform to ASTM A615, Grade 40.
- C. Welded Wire Fabric: Conform to ASTM A185, using bright basic wire conforming to ASTM A82. Wire gage No. 11 or smaller shall be galvanized.
- D. Bolsters, Chairs, and Accessories: Conform to ACI 315.

2.05 GROUT:

- A. Plain Grout:
 - 1. Volume: 1 part portland cement to 2 parts sand.
 - 2. Keep water to a minimum as required for placing by the dry packing method.
 - 3. Place after the mixed grout has been allowed to stand for 2 hours.
- B. Grout for Bonding:
 - 1. Weight: 1 part cement to 1-1/2 parts sand.
 - 2. Keep water to a minimum.
 - 3. Place immediately.

PART 3 - EXECUTION

3.01 FIELD TESTING:

- A. Field Testing of Concrete and Making of Concrete Test Cylinders:
 - 1. Test concrete and make test cylinders conforming to ASTM C31, C143, and C172.
 - 2. Perform slump tests throughout any placement as required to maintain constant quality of fresh concrete, and as approved by Owner.
 - 3. Make not less than six test cylinders for each 150 cubic yards of concrete or fraction thereof for each day concrete is placed. Deliver to testing laboratory within 24 hours after taking cylinders. Exercise care not to damage cylinders in transit.
- B. Laboratory Testing:
 - 1. Laboratory for testing shall be selected and paid by Contractor and approved by Owner.
 - 2. Laboratory will furnish cylinder molds with cap seals or adequate means of identification.
 - 3. Cylinders shall be tested conforming to ASTM C39. Average strength of two cylinders (same age) shall be used as result of the test. Break two cylinders at 7 days, two at 14 days, and two at 28 days.

3.02 LOW-STRENGTH CONCRETE:

- A. Defined as concrete whose 7-day and 14-day test (average of two cylinders) is less than 70% and 85% respectively of the specified minimum 28-day compressive strength.
- B. Disposition of Concrete:
 - 1. Concrete shall remain accessible with no other Work performed that relates to or depends upon the questionable concrete until a final decision as to the disposition of the concrete is given by Owner.
 - 2. Low-strength concrete shall be removed and replaced if so requested by Owner.

3.03 PLACING OF CONCRETE:

- A. Preparation:
 - 1. Clean bonding surfaces free from laitance and foreign materials.
 - 2. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavations.
 - 3. Do not deposit partially hardened concrete or concrete contaminated by foreign materials.
- B. Placing Concrete:
 - 1. Conform to ACI 304R.
 - 2. Place within 45 minutes after mixing, except Owner may extend the period to 90 minutes (maximum) dependent upon weather conditions.
 - 3. Place in horizontal layers not exceeding 18 inches.
 - 4. Vibrate or spade concrete to produce solid mass without honeycomb or surface air bubbles.
- C. Curing Concrete:
 - 1. Cure with liquid membrane-forming compound conforming to ASTM C309, Type I. Apply according to manufacturer's recommendations.
 - 2. Apply curing compound to all exposed surfaces immediately after removing form or after finishing concrete.
 - 3. Keep formwork wet until stripped.
- D. Cold-Weather Placing: Conform to the practice recommended in ACI 306R when the temperature is below 40°F or is likely to fall below 40°F during 24-hour period after placing.

- E. Hot-Weather Placing: Conform to practices recommended in ACI 305R when temperature is 90°F or above or is likely to rise above 90°F within 24-hour period after placing.

3.04 CONSTRUCTION JOINTS:

- A. Locate where indicated. Conform to ACI 318.
- B. Clean and break laitance or other foreign material from bonding surface. Bed with 1 inch of grout for bonding in horizontal joints.

3.05 SURFACE FINISHES:

- A. Float Finish:
 - 1. Compact, accurately screed, and wood-float all slabs to a true uniform surface.
 - 2. Test surface with straightedge, and eliminate high and low spots of more than 1/8 inch in 10 feet.
- B. Defective Surface Treatments:
 - 1. After removal of forms, remove all fins, projections, and form ties.
 - 2. Grout and cure all voids, damaged areas, and tie holes.

3.06 FORMS:

- A. Treat forms with an approved oil or lacquer prior to placing reinforcement.
- B. Wet forms with clean, clear water prior to placing concrete.
- C. Adequately brace and stiffen forms to prevent deflection and settlement.

3.07 STEEL REINFORCEMENT:

- A. Place accurately, tie at intersections, and support on chairs. Conform to ACI 318.
- B. Tie securely with 16-gage or larger annealed iron wire.
- C. Unless otherwise indicated, the minimum length of lap for tension lap splices shall be as required for Class B splices as defined by ACI 318.
- D. Lap welded wire fabric not less than the length of one mesh.

END OF SECTION 03050