

# Yankee Springs Township

## SECTION 33 11 00

### WATER MAINS

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes the work required for water mains, structures and appurtenant work installed by open-cut excavation methods.

##### 1.02 REFERENCES:

- A. AWWA - American Waterworks Association, latest edition.
- B. ANSI - American National Standards Institute, latest edition.
- C. ASTM - American Society of Testing Materials, latest edition.

##### 1.03 SUBMITTALS:

- A. Submit the following for review by ENGINEER:
  - 1. Product Data on Valves, Hydrants and service fittings.
  - 2. Details for each connection to existing water main.
  - 3. Proposed equipment (calibrated) and method for flushing, pressure testing, leakage testing and chlorination.
- B. Report the following "as built" information to ENGINEER:
  - 1. Three (3) witness measurements to buried fittings, valves and curb boxes from permanent fixtures such as building corners, power poles and trees 8 inch diameter and larger.
- C. Manufacturer's certifications on pipe and fittings indicating conformance to specifications prior to installation.

##### 1.04 JOB CONDITIONS:

- A. Interrupting Water Service:
  - 1. Scheduling: Obtain OWNER's approval prior to interruption of service.
  - 2. Provide notice of twenty-four (24) hours to affected occupants and twenty-four (24) hours to Fire Department of time and duration.
  - 3. Provide stand-by service as required; outage not to exceed four (4) hours.
  - 4. Existing valve operation shall be by OWNER's employees only.
  - 5. Prevent contamination of existing water mains.
- B. Install service lines after pressure and bacteriological testing is accepted.
- C. Clean up promptly following pipe installation within maximum of 600 feet behind pipe laying operation. Clean up includes backfill and rough grading.
- D. Salvage all existing valve boxes, curb boxes and hydrants removed and deliver to the OWNER's yard. Hydrants shall be removed carefully without causing damage to the hydrant and fittings.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL:**

- A. Cement Lining: AWWA C104 / ANSI A21.4 standard thickness for ductile iron pipe and fittings.
- C. Hydrant Leads: Ductile iron pipe with mechanical joints.
- D. All materials which may come in contact with water intended for use in the public water supply shall be certified to meet ANSI/NSF Standard 61 and 372.
- E. All chemicals which may come in contact with water intended for use in the public water supply shall be certified to meet ANSI/NSF Standard 60.

### **2.02 PIPE:**

- A. Ductile Iron: AWWA C151 / ANSI A21.50 and ANSI A21.51; Class 52.
- B. Service Tubing:
  - 1. Copper: ASTM B88, Type K annealed and soft temper.

### **2.03 JOINTS:**

- A. Ductile Iron Pipe and Fittings:
  - 1. Mechanical: AWWA C111 / ANSI A21.11.
  - 2. Push-on: AWWA C111 / ANSI A21.11.
  - 3. Electrical Continuity: Provide conductive gaskets (M.J.), bronze wedges (3 per joint) (push-on), or thermite welded sockets and cables (push-on).
- B. Service Tubing and Fittings:
  - 1. Copper: Compression.

### **2.05 FITTINGS:**

- A. Ductile Iron: AWWA C110 / ANSI A21.10, or AWWA C153 / ANSI A21.53, Class 54, 250 psi working pressure through 12 inches and 150 psi above. Mechanical joint solid sleeves shall be Clow Corporation #F1012 or equal.

### **2.06 VALVES (OPEN LEFT):**

- A. Gate: AWWA C509 or C515 Resilient seated, epoxy coated surfaces, rubber encapsulated gate, bronze non-rising stem with double o-ring seal. Provide full diameter unobstructed flow. End connections shall match pipe.
  - 1. Manufacturer: East Jordan Iron Works.
- B. Boxes: Three (3) section cast iron with lid marked WATER:
  - 1. Upper section: Screw on adjoining center section and full diameter throughout. Place geotextile fabric around threaded joint of risers, if used.
  - 2. Center section: Minimum 5 inch inside diameter.
  - 3. Base section: Fit over valve bonnet and shaped round for valves through 10 inch and oval for 12 inch and over. Place geotextile fabric around valve bonnet.
  - 4. Manufacturer: East Jordan Iron Works, #8560 Series.

2.07 HYDRANTS (OPEN LEFT):

- A. AWWA C502, mechanical joint with drain outlet.
  - Plug drain outlet if any of the following conditions exist: 1. drain is below water table, 2. poor draining soils exist, 3. contaminated soils exist.
- B. 5 inch size with 6 inch inlet connection, 2 - 2½ inch hose nozzles and 1 - 4 inch pumper nozzle.
- C. Provide National Standard Fire Hose Thread.
- D. Manufacturer: East Jordan Iron Works, Model 5BR250.
- E. Color: Red. Painted at factory with primer and two (2) coats.
- F. Barrel length shall be properly sized so the centerline of the pumper nozzle is 21" to 27" above grade at the specified depth of cover over the pipe.
- H. Hydrant Extension: 36-inch maximum, limited to one per hydrant.
  - 1. Install between breakaway flange and top of hydrant lower section.

2.08 SERVICE FITTINGS:

- A. Corporation Stops: McDonald 4701-22(CTS) or equal by Ford (Compression Fittings).
- B. Curb Stops: McDonald 6100-22(CTS) or equal by Ford (Compression Fittings).
- C. Curb Boxes: McDonald 5605 (Arch Pattern).

2.09 MISCELLANEOUS:

- A. Service Clamps: Cast iron double strap, brass or bronze with stainless steel parts, AWWA C800 threads.
- B. Tie Rods and Clamps: Clow Corp. or Traverse City Iron Works.
- C. Mechanical Joint Restraint: Megalug by EBAA Iron Sales, Inc., or approved equal.
- D. Pipe Insulation: Closed cell extruded polystyrene 2 inch thick rigid board manufactured by Dow, Owens Corning or ENGINEER approved equal. Install when depth of bury is less than 4 feet.

**PART 3 - EXECUTION**

3.01 PREPARATION:

- A. Alignment and Grade:
  - 1. Deviations: Notify ENGINEER and obtain instructions to proceed where there is a grade discrepancy or an obstruction not shown on plans.
    - a. Verify location and depth of existing utilities in advance of construction and provide adjustments in alignment and grade of water main at no additional cost to OWNER.
  - 2. Depth of pipe: Minimum cover over pipe below finished grade: 5 feet - 6 inches.
  - 3. High points in pipeline: Locate at services and hydrants.

- B. Bedding:
  1. Use Class II sand bedding around pipe.
  2. Provide continuous bearing supporting entire length of pipe barrel evenly.
- C. Cleaning Pipe and Fittings:
  1. General: Provide interior free of foreign material and joint surfaces free of lumps and blisters.

3.02 INSTALLATION:

- A. General: Meet requirements of AWWA C600 for ductile iron pipe and these specifications.
- B. Laying Pipe:
  1. Prevent entrance of foreign material and plug watertight when left unattended.
  2. Provide pipe length and bedding as a unit in a frost free, dry trench.
  3. Provide minimum vertical separation between water main and crossing sanitary sewer, storm sewer or force main of 18 inches, measured from edge of pipe to edge of pipe. Provide minimum horizontal separation between water main and parallel sanitary sewer, storm sewer or force main of 10 feet, measured from edge of pipe to edge of pipe.
  4. ENGINEER's approval required for pipe lengths less than 6 feet.
  5. Joint deflection for ductile iron pipe shall not exceed the following values or as recommended by pipe manufacturer.

**Maximum Joint Deflection**

Nominal Pipe Size (inches)	Push-On Joint		Mechanical Joint	
	Deflection Angle (Deg-Min)	Maximum Offset (inches)*	Deflection Angle (Deg-Min)	Maximum Offset (inches)*
4	3° - 30'	14	6° - 15'	23
6	3° - 30'	14	5° - 20'	20
8	3° - 30'	14	4° - 00'	15
12	3° - 30'	14	4° - 00'	15
16	2° - 15'	8 ¼	2° - 40'	10
24	2° - 15'	8 ¼	1° - 45'	7

\*Offsets are based upon 18-foot lengths of pipe

- C. Cutting Pipe:
  1. PVC: Power saw or hand saw.
  2. Ductile iron: Power saw.
  3. Asbestos Cement: ASTM E 2394 – 04.
- D. Jointing:
  1. Mechanical:
    - a. Lubricate as recommended by manufacturer.
    - b. Tighten bolts evenly to 75 to 90 foot-pounds.
  2. Push-on:
    - a. Lubricate as recommended by manufacturer.
    - b. Shape beveling as recommended by manufacturer.
- E. Setting Valves, Fittings and Fire Hydrants:
  1. General: Article 3.05 SCHEDULES.

2. Valves: Set plumb.
  3. Valve boxes:
    - a. Base section: Center and plumb over operating nut and 2 inches above bonnet joint.
    - b. Upper section: Set cover ¼- inch below finished grade.
    - c. Witnesses: Provide 3 measurements to permanent surface features.
  4. Hydrants:
    - a. Connection: With ductile iron pipe and auxiliary valve.
    - b. Positioning: Plumb with pumper nozzle facing curb and nozzle centerline 21-27 inches above finished grade.
    - c. Provide necessary length of 6 inch pipe for hydrant leads.
    - d. Provide access to all hydrants.
  5. Tie valves to tees and crosses and tie hydrants to valves.
  6. Provide joint restraint using Megalug retainer glands in accordance with the pipe restraint table in Paragraph 3.02 I.1.
- F. Connections:
1. Existing water mains:
    - a. Provide temporary support during cut-in.
    - b. Disinfect by swabbing pipe, valves and fittings with four percent (4%) chlorine solution.
    - c. Pressure off: Install mechanical joint solid sleeve.
    - d. Pressure on: Install tapping sleeve, valve and box.
    - e. Asbestos cement pipe: Meet requirements of ASTM E 2394 – 04.
  2. Service lines:
    - a. Align at right angles to street or easement line.
    - b. Minimum depth shall be same as pipe.
    - c. Install after acceptable pressure test and chlorination of water main.
    - d. Curb boxes: Set plumb and provide 3 measurements to surface features.
      - (1) Locate at easement line within easement or at right-of-way line within road right-of-way, unless otherwise directed.
      - (2) Cover with 5' long section of 4" PVC pipe buried 2 feet.
      - (3) Set cover ¼-inch below finished grade.
    - f. Tapping shall be at 45° above center and shall provide horizontal loop at corporation stop.
      - (1) Plastic Pipe: Tap pipe using a hole saw cutter (new cutter) and double strap saddle per manufacturer's recommendation. No direct tapping allowed.
    - f. Maximum tap sizes shall be as follows:

Type of Pipe	Pipe Size									
	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	<u>Maximum Direct Tap Size</u>									
Ductile:	½"	¾"	1"	1¼"	1½"	2"	2"	2"	2"	2"
	<u>Maximum Tap Size with Double Strap Saddle</u>									
All Pipe:	1"	1½"	2"	2"	2"	2"	2"	2"	2"	2"

- H. Dead-end water main stubs longer than 20 feet:
1. Install standpipe with shutoff at dead ends to aid in chlorinating, testing and flushing. Remove standpipe upon approval of water main.

I. Pipe Joint Restraint:

1. Provide mechanical joint restraint for the minimum lengths shown in the table below:

PIPE RESTRAINT LENGTH (L) REQUIRED, FEET*							
Pipe Dia.	Tees, 90° Bends	45° Bends	22-1/2° Bends	11-1/4° Bends	Dead Ends	Reducers (one size)	**
4"	23	9	5	2	57		
6"	32	13	6	3	82	43	63
8"	41	17	8	4	104	43	55
12"	58	24	12	6	149	80	120
16"	74	31	15	7	192	82	110
20"	89	37	18	9	233	82	104
24"	104	43	21	10	272	82	99
30"	123	51	25	12	328	115	148
36"	141	58	28	14	379	115	140

\* The length of restrained pipe required shown in the table above is based on trench backfill being compacted to 95% of the maximum density according to the Modified Proctor Method. The above table does not consider polyethylene wrapped pipe. If the pipe is wrapped with polyethylene, a greater length of restrained pipe will be required. Unless otherwise specified, a multiplier of 1.5 shall be used to determine the required length when the pipe is wrapped with polyethylene.

\*\* If straight run of pipe on small side of reducer exceeds this value, then no restrained joints are necessary.

- a. Tees: Pipe restraint length shown in the table above shall be provided in the branch direction. Also, the minimum length of pipe restraint in the straight through (run) direction shall be 10 feet on both sides of the tee.
- b. Bends: Pipe restraint length shown in the table above shall be provided on both sides of the bend.
- c. Dead End: Pipe restraint length shown in the table above shall be provided back from the dead end plug.
- d. See 3.06 SCHEDULES for a detail illustrating the joint restraint requirements.
- e. All joints shall be restrained for pipe within casings.
- f. All joints between bends on water main offsets shall be restrained.

J. Repair sewer laterals disturbed during construction with PVC schedule 40 pipe and FERNCO fittings.

K. Pipe Insulation: Where noted on Drawings, place insulation board 4 feet wide over pipe at top of bedding.

3.03 FIELD QUALITY CONTROL:

A. Testing and Inspection:

1. General:

- a. Observation: By ENGINEER.
- b. Completion: Before connecting to existing line.
- c. Notification: Pretest and arrange with ENGINEER for observation of test. Contractor to pay additional cost for ENGINEER to witness retests.
- d. Equipment and assistance: Provide.
- e. Required water: By OWNER where available from municipal system.

- f. Connection to existing water main: After passing pressure and leakage tests, and bacteriological testing.
- g. Meet requirements of AWWA C600 for ductile iron pipe, AWWA C605 for PVC pipe and these specifications.
- 2. Electrical continuity: Test ductile iron pipe for continuity and repair breaks.
- 3. Pressure/Leakage Test:
  - a. Conditions: Air or air-water methods of applying pressure prohibited.
  - b. Sequence: Prior to Flushing and Chlorination.
  - c. Procedure: Fill system slowly, expel air through corporation stop at high points and apply pressure.
  - d. Pressure: Maintain 150 psi.
  - e. Duration: Two (2) hours.
  - f. Make-up water: From measurable source.
  - g. Leakage: Quantity of water supplied to maintain test pressure.
  - h. Allowable: Less than:

$$L = \frac{SD \times \text{square root of } P}{148,000}$$

where,

L = leakage (gallons per hour).

S = length of pipe (feet).

D = nominal pipe diameter (inches).

P = average test pressure (pounds per square inch gauge).

- i. Correction: Repair defects and repeat test until acceptable.
- j. Maximum length of pipe to be tested shall be 2000 feet.
- 4. Testing valves only: Maintain pressure on main and check all valves as follows:
  - a. Vent extreme ends of main and briefly check each valve progressively back towards test point.
  - b. Allowable pressure drop shall be less than 10 psi in five (5) minutes with test pump off.
  - c. Correction: Repair defects and repeat test until acceptable.

#### 3.04 FLUSHING:

- A. Flushing: Shall be performed in accordance with ANSI/AWWA C651-14.
  - 1. Sequence: Following pressure testing and prior to chlorination.
  - 2. Maximum intervals: 2,000 feet.
  - 3. Required water: By OWNER where and when available from municipal system. Maintain minimum of 40 psi residual pressure in existing water system.
  - 4. Minimum velocity: 3.0 feet per second at pipe wall. See table below for size and number of taps or hydrant openings required to achieve minimum velocity:

Required Flow and Openings (either taps or hydrants) to Flush Pipelines at 3.0 ft/sec						
Pipe Dia.	Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main	Size of Tap Used			Number of Hydrant Outlets	
		1"	1-1/2"	2"		
<i>inch</i>	<i>gpm</i>	Number of Taps Required on Pipe			2-1/2"	4-1/2"
4	120	1			1	1
6	260		1		1	1
8	470		2		1	1
10	730		3	2	1	1
12	1,060			3	2	1
16	1,880			5	2	1

- B. The CONTRACTOR shall submit to the ENGINEER a procedure schedule outlining the method the CONTRACTOR proposes to use for flushing water mains. Utility owner shall be given notice by CONTRACTOR prior to any flushing.
- C. Flushing may be performed prior to pressure testing or following pressure testing, but in any case, prior to chlorination of the water main.

3.05 DISINFECTION:

- A. Chlorination: Shall be performed in accordance with ANSI/AWWA C651-14, continuous feed method.
  - 1. Observation: By ENGINEER.
  - 2. Required water: By OWNER where available from municipal system utilizing a cross-connection control device.
  - 3. Chlorine gas: Not permitted on job-site.
  - 4. High Test Calcium Hypochlorite (HTH, "Perchlolen," "Maxochlor," "Pittchlor"): Powder and water shall be mixed to form a 1 percent chlorine solution (10,000 ppm). Pump solution at a constant rate into the water main while bleeding off the water at the extreme end. AWWA B300.
  - 5. Liquid Chlorine: Liquid chlorine may be applied to the water main much the same way as the hypochlorite solution listed above. AWWA B301.
  - 6. Sequence: Following pressure test and flushing and prior to connection to existing water main.
  - 7. Retention time: Chlorinated water of at least 25 mg/l initial free chlorine shall remain in the pipe for at least 24 hours. At the end of the 24-hour period the chlorine residual shall be at least 10 mg/l of free chlorine or re-chlorination must take place.
  - 8. Procedure: Operate all valves during disinfection.
  - 9. Bacteriological Testing:
    - a. Two consecutive safe bacteriological samples shall be taken 24 hours apart before placing the water main into service. Samples shall be collected for every 1,200 feet of new main, plus samples from each branch and the end of the line. If excessive quantities of debris, or trench water, have entered the main, samples shall then be taken at approximately 200-foot intervals.
    - b. Sampling: By OWNER.
    - c. Laboratory: State of Michigan certified for Drinking Water.
  - 10. Correction: Re-chlorinate sections not meeting MDEQ bacteriological requirements.
    - a. Retesting shall be paid by CONTRACTOR.

- B. Disinfection report; record:
  - 1. Type and form of disinfectant used.
  - 2. Date and time of disinfectant injection start and time of completion.
  - 3. Test locations.
  - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  - 5. Date and time of flushing start and completion.
  - 6. Disinfectant residual after flushing in ppm for each outlet tested.
  
- C. Bacteriological report record:
  - 1. Date issued, project name, and testing lab name, address, and telephone number.
  - 2. Time and date of water sample collection.
  - 3. Name of person collecting samples.
  - 4. Test locations.
  - 5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
  - 6. Coliform bacteria test results for each outlet tested.
  - 7. Certification that water conforms, or fails to conform, to bacterial standards.
  - 8. Bacteriologist's signature and authority.
  
- D. De-chlorination: After chlorination, the water shall be flushed from the line at its extremities until all of the heavily chlorinated, but before bacteriological sampling, the water main shall be flushed and then filled with potable water from a suitable source with a residual chlorine concentration in the water that is no higher than that generally prevailing in the distribution system and that is acceptable for domestic use. If flushed water is discharged directly to open drains, discharge water through de-chlorinated tablets in mesh sack.
  
- E. Collect water samples in sterile bottles containing sodium thiosulfate for bacteriological analysis from the end-most outlet of the pipe line at the end of every branch and every 1200 feet of new main. Two (2) samples must be taken 24 hours apart for each section of the line tested. If both samples show safe results, and meet the Safe Drinking Water Standards, the new pipe line may be placed in service through cooperation of the OWNER and CONTRACTOR. If, however, the results are unsafe, a repetition of the chlorine treatment is necessary. Samples should never be collected from hoses or fire hydrants. A suggested sampling tap is a corporation cock with copper goose neck assembly. The goose neck assembly may be removed after use, at the option of the OWNER, samples shall be taken during chlorination.
  
- F. If cutting into or repairing existing water mains, follow procedures outlined in ANSI/AWWA C651-14.

3.06 SCHEDULES:

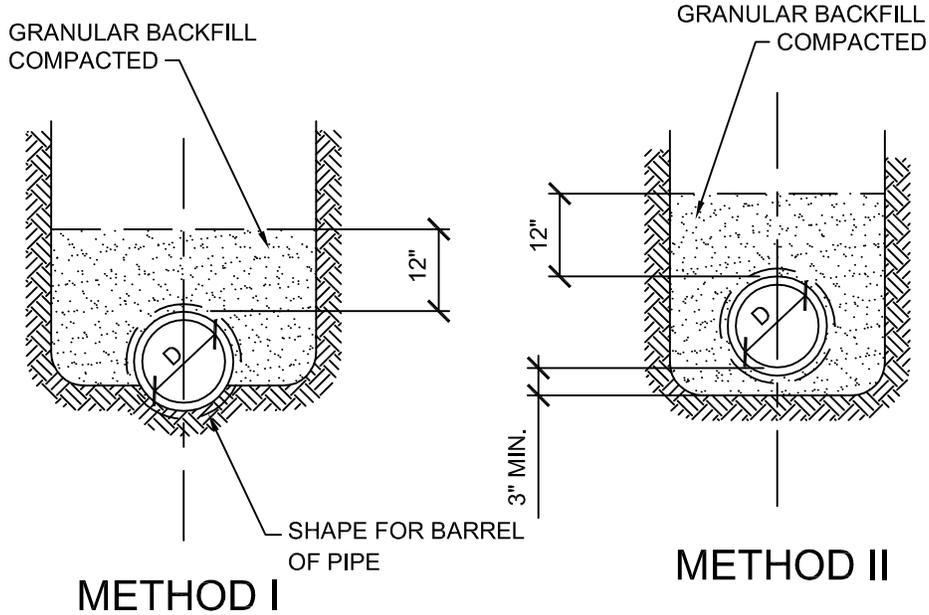
- A. Standard Details:
  - 1. Methods of bedding pipe – pressure pipe.
  - 2. Hydrant assembly.
  - 3. Copper service lead connection / sample point.

**END OF SECTION**



BELL HOLE EXCAVATIONS  
REQUIRED FOR METHODS I & II

## EXCAVATION FOR BELLS

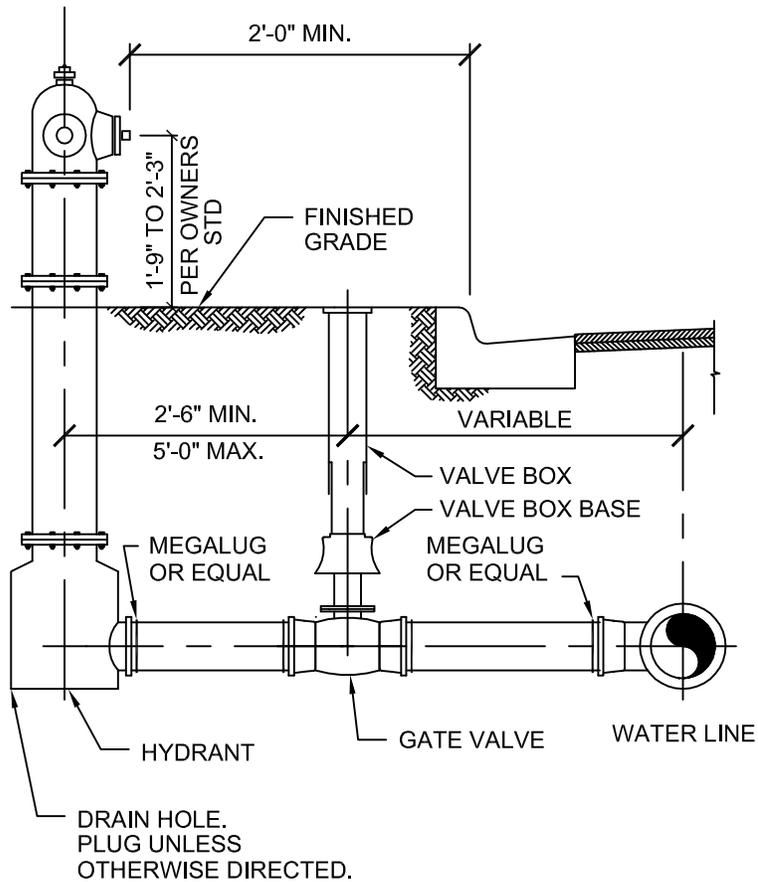


NOTES:

1. METHOD I: IN AREAS OF UNCONSOLIDATED SOILS  
(SAND, GRAVEL, ETC.)
2. METHOD II: IN AREAS OF CONSOLIDATED SOILS  
(CLAY, HARDPAN, ROCK, ETC.)

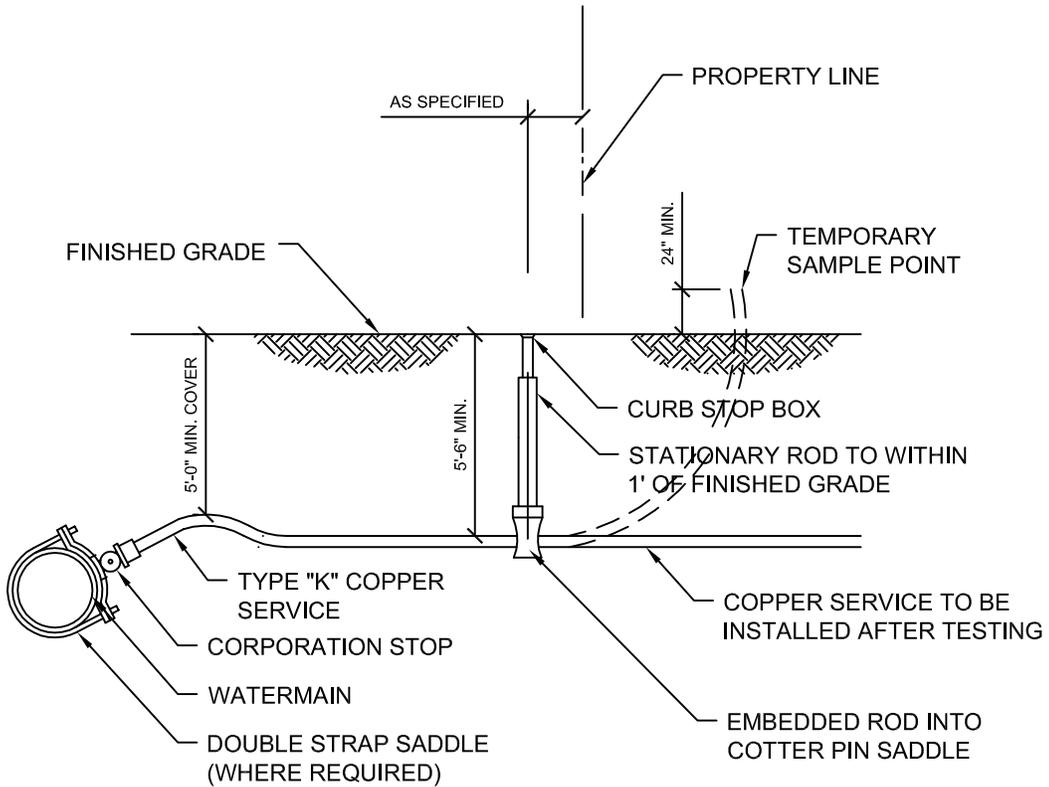
331100  
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## METHODS OF BEDDING PRESSURE PIPE



## HYDRANT ASSEMBLY

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NOTES:

1. SAMPLE POINT TO BE USED FOR FUTURE SERVICE LEAD.
2. NO TAP SHALL BE MADE CLOSER THAN 18" TO ANY COUPLING OR JOINT IN THE PIPE.
3. STATIONARY ROD REQUIRED IN AREAS OF HIGH GROUNDWATER.

**COPPER SERVICE LEAD**  
**CONNECTION/SAMPLE POINT**

331100  
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