

**City of Franklin**  
**Specifications For Water Works Construction**

**CONSTRUCTION OF WATER SYSTEM FRANKLIN, NEW HAMPSHIRE**

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## SECTION 1 WATER SYSTEM DESIGN

### PART 1 GENERAL

#### 1.1 DESIGN GUIDELINES

- A. These general design criteria are established for the design of water distribution systems in the City of Franklin. This portion of the document shall be utilized concurrently with the applicable sections of the Construction Standards and Technical Specifications.
- B. All design and construction drawings for water distribution systems shall comply with these standards, or the standards titled “Recommended Standards for Water Works,” established by the Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers, or the standards established by the Department of Environmental Services (DES), which ever is more stringent, unless otherwise approved by the City of Franklin.
- C. The Design Engineer/Developer should supply a utility construction plan submission to the City of Franklin in accordance with the Site Review Regulations and Department of Environmental Services Requirements. Anticipated design flow for the water system shall be based on the type of use and as determined in Env-Ws 370-372 DESIGN STANDARDS FOR WATER SYSTEMS. The plans shall be signed and sealed by a professional engineer licensed by the State of New Hampshire.
- D. The Design Engineer/Developer should obtain and submit Fire Department approval of fire protection system.
- E. Plans should show appropriate clear phase lines and match lines. Provide all applicable detail drawings. Call out interferences with conflicting pipes with indication of “over” or “under” on plan sheet.
- F. Certificates of Compliance shall be submitted by the Contractor for each material to the Municipal Services Department of the City of Franklin’s for review and approval.
- G. All design approvals shall lapse 4 years after issuance, if system construction has not been started. Systems that have begun construction, but not started operation on the 4th anniversary of the approval date, shall meet all then current design criteria prior to startup. A new design review fee and appropriate design revision shall be required for reapproval of lapsed designs.

## 1.2 PRESSURE

- A. All water mains shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi (140 kPa) at ground level (house sill) at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 to 80 psi (410 - 550 kPa) and not less than 35 psi (240 kPa). City of Franklin shall determine compliance with this criteria. The following specific sill elevations apply for the minimum pressure:

Pleasant Street – N Main Street Tank	470 USGS
Cross Street Tank	575 USGS
E. Pleasant Street Tank (above vault)	755 USGS

- B. Individual booster pumps shall not be allowed for any individual residential service from the public water supply mains. Individual booster pumps shall be not used to achieve the 35 psi minimum pressure.
- C. Maximum pressure in the water distribution system shall be 100 psi.

## 1.3 DIAMETER

- A. The minimum size of water main which provides for fire protection and serving fire hydrants shall be eight-inch diameter. Larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in Section 1.1
- B. Water main shall be 8, 12, 16, and 20 inch in diameter.
- C. When fire protection is to be provided, system design should be such that fire flows and facilities are in accordance with the requirements of the City of Franklin Fire Department.

## 1.4 DEAD ENDS

- A. Dead ends shall be minimized by making appropriate tie-ins whenever practical, in order to provide increased reliability of service and reduce head loss.
- B. The maximum length of pipe with out a loop shall be 750 feet, unless specifically waived by the City of Franklin.
- C. Dead end mains shall be equipped with a means to provide adequate flushing. Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. They may be provided with a fire hydrant if flow and pressure are sufficient. No flushing device shall be directly connected to any sewer.

- D. All mains that dead end and that are intended for future expansion shall include a line size valve and blow-off. The gate valve shall be mechanically restrained two full joints of pipe. The blow-off must be designed to be removed without interruption to service.

## 1.5 VALVES

- A. A sufficient number of valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs.
- B. All distribution systems shall be valved to facilitate the isolation of each section of pipeline between intersections of the grid system. Generally, the number of valves at an intersection shall be one less than the number of pipes forming the intersection.
- C. It is the intent of this criteria to provide for the isolation of mains that serve areas containing more than 25 service connections. Valves should be located at not more (1)500 foot intervals in commercial districts and (2) one block or 800 foot intervals in other districts.
- D. Valves twelve inches and smaller shall be gate type, cast iron, resilient wedge and mechanical joints conforming to AWWA C509 latest revision as provided in the construction specifications. Valves shall be designed for a working pressure of not less than 200 psi, and each shall have the pressure rating cast into the body and manufacturer's name or initial cast into the body or bonnet. Valves sixteen inches (16") and larger shall be butterfly type, ductile iron with rubber seat and mechanical joint ends with side gear operator..

## 1.6 Hydrants

- A. Fire hydrants should be provided at street intersections and at intermediate points between intersections as recommended by the City of Franklin Fire Department. Generally, fire hydrant spacing ranges from 350 to 600 feet depending on the area being served.
- B. Each fire hydrant shall be capable of delivering a flow of at least 500 gallons per minute with a residual pressure of not less than 20 psi. The hydrant system shall be designed to provide for the fire flow requirements of the City of Franklin Fire Department.
- C. Fire hydrants should have a bottom valve size of at least five inches, one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles.

- D. Hydrant drains should be plugged, unless otherwise approved by the City of Franklin. Where hydrant drains are not plugged, a gravel pocket or dry well shall be provided.

## 1.7 AIR RELIEF VALVES

- A. At points in the water main profile where entrapped air can accumulate, which may result in flow restriction, provisions shall be made to remove the air. This shall be accomplished in distribution systems by use of strategically placed fire hydrants or blow-offs. In general, air relief assemblies shall only be used at aerial crossings and other similar circumstances.
- B. Use of manual air relief valves is recommended wherever possible. The open end of an air relief pipe from a manually operated valve should be extended to the top of the pit and provided with a screened, downward-facing elbow if drainage is provided for the structure. Discharge piping from air relief valves shall not connect directly to any storm drain, storm sewer, or sanitary sewer.

## 1.8 VALVE CHAMBERS

- A. Wherever possible, chambers, pits or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be located in areas subject to flooding or in areas of high groundwater. Such chambers or pits should drain to the ground surface, or to absorption pits underground. The chambers, pits and manholes shall not connect directly to any storm drain or sanitary sewer. Blow-offs shall not connect directly to any storm drain or sanitary sewer.

## 1.9 INSTALLATION OF WATER MAINS

- A. Water mains shall be buried at a minimum depth of five feet six inches (5'-6") and a maximum depth of eight feet (8'-0"). In no case will the pipe depth be allowed in excess of 6-feet at water main valves.
- B. Standard fittings allowed by the City of Franklin include tees, reducers, crosses, and bends. There shall be no 90 degree bends.
- C. All tees, bends, plugs and hydrants shall be provided with mechanical restraint tie rods or joints designed to prevent movement. Concrete thrust blocks shall not be allowed unless required for connection of a new water main to an existing water main.
- D. In areas where aggressive soil conditions are suspect, or in areas where there are known aggressive soil conditions, analyses shall be performed to determine the actual aggressiveness of the soil. If soils are found to be aggressive, take necessary

action to protect the water main, such as by encasement of the water main in polyethylene, provision of cathodic protection (in very severe instances), or using corrosion resistant water main materials.

- E. Water mains shall be laid at least 10 feet horizontally from any existing or proposed gravity sewer, septic tank, or subsoil treatment system. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, the City of Franklin/DES may allow deviation on a case-by-case basis, if supported by data from the design engineer.
- F. Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is above the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.
- G. When it is impossible to obtain the minimum specified separation distances, the Franklin/ DES must specifically approve any variance from the requirements. Such deviation may allow installation of the water main closer to a gravity sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the gravity sewer. The sewer materials shall be water works grade 150 psi (1.0 Mpa) pressure rated pipe meeting AWWA standards or pipe approved by the Franklin/DES and shall be pressure tested to ensure water tightness.
- H. Other utilities, including but not limited to natural gas, storm drainage, electric, telephone, steam and cable television shall not be installed within three feet of water-mains.

#### 1.10 WATER SERVICE CONNECTIONS AND METERS

- A. Individual service taps shall not be placed closer than thirty-six inches apart. A minimum of 24 inches must be maintained from all water main joints and appurtenances. Individual service taps shall be constructed with double strap saddles and corporation stops. Services shall not exceed 100 feet in length to the curb stop with the curb stop generally placed at the property line, at an accessible location.
- B. Services shall have a minimum of five feet (5'-0") cover. Proper sizing of non-residential meters and services is the responsibility of the Developer or his Engineer subject to the City of Franklin's approval. Acceptable size service pipe is ¾", 1", 1 ½", 2", 4", 6", 8", and 12". Dual metering of a single building service (i.e.) two one-inch meters instead of one two-inch meter) shall not be permitted.

- C. Construction drawings shall include a typical meter installation for each meter to be installed. Meters shall be installed in buildings. The backflow prevention device shall be installed in building, close to the meter. No taps or connections are allowed between the meter and the backflow prevention device. Curb stops shall be set in grassy unobstructed areas generally at property lines, clear from buildings, fences, shrubs, trees, fire hydrants, cable boxes, etc. Curb boxes shall be kept out of pedestrian walkways and out of driveway areas or other concrete/paved surface, unless approved by the City of Franklin.
- D. Meter size shall be as required by the City of Franklin for single residences. For water main construction in front of vacant lots, service lines shall be installed from the main to property line with a magnetic marker identifying the location of the end of the service. Service lines for existing residences shall be provided with a curb stop and meter installed at the end of the service in accordance with the standard construction details.
- E. Meter horns shall be isolated with full open valves per the City of Franklin's Building and Plumbing Code Regulations and the International Plumbing Code, 2003 Edition.
- F. City of Franklin requires separate water services for Buildings with sprinklers. There shall be a separate valve/curb stop at the property line for each service.

## SECTION 2A

### SANITARY SEWER AND WATER EARTHWORK

#### PART 1 GENERAL

##### 1.01 SCOPE

- A. The work of this section includes all labor, materials, tools, equipment, accessories and appurtenances necessary to satisfactorily complete all stripping of topsoil, excavation of earth and rock, stockpiling, removal of unsatisfactory bearing materials, backfilling, filling, and grading not specified elsewhere, and all incidental work pertaining thereto within the limits of the work indicated and as specified herein.

##### 1.02 SPECIAL REQUIREMENTS

- A. Contractor shall perform his operations in a manner which will not damage utility lines, roads, structures or any other installation located in or adjacent to work areas. The Contractor shall be responsible for any damage caused by his operations whether within or beyond the limit of work lines. If existing utility lines are damaged, they shall be repaired with similar or better materials of the same size and in conformance with the requirements of the affected utility. The Contractor shall have on site the necessary manpower, materials and equipment such as pumps and piping bulkheads, required to protect and maintain uninterrupted flows in existing utilities during construction.
- B. The Contractor shall maintain all benchmarks, monuments and other reference points and, if disturbed, shall replace them at no additional cost to the City.
- C. Where excavations are to be made in paved or surface treated areas, the pavement shall be cut with a pavement saw or wheel cutter before excavation. In areas where the trench width is greater than anticipated, the pavement shall be re-cut before excavating to the greater width. In no case shall pavement be excavated beyond the cut line.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Fill materials, meeting the following requirements, shall be used in the areas shown on the drawings or where specified herein. Fill materials may be obtained from either on-site excavations or from off site sources as required.

##### 2.02 COMMON FILL

- A. Common fill shall be granular material, consisting of hard, sand and gravel with less than 35 percent passing the No. 200 sieve, free of organic matter, trash, roots or other deleterious material. Common fill material shall contain no stone measuring greater in any dimension than two-thirds of the loose lift thickness or 12 inches whichever is smaller. Common fill material shall be capable of forming a firm, stable base when spread and compacted in accordance with this specification. In addition, the common fill shall be non-plastic (plasticity index zero, defined as liquid limit minus plastic limit). Any materials, excavated from the site, not conforming to this specification, shall be disposed of as specified and replaced with approved material, as required, at no additional cost to the City.

##### 2.03 GRAVEL FILL

- A. Gravel fill shall consist of hard, durable gravel and sand, free from trash, organic matter and clay, surface coatings, and other deleterious materials.
- B. Gravel fill shall have a maximum stone size of two thirds of the loose lift thickness or 8 inches whichever is smaller. Gravel fill used for pipe bedding shall have a maximum stone size of 2 inches. That portion passing the 4 inch sieve shall meet the following gradation requirements, as determined by ASTM C136 and ASTM C117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
4 inch	100
1/2 inch	50-85
No. 4	40-75
No. 40	10-35
No. 200	0-10

2.04 SELECT FILL

- A. Select fill shall consist of hard durable sand or sand and gravel, free from trash, organic matter, clay, surface coatings and other deleterious materials. Select fill placed between the mid-height of a pipe and 12 inches above a pipe shall have a maximum stone size of 4 inches. Select fill used for other purposes shall have a maximum stone size of two thirds of the loose lift thickness and that portion passing the 4 inch sieve shall meet the following gradation requirements, as determined by ASTM C136 and ASTM C117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
4 inch	100
No. 10	30-100
No. 40	0-70
No. 200	0-15

2.05 CRUSHED STONE

- A. Crushed stone shall consist of clean, crushed, non-porous rock, or crushed gravel, uniformly blended, and shall conform to ASTM D448, size Number 6, 3/4 in. to 3/8 in. stone.

2.06 GRANULAR FILL

- A. Granular fill utilized as a bedding material from the mid-diameter of the pipe to the bottom of the excavation shall be crushed stone or gravel borrow meeting the following specifications:

1. Crushed stone shall consist of clean, crushed, non-porous rock, or crushed gravel, uniformly blended, and shall conform to the following tabulation of sizes as determined by ASTM D422 and D2217, Paragraph B:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
3/4 inch	90-100
1/2 inch	10-50
3/8 inch	0-20
No. 4	0-5

2. Gravel borrow shall consist of hard, durable stone and coarse sand, free from loam and clay, surface coatings and other deleterious materials. Gravel borrow shall be uniformly blended, and shall conform to the following tabulation of sizes as determined by ASTM D422 and D2217, Paragraph B:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
3 inch	100
1/2 inch	50-85
No. 4	40-75
No. 40	10-35
No. 200	0-8

3. Material removed from the trench excavation, satisfying the requirements for gravel borrow, shall be used for pipe bedding. However, it will be responsibility of the Contractor to have a sieve analysis performed by an independent testing laboratory to demonstrate that the excavated material meets the above specification. The number and frequency of the sieve analysis shall be at the descretion of the Engineer.

2.07 FILTER CLOTH

- A. filter cloth shall be Mirafi 140N, Carthage Mills FX-40HS, Amoco 4545 or equal approved by the City.

PART 3 EXECUTION

3.01 PREPARATION

A. Stripping

1. Prior to any excavation, filling, or grading operations, all topsoil and subsoil or similar organic soils found within the Limit of Work line shall be stripped to their full depth in the area of all structures and in all areas required to be filled, excavated or graded. Stripped materials suitable for re-use as loam shall be stockpiled. Stockpiles shall be kept separate and stabilized. Excess stripped materials and unacceptable materials shall be disposed of off site by the Contractor.
2. All excavated material from the City of Franklin right-of-way remains the property of the City of Franklin. The material may be disposed with permission of the City of Franklin.

### 3.02 EXCAVATION

#### A. General

1. Excavation shall consist of the removal of soil, rock, and other materials to the limits shown on the drawings, specified herein, and as required to provide firm bearing.
2. Earth excavation shall include all materials other than solid rock and detached rock or boulders exceeding 1 cu. yd. in volume.
3. Rippable rock shall be considered earth excavation. Rippable rock is defined as rock which can be excavated using a single tooth hydraulic ripper pulled by a D8 or equivalent dozer.
4. Excavated materials meeting the requirements for the various fill materials specified herein shall be stockpiled for reuse. Unsuitable or excess suitable materials shall be disposed of off site by the Contractor.
5. Excavation shall be to the limits shown on the drawing or, where limits are not shown, as necessary to install foundations, utilities, pavement or other facilities.
6. The proposed contour lines and spot grades shown on the drawings are finish elevations. Excavation to subgrade shall be the distance below these elevations as may be required by the size and thickness of pavements, structures, utilities and surface treatments as shown on the plans, details and sections, or as specified herein.
7. Excavating equipment shall be of such size and type, and used in a manner, that will not damage existing paved surfaces, utilities, structures, trees, etc. Rubber tired equipment shall be used for backfilling trenches in paved areas.

#### B. Trench Excavation

1. Trench excavation shall consist of the satisfactory removal of all materials encountered. Excavations shall be made to accommodate the elevation, depth of cover, or detail shown on the drawings or specified. Trench widths shall be kept to the minimum practicable but shall be at least 3 feet wide or 2 feet, plus the outside diameter of the pipe, whichever is greater. The bottom of the trenches shall be firm and free of water and shall be accurately graded and shaped to allow placement of required bedding beneath the bottom of all barrels, bells or couplings of all pipes installed. Trenches for utilities in fill areas shall be excavated after all fill materials have been placed, spread and compacted to an elevation at least one foot above the top of the proposed utility.
2. If, through the Contractor's error, the excavations are carried beyond the specified limits, or if inadequate dewatering causes softening of the subgrade which necessitates removal, backfill shall be with gravel fill as specified and installed in accordance with the requirements for compaction of pipe bedding.
3. When trenching occurs around trees to remain, the tree roots shall not be cut but rather, the trench shall be tunnelled under or around the roots by careful hand digging and without injury to the roots.
4. The Contractor shall excavate to provide a minimum cover over the top of pipe of 5 feet below finished grade unless otherwise shown. For pipes laid within a slope which rises above the adjacent roadway, the top of pipe shall be 5 feet below the top of the adjacent roadway. See Typical Trench Section.

#### C. Excavation in Graded Areas

1. Excavation in graded areas shall be performed as necessary to bring such areas to proper subgrade or finish grade as the case may be. Subgrade for grass areas shall be 6 inches below finish grade.

#### D. Rock and Boulder Excavation

1. Rock excavation shall include the excavation, removal and disposal of rock and all boulders 1 cubic yard or more in volume which require blasting or drilling and splitting.
2. Blasts shall be covered to prevent scattering of material and all adjacent property shall be suitably protected. Explosives shall be transported, handled and stored in a safe manner and in compliance with all state and local regulations. Charges shall not be so large as to shake, loosen or endanger adjacent structures or their contents or to do harm to their occupants. Responsibility for damage to persons or property shall rest solely with the Contractor. Only personnel qualified in the use of explosives shall be employed for blasting.
3. The Contractor shall design his blast pattern and use blast control methods to prevent detrimental effects to the rock outside of the excavation limits. All loose, unsound or semidetached rock fragments which may be detrimental to the proposed structure or installation shall be removed from the excavation. Excavation beyond the required limits, made to remove damaged rock shall be backfilled by the Contractor.
4. After blasting, the rock surface at subgrade shall be thoroughly cleaned of all vegetation, soil, excessively broken rock, excessively weathered or decomposed rock, loose fragments, ice, snow, and other objectionable substances. Picking, barring, wedging, streams of water, hammers, and other effective means shall be used as required to accomplish this cleaning. All free water left on the surface of the rock shall be removed. The Engineer shall be notified and provided the opportunity to observe the cleaned rock surface before any masonry, concrete, bedding, or fill is placed on or against the rock.
5. Where boulders are on the sides of or in the bottom of excavations, they shall be wholly or partially removed. In removing boulders lodged in the sides of the excavations, the Contractor shall not disturb or undermine adjacent pavement or structures. If pavement surfaces are damaged beyond reasonable limits, the Contractor shall repair such damage. In general, boulders or rock fragments which extend under paved surfaces shall be removed by blasting or mechanical splitting.
6. Unauthorized excavations in rock, or excavations made beyond or below the indicated or directed limits shall be refilled and compacted with approved gravel fill.
7. Depressions below the required grade resulting from the removal of boulders and rock fragments shall be refilled with compacted gravel.
8. Whenever provisions for a future connection are placed in pipelines in rock areas, the rock shall be removed for a distance of at least 3 feet, or more if directed, horizontally from the end or face of the pipe and in the direction of the future connection.
9. Rock encountered in areas where blasting is not permissible shall be removed by drilling and splitting using rock splitters, feathers and wedges, jackhammers or by hand.

#### E. Excavation of Unsuitable Materials

1. Existing soils, which are considered unsuitable foundation materials by the Engineer, shall be removed to the limits required. For pipelines, the horizontal limits are defined as one foot beyond the outside face of the pipe or a minimum of 3 feet whichever is larger unless otherwise directed or shown. For manholes and catchbasins, the horizontal limits are defined as 2.5 feet outside the inside face of the structure. The exposed subgrade shall be compacted and the area backfilled with gravel fill as specified.

### 3.03 TEMPORARY EARTH SUPPORT

- A. The Contractor shall design, furnish, install and maintain temporary earth support systems, as required, to prevent injury to persons, collapse of the sides of the excavation, and damage, disturbance and settlement of adjacent property. Sheet piling, bracing, trench box shall be of adequate type, size and strength for the conditions encountered and shall be driven to true alignment in a workmanlike manner. Temporary Earth support shall be in compliance with OSHA standards.

### 3.04 CONTROL OF WATER

- A. Contractor shall be responsible for obtaining all federal and state permits. Contractor shall provide a stormwater pollution prevention plan at the job site, as required by federal and state regulations.
- B. The Contractor shall provide and maintain all pumps, piping, drains, wellpoints, or any other facilities for the control and collection of groundwater or surface water. The dewatering operations shall be such that excavations are kept free from water at all times so that all construction work may be performed in the dry. Pumping shall be continuous where required to protect the work and to maintain satisfactory progress. All pipelines and structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected.
- C. Excavation shall be protected from flooding by surface water by use of berms, ditches or other suitable means.
- D. The Contractor shall dewater in a manner which does not cause loss of ground or disturbance to the bearing soil or soil supporting adjacent structures.

### 3.05 BACKFILLING TRENCHES AND AGAINST STRUCTURES

#### A. General

1. The requirements for pipe bedding and trench backfilling are described herein and are shown in the Typical Trench Section.
2. Pipe and/or structures shall be placed on specified bedding materials, to provide uniform support and a stable foundation for the pipeline or structure and backfill material. No bedding shall be placed on unstable subgrade soils. An unstable subgrade is defined as a condition of running sand, running silt, quick bottom, or otherwise soft, soupy or spongy bottom. If an unstable condition exists, or developed during the excavation, the Contractor shall excavate, dewater and stabilize the subgrade to the extent necessary to provide a firm stable foundation prior to placing bedding, pipe and/or structures.
3. The height of fill adjacent to structures and pipelines shall be increased at approximately the same rate on all sides to prevent displacement.

#### B. Trench Bedding

1. Pipelines and appurtenant items of work shall be laid in the bedding material, from the bottom of the excavation to the mid-diameter of the pipe, for the full width of trench. Bedding material shall be compacted to a minimum density of 95 percent of the maximum density as determined by ASTM Methods 1557 (Modified Proctor) and shall meet the requirements for ¾" crushed stone.
2. The type and thickness of bedding material will be determined based on field conditions, as follows:
  - a. The excavation shall be made to a depth of 6 inches below the bottom of pipe for placement of bedding material.
  - b. Where the bottom of the trench excavation is below the groundwater level and pumping of water is done from within the excavation, the Contractor shall use a bedding system which provides a stable working surface which limits the disturbance of the subgrade and prevents piping or washing of fine soils from the subgrade due to the flow of water into the trench. If the subgrade is stable and meets the requirements of gravel fill, excavation for 6 inches of bedding material is not required.
  - c. Where the subgrade soil type is a low or nonplastic silt (ML), silty or clayey sand (SM, SC), fine to medium sand (SP), or silty or clayey gravel (GM, GC), as defined by the soil classification system described in ASTM Standard Method D2487 (Unified System), a 2-layer bedding system shall be utilized, with an approved filter cloth to prevent migration of silt into the bedding material. The top layer of this bedding system, from the mid-diameter of the pipe to 6 inches below the bottom of pipe, shall be crushed stone as described hereinbefore, and the lower layer shall be at least 6 inches of gravel fill placed on top of the filter cloth. The filter cloth shall be continuous along the trench bottom, and shall wrap up the sides of the trench, to above the mid-diameter of the pipe. All joints in the filter cloth shall lap at least 18 inches.
3. No more than 6 inches of crushed stone bedding shall be placed beneath the bottom of any pipe or structure. If through an error in excavation, or the need to remove unsuitable material to greater depths than required to install the pipe bedding, the Contractor shall backfill this additional excavation with specified compacted Gravel Fill. Bedding material and Gravel Fill used to replace unsuitable material shall be placed in lifts not exceeding 6 inches loose measure and shall be compacted to a minimum density of 95 percent of the maximum density determined by ASTM Method D1557, (Modified Proctor).
4. If crushed stone is used as bedding material, a 12-inch wide impermeable clay cutoff barrier shall be installed across the trench from the bottom of the excavation to the mid-diameter of the pipe every 300 feet to prevent groundwater from flowing unimpeded along the pipe trench, through the crushed stone. Trenches for sewer pipes with slopes over 0.08 feet per foot and trenches for sewer pipes below seasonal high ground water level shall have impervious trench dams constructed every 300 feet to prevent potential disturbance to pipe bedding and blanket materials.

#### C. Trench Backfilling

1. Paved Areas: Backfill materials, meeting the requirements for Select Fill, having a maximum particle size of 4 inches, shall be installed above the mid diameter of the pipe to 12 inches above the pipe. All trenching shall be backfilled with either crushed surfacing materials conforming to Section 4-04 of the "Standard Specifications for Road and Bridge Construction". All trench backfill materials shall be compacted to ninety-five percent (95%) maximum dry density, as determined by

ASTM D-1557. If the existing material is determined by the City to be suitable for backfill, the Contractor may use the native material. Backfill compaction shall be performed in 8 to 12 inch lifts. The Contractor shall perform compaction tests. The test results shall be given to the City for review and approval prior to paving. Tests shall be performed at maximum intervals of 50 feet along the length of the trench.

2. Cross-Country Areas: In trenches through unimproved areas, pipe shall be bedded as specified. The remaining backfill shall be compacted to a minimum of ninety percent (90%) of maximum dry density, as determined by ASTM D-1557. Backfill materials placed from 12 inches above the pipe to the bottom of the roadway base course in paved areas or to the bottom of the loam in cross country areas shall meet the requirements for Common backfill. It shall have a maximum stone size of 6 inches. The backfill shall be placed in layers not exceeding 12 inches before compaction. Backfill shall be mounded 6 inches above original ground at cross country locations
3. All settlement shall be repaired by the Contractor at its own expense. Driving over trenches with trucks and/or excavation equipment will not be considered suitable compaction.
4. All surplus material shall be removed and disposed of by the Contractor after trenches have been backfilled. The removal of surplus material, cleaning up of trench surfaces along streets and premises shall closely follow the pipe laying.
5. Where hardened surfaces or roadways, driveways, or walls are dug up or interfered with, special attention shall be given to the backfilling operations before resurfacing.
6. The Contractor shall continually provide street sweeping on roadways used by his vehicles in order to reduce dust, siltation and nuisance problems.

#### D. Against Structures

1. Unless otherwise specified, backfill against structures shall meet the material requirements for Common Fill. No backfill whatever shall be placed on or against masonry, or other cast-in-place structures until the masonry has been in place a minimum of 7 days, or has been suitably braced. Backfill shall be uniformly distributed, and compacted to a minimum density of 90 percent of the maximum density determined by ASTM D1557, (Modified Proctor). All piping into structures shall have a joint within 2 feet of the exterior face of the wall.

### 3.06 SOIL TESTING

#### A. General

1. Three types of soil tests shall be performed by an approved soil testing laboratory furnished by the Contractor. The type of tests, timing and frequency are described below. The performance of these tests does not relieve the Contractor of his responsibility to control his operations and perform tests as necessary to assure that the work performed meets the requirements of the specifications.

#### B. Sieve Analysis Tests

1. Sieve analysis tests shall be performed on soil samples obtained by the Contractor for approval of material from off site borrow sources or from on-site excavations. Additional tests shall be performed on samples obtained from the fill when it is suspected by the City that the material does not meet specifications. Tests shall also be performed when it is noted that the gradation of material actually being placed differs significantly from the documented gradation from a particular source.

2. Sieve analysis shall be performed in accordance with ASTM C136 and C117.

C. In-Place Density Tests

1. The City will determine the location, number and timing of In-Place Density tests. In general, at least one test shall be performed for each 300 feet of pipeline installed. Structural and embankment fills shall be tested at least once for each 1,000 cu. yd. of fill placed. For structures and embankments, a minimum of four tests shall be performed during each of two separate visits by the testing laboratory. Tests shall be performed in accordance with ASTM D-1556 or ASTM D-2167. Additional tests shall be performed in areas where compaction is doubtful.

D. Moisture Density Relationship Test

1. Moisture Density Relationship Tests (Proctor Tests) shall be performed in conjunction with In-Place Density Tests for each different fill material tested. Tests shall be performed in accordance with ASTM D1557.

3.07 GRADING

A. General

1. The areas to be graded shall be raked or machine-graded to remove stones and other unsatisfactory material and then shall be compacted as specified. Any depressions which occur during the compaction operation shall be filled with additional suitable material and the surface then regraded and compacted until true to line and grade as required.
2. The work includes all grading required including shaping, trimming, compacting and finishing of the surfaces. The grading of shoulders and sloped areas may be done by machine methods. Up to 2 inches in 10-foot tolerance will be permitted on slopes over 2 percent, and 1 inch in 10-foot on slopes under 2 percent provided the slopes are uniform in appearance and without abrupt changes. All ruts shall be eliminated. Grading of subgrades for paved areas shall be finished at the required depth below and parallel to the proposed surface with 1/2 inch in 10-foot tolerance.
3. No stones larger than 4 inches in largest dimension shall be placed in the upper 6 inches of fill. Grading operations shall be completed after the buildings have been finished, the utilities installed, the site improvements constructed, and all materials, rubbish and debris removed from the site.

B. Paved Areas

1. The subgrade for areas on which pavement is to be placed shall be finished to the required depth below and parallel to the proposed pavement surface, after any pipes in the paved area are in place and tested.

C. Loamed Areas

1. The grading of the slopes and other areas to be loamed may be done by machine methods and a tolerance will be permitted in slopes as specified above, provided the slopes are uniform in appearance and without abrupt changes. All ruts shall be eliminated.

D. Finish Grades

1. Finish grades shall be as indicated, and unless otherwise specified, excavations and fills shall be carried to proper subgrade levels below finish grades and contours

shown, to allow for finish work.

E. Grading Around Trees

1. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:
2. When the existing grade at the tree is below the new finished grade and fill not exceeding 16 inches is required, crushed stone shall be placed directly around the tree trunk. The stone shall extend out from the trunk on all sides a minimum of 18 inches and finish approximately 2 inches above the finished grade at tree. New earth shall not be left in contact with the trunks of any trees requiring fill.
3. Existing trees in areas where the new finished grade is to be lowered, shall have regrading work done by hand to elevation as indicated. Roots as required shall be cut cleanly 3 inches below finished grade and scars covered with tree paint.

## SECTION 2B

### WATER MAINS AND APPURTENANCES

#### PART 1 GENERAL

##### 1.01 SCOPE

- A. The work of this section includes the furnishing of all labor, tools, equipment and materials and performing all operations necessary for the construction of water mains, fittings, valves, hydrants and other related items as specified herein and as shown on the drawings. All products and materials shall conform to the latest appropriate AWWA Standards, and as otherwise specified hereinafter.

##### 1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All pipe when shipped shall be packed and separated by wood separators such that pipe to pipe contact is prevented during transit or storage.
- B. The loading, trucking, unloading, and handling of pipe and appurtenant materials shall be done by the Contractor. Care shall be taken so as not to damage the pipe, appurtenant materials or the street surface. Dropping pipe, special castings, valves, hydrants, etc. directly from the trucks upon the ground will not be permitted. Suitable effective buffers or runners shall be provided. Metal chain shall not be used for lifting pipe materials. The Contractor shall be responsible for any damage done to the pipe or appurtenant materials until they are accepted in the completed work.
- C. Distribution of pipeline materials along the line of work will not be permitted, unless approved by the Municipal Services. The Contractor shall not obstruct driveways, sidewalks, walkways, etc., nor shall pipeline materials be placed on private property without the express written approval of the property owner.

##### 1.03 SUBMITTALS

- A. Shop drawings, brochures and samples shall be submitted for all items to be furnished to the City of Franklin for approval. These shall include but not limited to manholes, frames, covers, pipe, and brick.

#### PART 2 MATERIALS

##### 2.01 DUCTILE IRON PIPE

- A. All ductile iron pipe shall have push-on joints, except as may be otherwise noted. Pipe shall be designed for the rated working pressure in pounds per square inch shown below and for laying condition type 2 (flat bottom trench, backfill consolidated to centerline of pipe) and for 8 feet of earth cover. Thickness shall be as specified hereinafter. The grade of iron from which the pipe is made shall be 60-42-10, having 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength, and 10 percent minimum elongation. Pipe shall be Class 52.
- B. The interior of all ductile iron pipe shall be cement lined to twice the thickness specified in ANSI A21.4 (AWWA C104) and asphalt seal coated. Asphalt seal-coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphalt seal coat shall be a product acceptable to the National Sanitation Foundation (NSF) for use in potable water and shall be so listed in the most current NSF summary of

approved products (ANSI/NSF Standard 61). The asphalt seal coat shall be applied and cured in strict conformance with the coating manufacturer's cautions and instructions. The seal coat shall be applied by the pipe manufacturer under controlled factory conditions and field application is strictly prohibited. Exterior surface of buried ductile iron pipe shall be bituminous coated. Joints shall be rubber gasketed, push-on type in accordance with ANSI A21.11 and AWWA C 111. Fittings shall be furnished with restraining devices as specified herein.

## 2.02 RESTRAINED JOINTS

- A. mechanical joint restraint devices shall be used with all mechanical joints. Glands shall be manufactured of ductile iron conforming to ASTM A 536. Restrained joints shall be used at MJ pipe joints, fittings, valves, short pieces (less than 10 feet from MJ joint), etc., and where directed by the Municipal Services, and shall be Romac "Grip Ring", "Field Lok" gasket system, or approved equal.
- C. All joints with fittings are to be restrained. All restrained joints shall be assembled in strict accordance with manufacturer's instructions.

## 2.03 INSULATION

- A. Insulation for shall be 2-inch (min) thick rigid polystyrene thermal insulation in 4'X8' sheets having an R value of 10 and conforming to ASTM C 578, Type II and shall be Styrofoam HI-60 as manufactured by Dow Corning Chemical Company or approved equal.

## 2.04 FITTINGS

- A. Fittings shall be made in the USA.
- B. Fittings shall be mechanical joint type pressure rated, Class 350 minimum. Ductile iron compact fitting with double cement lining and seal coated inside and out in accordance with ANSI 21.4 and AWWA C 104. Fittings shall be complete with accessories, tee bolts shall be either ductile iron or corten per ANSI/AWWA A21.53/C-153.
- C. Branch of tees for hydrants or stubs shall be mechanical joint anchoring tees. They shall conform to ANSI Specifications A21.53 and A21.11 (AWWA C153 and AWWA C111) for joints and ANSI A21.4 A and AWWA C-104 for cement lining."

## 2.05 PLUGS AND/OR CAPS

- A. Furnish and install permanent pipe plugs, caps or blank flanges as shown on the drawings and/or as directed by the Municipal Services. The wetted surfaces of all plugs, caps, and blank flanges shall be cement coated and asphalt seal coated as specified hereinbefore for ductile iron pipe.
- B. Furnish and maintain on the project site temporary watertight plugs in the various sizes required for the water mains to be installed.

## 2.06 SOLID SLEEVE, FLEXIBLE AND TRANSITION COUPLINGS

- A. Solid sleeves shall be furnished and installed where shown on the drawings or wherever the intent for their use is indicated or may be required by the Municipal Services. Sleeve shall be cast iron with mechanical joints and complete with all accessories. Solid sleeves shall be as manufactured by Clow Corporation, or equal and shall be cement lined and

seal coated as specified hereinbefore for ductile iron pipe.

- B. Flexible couplings or transition couplings shall be furnished with approval of the City of Franklin. Flexible couplings shall be cast iron with rubber gaskets. Bolts shall be properly spaced to insure uniform gasket compression. Transition couplings shall be Ductile iron pipe coupling in conformance with ASTM A536-80 with SBR gasket in conformance with ASTM D2000 3 BA715 or approved equal. Flex couplings shall be as manufactured by Dresser Industries, Smith Blair, Romac or equal and shall be cement lined and seal coated as specified hereinbefore for ductile iron pipe.

## 2.07 VALVE BOXES AND COVERS

- A. Valve boxes shall be furnished and installed for all valves. They shall be cast iron, tar coated, sliding type adjustable valve boxes, with cast iron top-flange covers. The word "WATER" shall be cast into the cover.
- B. The bell end of the lower sections shall in all cases be sufficiently large to fit over the stuffing boxes of the valves. (Operating nut shall be centered in the bell end of the valve boxes.) The smallest inside dimension of the shaft shall not be less than 5 1/4 inches. Upper section shall have a flange sufficiently strong to furnish the bearing for that section so that all weight or jolting from street traffic or the like shall not be transmitted to the valve. Valve box extensions if required, shall be supplied at no additional cost to the Owner. Valves shall be Buffalo, Tyler or approved equal.

## 2.08 VALVES

- A. Gate valve shall be used for water main sizes 12-inch and less. All gate valves shall be manufactured in full compliance with the content and intent of this specification. Gate valves shall be 200 psi working pressure, vertical, plain non-rising stem, nut operated, open right with mechanical joint end connections. Valves shall comply with AWWA C509. Valves shall be resilient seat. Valves shall open right.
- B. Gate valves shall also conform to the specifications of the AWWA as to size of stem, pitch of thread, etc. When mechanical joint ends are specified for use, the gasket seating area shall be fully machined to fixed dimensions and tolerances as per AWWA specifications. All valves shall be provided with "O" rings. The design of the valve shall be such that the seal plate can be fitted with new "O" rings while the valve is under pressure in a fully open position.
- C. Gate valve interiors and exterior shall have a 100% solids thermoset or fusion bonded epoxy protective coatings, holiday-free in the waterway, which shall meet all requirements of AWWA C550. The epoxy coating shall not impart taste or odor to the water. The coating shall be a product acceptable to the National Sanitation Foundation (NSF) for use in potable water and shall be so listed in the most current NSF summary of approved products ANSI/NSF Standard 61. The coating shall be applied and cured in strict conformance with the coating manufacturer's cautions and instructions. The coatings shall be applied by the valve manufacturer under controlled factory conditions and field application is strictly prohibited.
- D. Butterfly valves shall be used for all pipe 16-inch and larger. Butterfly valves shall comply with AWWA C 504. Butterfly valves shall be Henry Pratt "Groundhog", Dresser BF or Allis Chambers steamseal. Butterfly valves shall open right.

## 2.09 FRICTION CLAMPS

- A. Friction clamps shall be carbon steel and of a design to restrain pipe joints, caps, plugs, or valves as shown or specified. Thrust rods shall be 3/4-inch minimum diameter carbon steel and the clamps and rods shall be capable of withstanding a sustained pressure of 150 psi and an intermittent pressure of 300 psi. Clamps, rods and associated hardware shall be protective coated. All exposed rods shall be asphalt coated twice after installation.

## 2.10 HYDRANTS

- A. Furnish break type flange, swivelhead 6-inch mechanical joint inlet nozzle with fusion bonded epoxy shoe. Hydrants of the following make and type:

Make and Model - American Darling B-84-B, Waterous, or Metroplitian Hydrant  
Type of Thread - National Standard  
No. Outlets two, 2-1/2" hose conn. one 4-1/2" steamer conn.  
Diameter Valve Opening - 5-1/4 inches (minimum)  
Diameter of Barrel - 7-1/4 inches (minimum)  
Hub - mechanical joint  
Direction of opening - open right  
Depth of Bury - 5'-6" minimum or to suit trench conditions  
Color - to match existing hydrants of the Owner.

- B. Hydrants shall be designed for 250 pounds per square inch working pressure and shall conform in every respect to the specifications adopted for hydrants by the AWWA. Hydrants shall be given two coats of quality paint before shipment.
- C. Hydrant barrel extensions shall be furnished and installed where directed by the Municipal Services on new hydrant installations. Extensions shall be as recommended by the manufacturer of the hydrant and shall include all couplings, pins, flanges, gaskets, nuts and bolts, etc., necessary to provide a complete and workable installation. If more than one type of extension is available, the Municipal Services shall direct the type to be provided.

## 2.11 WATER SERVICES AND PERMANENT BLOWOFFS

- A. Service Pipe

1. Service pipe larger than 1" diameter shall be copper tubing, Type K for buried service, and shall be American made, by a manufacturer approved by the Owner.
2. Service pipe 1" or less shall be copper tube type K or 3/4" service pipe shall be plastic service tubing manufactured from high molecular weight polyethylene and shall meet the extruded materials standard as defined by ASTM D-1248. Tubing shall be 3/4" CTS service tubing. Pipe and tubing shall be made from all virgin materials and conform to product standard ASTM D-2239. Tubing shall conform to ASTM D2737 and shall be NSF approved.
  - a. Piping shall have the specific use, class, size and manufacturer's name clearly printed at specific intervals. Service pipe shall be manufactured by Hastings Inc., or approved equal.
  - b. Pipe shall have a minimum working pressure of 160 PSI at 73.4 degrees F.
  - c. Pipe and tubing must be capable of maintaining pressures of 340 PSI at 73.4

degrees F for 1000 hours when tested in accordance with ASTM D-1598 and must have a minimum quick burst of 630 PSI when tested in accordance with ASTM D-1599.

- d. Piping compound shall comply with the regulations of the Food Additives Regulations under the Federal Food, Drug and Cosmetic Act of the United States Government.
- e. Piping shall be covered by a minimum of 50-year guarantee against rot, rust and electrolytic corrosion and a 25-year cost-of-replacement warrantee.
- f. All connections with the polyethylene services tubing shall contain a stainless steel insert for stability.

B. Service Boxes

- 1. Service boxes shall be Erie pattern and shall be tar coated, cast iron, sliding type with inlaid covers. Covers (plug cover) shall have the word "WATER" cast in the top, and shall be held in place with bronze bolts. Shaft shall be 2-1/2 inches inside diameter with extension rods, and be the extension type extending from 4 feet to 5 feet, 6 inches. Service box rod shall be stainless steel 1/2" diameter. Service boxes shall be as manufactured by Caldwell, Pioneer Foundries, or equal.

- C. Required Brass Goods shall include Corporation Stops, Curb Stops, Misc. Couplings, and Fittings. Castings shall be sufficiently heavy to meet all service conditions without springing or leaking and be clean and free from roughness both inside and out. Waterways shall be smooth, full size and free from obstruction.
- D. Nuts shall be of commercial bronze containing not less than 89 percent copper and finished on both sides to true faces. Adjusting nuts shall also come to a true facing against bottom of the bronze washer, and proper adjustment shall be made to assure easy turning and freedom from leakage. Adjusting nuts shall be properly locked to the stop plug to avoid change in position in operation of stop.
- E. Curb and corporation stops shall be Ford Ball Valve, or equal.
- F. Corporation stops and curb stops shall open right, and shall be of the compression type.
- G. Compression fittings for joining copper tubing shall be Dresser Style 88, or equal.
- H. Couplings for connecting copper to cast iron pipe shall be brass and both ends shall be compression type with grip joint. Couplings as manufactured by Ford Meter Box Company, Hays, or Mueller.
- I. All permanent blow-offs shall be comprised of a 1-inch corporation stop, a 1-inch curb stop, a 4-foot length of 1-inch type K copper tubing, two 1-inch elbows, a 4-1/2 foot length of 1-inch type K copper pipe, a 3/4-inch x 1-inch hose bib adapter, a 3/4-inch cap, and a cast iron gate box and cover (as specified previously).
- J. Service saddles shall be 304 stainless steel, suitable for use with ductile iron and cast iron water mains and corporation stops specified. Saddles shells shall be 304 stainless steel, fully passivated. Service saddles shall have CC thread. Gasket shall be NBR compounded for water service. Tapped outlet shall be 304 stainless steel. Stainless steel saddles shall be double bolt, Model "306", as manufactured by Romac Industries, Inc., or approved equal by Ford Meter Box Co., Cascade Waterworks Mfg. Co., or Mueller Co. Saddles shall meet all applicable parts of AWWA C800.

- K All water services shall have a water meter as required by the City. All water services with greater than 60 psi of pressure shall have a pressure reducing valve (this shall be shown on the plans). Water services with sprinkler connections shall have backflow preventers.
1. Backflow preventors shall be reduced pressure devices conforming to AWWA C506, and shall be acceptable to the **New Hampshire Department of Environmental Services** and by the City of Franklin.
  2. Backflow preventors shall be constructed of bronze, with 316 stainless steel trim including all valve seats, valve shafts. Units shall be supplied with bronze body ball valve test cocks. Units shall be suitable for continuous service at 150 psi.
  3. Approved non-testable double-check backflow prevention devices will be required for residential use. Any American Water Works Association (AWWA) or University of Southern California (U.S.C.) approved dual-check is acceptable. Example: Watts #7 or Ford (Style kh-hhch-1).
  4. Non-residential or lawn irrigation system installations shall require either a testable double-check (DCVA) or a reduced pressure principle (RP) device. The Contractor is to contact the department, to arrange for a sanitary survey and/or site analysis for confirmation.
  5. Backflow preventors shall be Watts Model No. 909 QTS, Hersey/Beeco Model 6CH, or approved equal.

#### 2.12 TAPE

- A. Detectable Tape shall be 6" polyethylene, suitable for burial and labeled "water".

#### 2.13 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves and valves shall conform to the most current AWWA specifications for tapping sleeves and valves.
- B. Tapping sleeves shall be 304 stainless steel tapping sleeve with a fully circumferential seal and 304 ss nuts, 304 ss w/teflon coated bolts, shall be "SST" or approved equal.
- C. Prior to ordering the sleeve, the Contractor shall check the dimensions of the pipe on which the tapping sleeves are to be installed.

### PART 3 EXECUTION

#### 3.01 INSTALLING WATER MAINS AND APPURTENANCES

- A. Pipes shall be thoroughly cleaned before being laid. Particular attention shall be paid to the proper positioning of the rubber gaskets. Under no conditions will the Contractor be allowed to "pop" the pipe home. Only approved methods such as driving the pipe home with a bar and block, by using the bucket of the backhoe to push the pipe home (utilizing a block in front of the bell to push against), or other methods as may be approved by the Municipal Services will be allowed. Special care shall be used in following the Manufacturer's instructions for pipe joint systems. Water main shall be buried a minimum of 5'-6".

- B. Temporary watertight plugs shall be utilized at the end of each working day to prevent the intrusion of silt, debris and water into the mains. When working in areas with a high potential for flooding the main from groundwater, streams, storm drains, sewers or other water mains, or as directed by the Municipal Services, temporary plug shall be provided on each pipe length.
- C. In the event of flooding of the main, all pipe laying shall cease until the mains have been thoroughly cleaned and observed by the Municipal Services.
- D. When joined together, pipes shall form a smooth continuous line and grade on straight sections of the road and on curved sections (both vertical and horizontal) shall have uniform deflections within the required limits and conforming in general to the line and profile of the adjacent roads. Location of rubber rings shall be determined with a checking gauge before backfilling the pipe.
- E. Pipe shall be joined and laid in accordance with the manufacturer's latest published instructions and AWWA C600 for Gray and Ductile Cast Iron Water Mains and Appurtenances, (or ASTM-D2321 for PVC Pipe).
- F. Pipe shall not be laid with deflection of more than one-half the maximum deflection as recommended by the manufacturer.
- G. Backfill shall be placed on both sides of the pipe and compacted simultaneously with approved tamping bars for the full length of pipe. Backfill shall be placed on both sides of the pipe and compacted simultaneously with approved tamping bars for the full length of pipe. Bell or coupling holes shall be excavated as necessary to ensure that the pipes and not the pipe bells or couplings are bearing the weight of backfill and the traffic load. A minimum of three feet of compacted soil is required over pipe, with a maximum lift depth of 1 foot. Water pipe must be placed on a 6" sand cushion and covered with a 12" layer of compacted sand. When unsuitable material is encountered below grade it shall be remove and replaced with crushed stone or gravel fill.
- H. Pipe shall not be laid in areas where excavation has been carried below trench grade, or where water conditions create unstable bottoms, until the trench is excavated, refilled and compacted to the satisfaction of the Municipal Services.
- I. Bells or other joints shall not be installed directly under existing utilities or structures. Use short or random lengths to avoid such conditions.
- J. Water marking tape shall be installed 24" over all newly installed pipe.
- K. The requirements of the State of New Hampshire, Department of Environmental Services, Water Supply Statutes (2006 in relation to water mains to sewer mains shall apply as required State regulations require water mains to be separated from sanitary sewer mains by a minimum of 10-feet (horizontally). Should a sewer main cross a water main, the sewer must be replaced with ductile iron pipe/PVC pressure pipe for a minimum distance of 6-feet in each direction or until the required separation is achieved. Pipe joints shall not be located within 6 feet of the crossing. A minimum of 18- inches vertical separation shall be maintained at all crossing.
- L. Trench excavation and backfill shall be in conformance with utility excavation and EARTHWORK specifications requirements of the City of Franklin.

### 3.02 INSULATION

- A. Where pipe has less than 5-6" feet of cover, the pipe shall be insulated with materials as specified.
- B. Should water main be less than 2 feet separation from storm drain manhole or storm sewer then 2 " rigid polystyrene thermal insulation with an "R" value of 10 will be required for a distance of 8 feet.

### 3.03 MECHANICAL JOINTS

- A. Mechanical joints shall be an approved type with the required joint accessories, gaskets, cast iron follower glands with drilled bolt holes, cast iron tee head bolts, hexagonal nuts, etc. Torque wrenches shall be used to take up the joints. Wrenches shall be equipped with adjusting breakable tension gauge, set to break the tension at the tension loading recommended by the manufacturer.
- B. Mechanical joints shall be made to secure tight joints. Every means shall be taken to secure this result. Where required, joints shall have a deflection of not more than one-half the recommended maximum deflection allowed by the standards of CIPRA.
- C. Retainer glands tie rods or a combination of poured concrete thrust blocks and retainers must be used on all mechanical fittings. Tie rods (4) shall be coated with approved rust proofing agent.

### 3.04 CUTTING OF PIPE

- A. All cuts of ductile iron pipe shall be made with either an electric, pneumatic, or gasoline driven power saw. Blades shall be carbide tipped for cutting cement lined ductile iron pipe. Hydraulic cutters may be used for cutting cast iron pipe, provided the cement lining is not damaged by this method.
- B. When lengths of ductile iron pipe are field cut to provide for short lengths, the outside of the cut ends shall be tapered back about 1/8 inch at an angle of 30 degrees with the centerline of the pipe, before field cut pieces are used in the push-on type joints.

### 3.05 HYDRANT BRANCHES

- A. Furnish and install hydrants on hydrant branches where shown on the drawings or where directed by the Municipal Services. Each branch shall consist of a valve anchoring tee, 6-inch gate valve (mechanical joint) and one 6-inch ductile iron, mechanical joint nipple of the required length. The base of the hydrant shall be set on a concrete pad where required. Hydrants shall be restrained with bitumastic coated thrust rods. Hydrant barrel extensions shall be installed where necessary to provide a hydrant elevation acceptable to the Municipal Services. A 1/2 cubic yard hydrant drainage well shall be built at each hydrant location, using 2-inch stone placed in the excavation below and around the hydrant bottom. A concrete thrust block shall be placed between the hydrant and the undisturbed soil to overcome thrust where required by the Municipal Services.
- B. Following final project cleanup, all hydrants shall be given one field coat of paint, which shall be compatible with, and match the type and color given by the manufacturer (to match existing system hydrants).

### 3.06 CONNECTIONS TO EXISTING MAINS

- A. At least 24 hours prior to connecting to any existing water main, the Contractor shall

notify the water department. At no time shall the contractor operate any existing system valve. All such operations shall be performed by water department personnel. Prior to connecting or disconnecting any fire sprinkler service line, the Contractor shall notify the fire department, water department and a responsible party at the building(s) being serviced by the line.

- B. Make all taps, (wet) into the various water pipes, and install the required sleeves, tees, couplings, adapters, reducers, pipe nipples, jointing materials, and other fittings which may be required and make all joints watertight, as shown on the drawings or as specified herein, and do whatever work is shown or intended to be done in order to make complete and effective connections to existing water mains.
- C. The cutting, removal, plugging, and bracing of parts of the existing water mains made necessary by this work, and the shutdown of the existing water system, and subsequent pumping, hand excavating and whatever time that may be required by the Owner to notify customers of discontinuation of water service, time required to effect tight closures of existing valves, and any reasonable changes that may be required by the Municipal Services, or any other work done hereunder shall be considered as an obligation of the Contractor to complete the work. No additional compensation will be made for such work, other than that directly covered by the applicable bid items listed in the proposal.
- D. The work shall be coordinated with the Owner and such connections that may be required shall be made at such times and in such a manner as to cause as little interference in water service within the existing system as practicable.

### 3.07 CONCRETE THRUST BLOCKS AND FRICTION CLAMPS

- A. Furnish and place cement concrete in such locations and quantities as may be required by the Municipal Services. Concrete thrust blocks shall not be allowed unless specifically approved by the City.
- B. Concrete shall be of proportions, 1 part cement to 2 parts sand and 4 parts coarse aggregate, as approved by the Municipal Services.
- C. Care shall be taken to ensure that all concrete thrust blocks bear against undisturbed trench walls, and not to encase flanges and bolts on mechanical joint fittings.
- D. Thrust block bearing areas and volumes shall conform to the minimum dimensions found in the "Vertical and Horizontal Anchoring", available from the City for the various soil and fitting types noted. Where unsuitable bearing material is encountered, the Contractor shall excavate and place sufficient concrete ballast, to offset the anticipated thrusts.
- E. Precast thrust blocks may only be used for hydrant installations when authorization is obtained from the Municipal Services.
- F. Thrust rods shall be used in conjunction with concrete thrust blocks for each hydrant installation or as otherwise directed by the Municipal Services.
- G. Friction clamps and thrust rods shall be installed in accordance with the manufacturer's instructions, as directed by the Municipal Services. All exposed rods shall be coated twice with asphaltum after installation.

### 3.08 VALVE BOXES

- A. Valve boxes shall be cut with a wheel cutter, if it becomes necessary to cut them to adjust

for height.

- B. Valve boxes shall be properly centered and plumbed over the operating nuts of valves and adjusted to the proper height to correspond to the finished street or ground surface.
- C. Valve boxes shall be installed with a cushion of sand between the valve and the valve box. In wet areas, washed stone is to be placed around valve box wrapped by geotextile fabric to separate stone from existing soil.
- D. Valves greater than 10" must be supported during installation.
- E. All main line valves at pipe intersections (including hydrant valves) must be placed within 2 feet of tees.

### 3.09 SERVICE CONNECTIONS AND PERMANENT BLOW-OFFS

- A. All services shall be connected to the new main as directed by the Owner, the Municipal Services, and as specified herein. Services shall be connected after the new main has been tested, chlorinated and approved for service. The work shall be scheduled and executed to result in a minimum disruption of service to water customers.
- B. Only "wet taps" shall be made into new water mains unless specifically authorized otherwise by the Municipal Services. Corporation stops, water service pipe, new curb stops (if required), new service boxes (if required), fittings, etc., shall be installed, and all joints shall be made water tight. Services shall be installed to the limits and at locations directed by the Municipal Services, utilizing to the fullest the existing materials.
- C. Prior to excavating for the service connections, all sod on established lawns shall be stacked. Shrubs, hedges, fences, trees, etc. that may require removal or are damaged by construction operations, shall be removed and replanted or replaced.
- D. The Contractor shall install Service pipe beneath paved surfaces and sidewalks wherever possible, by jetting, jacking, boring or pulling the existing service pipe. Breaking up of existing pavement will not be permitted if jetting, jacking, boring, or pulling the pipe is possible.
- E. Equipment with rubber-tracked wheels shall be used to excavate and backfill within a paved road surface of an established lawn, unless waived by the Municipal Services.
- F. Water mains shall be tapped in accordance with the manufacturer's latest published recommendations, i.e., depth of tap, number of threads exposed, allowable sizes, etc., and the Contractor shall adhere strictly to these recommendations. The Contractor shall be held responsible for all subsequent leaks or failure of the taps for one year from the date of final acceptance of the project and he shall make all necessary repairs that may be required during this period.
- G. Drills or taps shall be inspected frequently for signs of wear, and in general the Contractor shall not exceed the number of taps specified by the manufacturer before reconditioning or replacement. Service pipe shall be cut only with approved wheel cutters.
- H. Service pipe shall be laid to a minimum depth of 5 feet, and laid in a straight line wherever practicable to the structure to be serviced or to the point of termination of existing service.

- J. The Contractor shall excavate at the existing water main to confirm location prior to starting, if required by City
- K. Where required, the Contractor shall flush all new services before connecting to the existing water service. The Contractor shall also assist Water Department personnel is flushing service lines if sediment or debris from existing mains plugs piping or meters, as a result of the work under this contract.
- L. A contractor installing a new or larger water service shall be responsible for properly discontinuing the abandoned service connections. The contractor shall not disconnect any service connections without the proper authorization from Municipal Services.
- M. Discontinued service connections are normally retired at the water main. A copper service can be cut and capped at the property line should circumstances exist where access to the water main is impracticable. Discontinued service connections of lead or iron piping shall be abandoned at the water main.
- N. Saddles are required for service taps; and double strapped saddles with a CC (AWWA) thread is required for service taps over 1" on mains larger than 6" diameter.
- O. Curb boxes shall not be set in driveways or walkways unless field conditions do not permit the installation. The City of Franklin's Representative shall be contacted if the requirement cannot be met prior to the installation.
- P. Adjacent curb boxes must be set at least 4-feet apart.

### 3.11 FLUSHING

- A. All new water mains, and existing water mains that have been drained and cut-into for making connections, shall be thoroughly flushed prior to pressure or leakage testing or final chlorination. Each section of main shall be slowly filled with water. Flushing shall be accomplished by partially opening and closing valves, hydrants, and blowoffs, etc., several times, under expected line pressure, with flow velocities of not less than 2.5 feet per second, in the main(s)

### 3.12 PRESSURE TESTING

- A. All new water mains, or any valved sections thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure that will exist at the point of testing, or 200 psi, whichever is greater. All pressure and leakage testing must be done in accordance with AWWA C 600.
- A. Test Pressure Restrictions. Test pressures shall:
  1. Be of at least 2-hour duration.
  2. Be not less than 1.25 times the expected system working pressure at the highest point along the test section.
  3. Not exceed pipe or thrust-restraint design pressures.
  4. Not vary by more than  $\pm 5$  psi for the duration of the test.
  5. Not exceed 2-times the rated pressure of the valves or hydrants when the pressure boundary includes closed gate valves or hydrants. Note: Valves shall not be operated in either direction at differential pressure greater than the rated pressure.
- B. Air Removal

1. Following flushing, and before applying the specified test pressure, air shall be completely expelled from the pipes, valves, and hydrants. After all air has been expelled, the air blowoffs can be closed, and the test pressure applied.

C. Pressure Test

1. Each valved section of pipe shall be slowly raised to the specified test pressure for two separate periods. The first period shall be for 15 minutes, after which the pressure in the main(s) shall be allowed to drop slowly back to system pressure. The pressure shall then be slowly raised again to the specified test pressure and maintained for 2.5 hours. The test pressure, as defined in Article 3.03 and Paragraph 3.03A above, shall be based on the elevation of the lowest point of the pipe, or section under test, and shall be corrected to the elevation of the test gauge, as directed by the Municipal Services. The test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Municipal Services, and which will prevent any backflow into the existing system. Valves shall not be operated in either the closing or opening direction at differential pressure greater than the rated pressure.

D. Examination

1. Any exposed pipe, fittings, valves, hydrants and joints shall be carefully examined during the test. Any damaged or defective pipe, fittings, hydrants, or valves discovered following, or as a result of the pressure test shall be repaired or replaced with sound material. If faulty materials are removed and replaced, the pressure test(s) shall be repeated until satisfactory to the Municipal Services.

3.13 LEAKAGE TEST

A. The leakage test shall be conducted concurrently with the pressure test.

1. Leakage Defined

- a. Leakage shall be defined as the quantity of water that must be pumped into the new main, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure, after the main(s) have been filled with water and all air has been expelled. Leakage shall be recorded to the nearest one-tenth of a gallon, by means of a calibrated test meter. If allowed by the Municipal Services, drawdown may be measured in a calibrated barrel. All records and charts shall become the property of the Municipal Services. The Contractor shall employ qualified personnel throughout the testing. Leakage shall not be measured by a drop in pressure over a period of time.

2. Allowable Leakage

- a. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD(P^{0.5})}{133200}$$

where

L = allowable gallons of leakage per hour

S = the length of pipe tested, in feet

D = the nominal pipe diameter in inches

P = the average test pressure during the test, in psi

- b. This formula is based on the allowable leakage of 11.65 gallons per day, per mile of pipe, per inch, (nominal) of pipe diameter, at a pressure of 150 psi. Allowable leakage at various pressures, for various pipe diameters is shown in Table 2.

TABLE 2  
ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE\*  
NOMINAL PIPE DIAMETER - IN.

Average Test Pressure psi	6	8	10	12	16	20	24	30	36	42	48
450	0.95	1.27	1.59	1.91	2.55	3.18	3.82	4.78	5.73	6.69	7.64
400	0.90	1.20	1.50	1.80	2.40	3.00	3.60	4.50	5.41	6.31	7.21
350	0.84	1.12	1.40	1.69	2.25	2.81	3.37	4.21	5.06	5.90	6.74
300	0.78	1.04	1.30	1.56	2.08	2.60	3.12	3.90	4.68	5.46	6.24
275	0.75	1.00	1.24	1.49	1.99	2.49	2.99	3.73	4.48	5.23	5.98
250	0.71	0.95	1.19	1.42	1.90	2.37	2.85	3.56	4.27	4.99	5.70
225	0.68	0.90	1.13	1.35	1.80	2.25	2.70	3.38	4.05	4.73	5.41
200	0.64	0.85	1.06	1.28	1.70	2.12	2.55	3.19	3.82	4.46	5.09
175	0.59	0.80	0.99	1.19	1.59	1.98	2.38	2.98	3.58	4.17	4.77
150	0.55	0.74	0.92	1.10	1.47	1.84	2.21	2.76	3.31	3.86	4.41
125	0.50	0.67	0.84	1.01	1.34	1.68	2.01	2.52	3.02	3.53	4.03
100	0.45	0.60	0.75	0.90	1.20	1.50	1.80	2.25	2.70	3.15	3.60

\* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

- 1) When testing against closed metal seated valves, an additional leakage shall be allowed per closed valve, of 0.0078 gallons per hour, per inch of nominal valve diameter.
- 2) When hydrants are in the test section, the test shall be made against the closed hydrant(s).
- 3) Zero leakage will be allowed on bridge crossings or jackings or borings.

### 3. Acceptance

- a. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe discloses leakage greater than that specified above, the Contractor shall, at his own expense locate and make repairs as necessary until the leakage is within the specified allowance.
  - 1) All visible leaks are to be repaired regardless of the amount of leakage.
  - 2) All water mains shall be pressure and leakage tested in the presence of the Municipal Services, in order to qualify for acceptance.

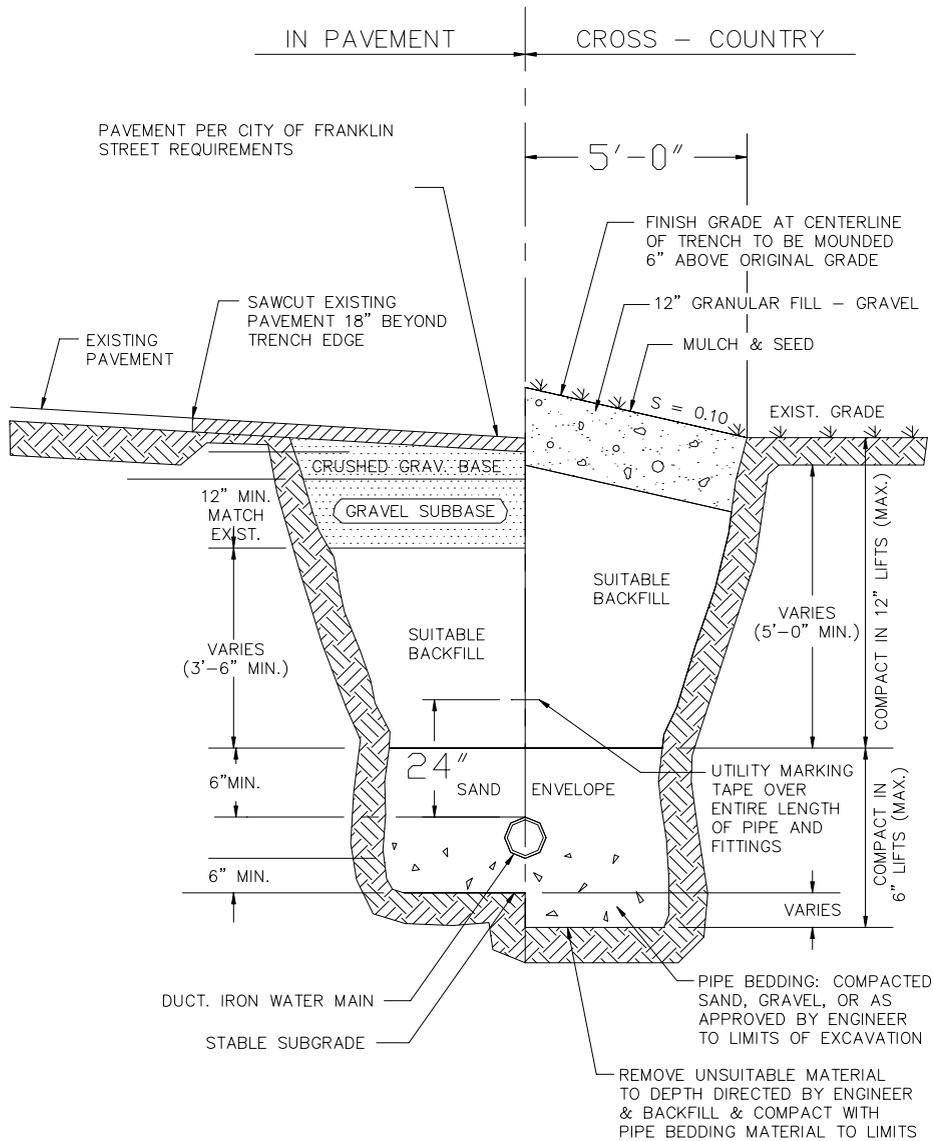
#### 3.14 CHLORINATION OF NEW MAINS

- A. All water mains greater than two inches in diameter must be disinfected. Disinfection shall be in accordance with the American Water Works Association (AWWA) standard C651(Disinfecting Water Mains). The contractor will use a liquid disinfectant to clean the pipeline. The chlorine solution shall remain in the pipeline a minimum of 24 hours.
- B. Standard Conditions: After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line, shall be tested for bacteriological quality in accordance with Standard Methods, and shall show the absence of bacteria. Samples shall be collected a minimum of 16 hours after the replacement water has occupied the water main.
- C. Samples for bacteriological analysis shall be collected, in the presence of the City of Franklin representative, in sterile bottles treated with sodium thiosulfate as required by Standard Methods. No hose or fire hydrant shall be used in collection of samples. A corporation cock shall be installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained, by the Contractor for future use.
- D. The Contractor shall deliver samples to the Department of Environmental Services (NHDES) laboratory, or other approved laboratory by the City of Franklin for bacterial analysis. Only after the samples are approved shall the mains be incorporated into the water system. In the event, that positive reports of contamination are received, the mains shall be flushed and chlorinated as many times as may be necessary to obtain approved (negative) results.

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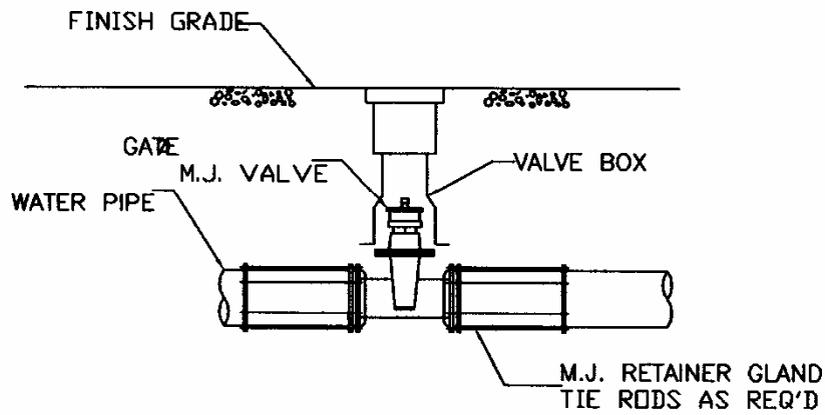
**City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH**

Water Trench Construction

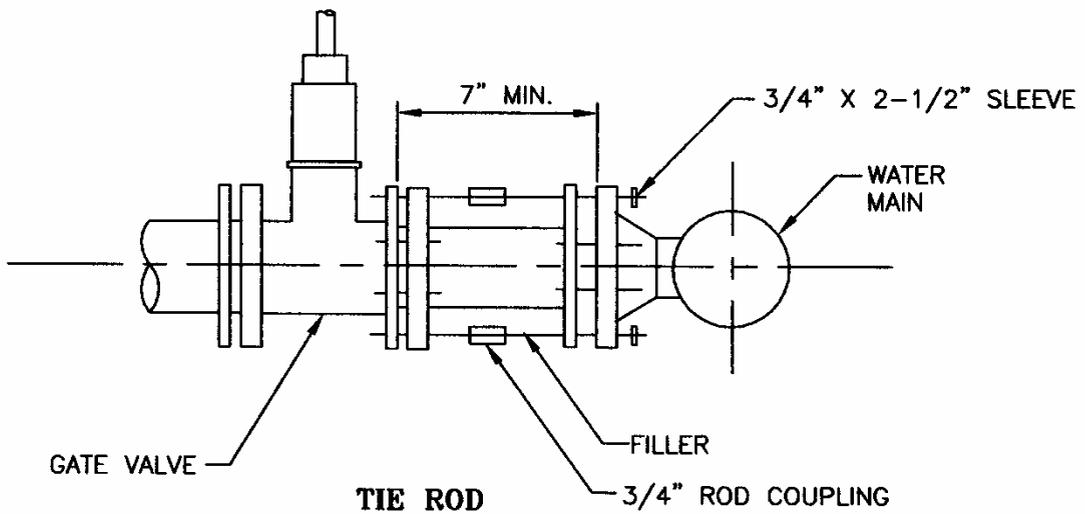


City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH  
Valve Detail

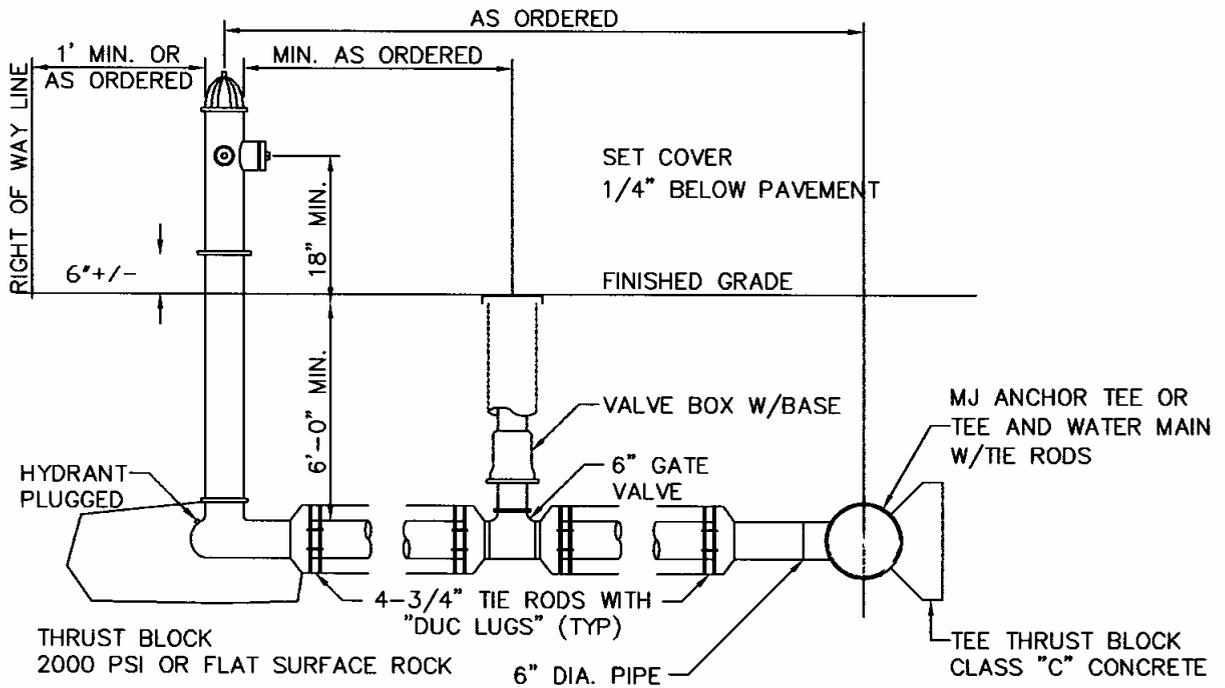
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**VALVE DETAIL**  
NTS

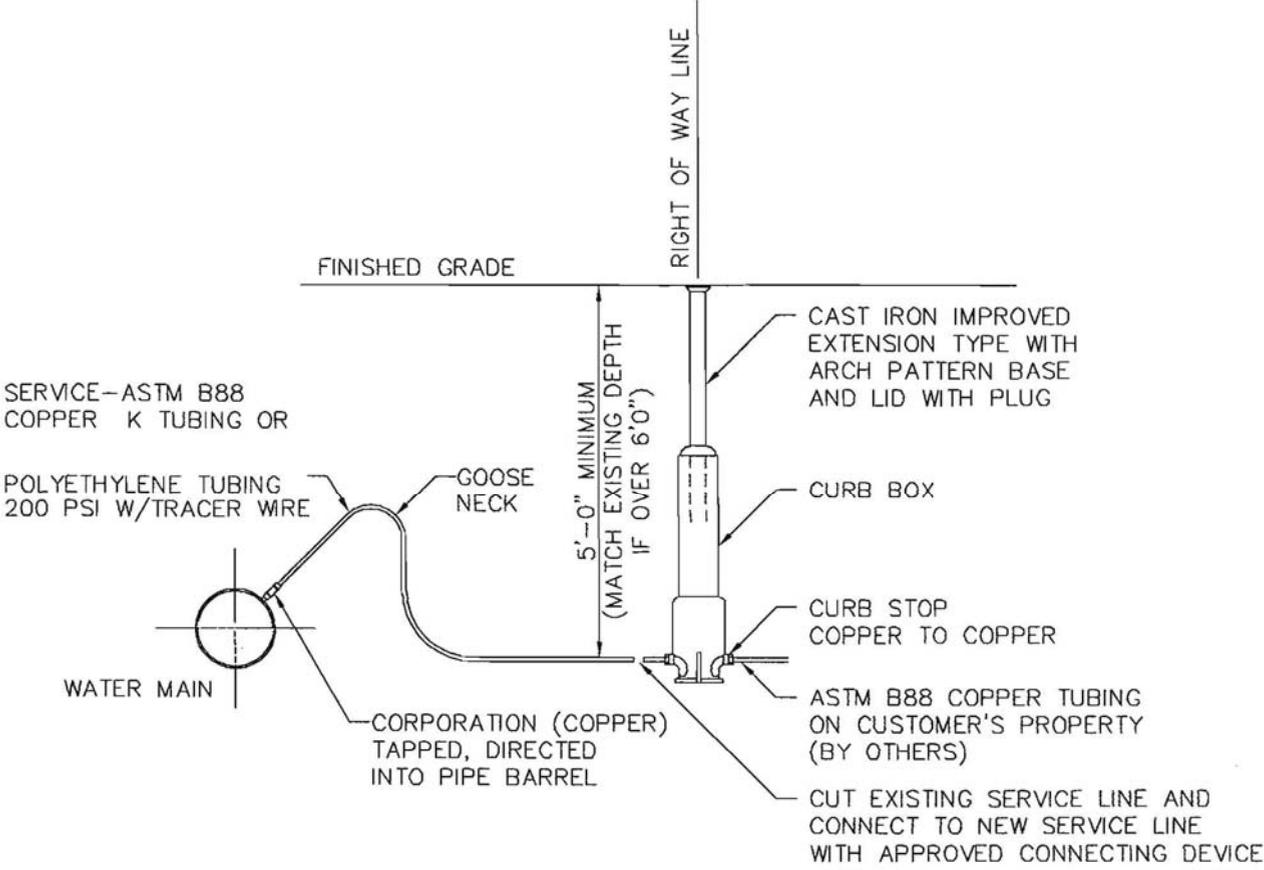


**City of Franklin**  
**Municipal Services Department**  
**43 West Bow Street**  
**Franklin, NH**  
Hydrant Detail



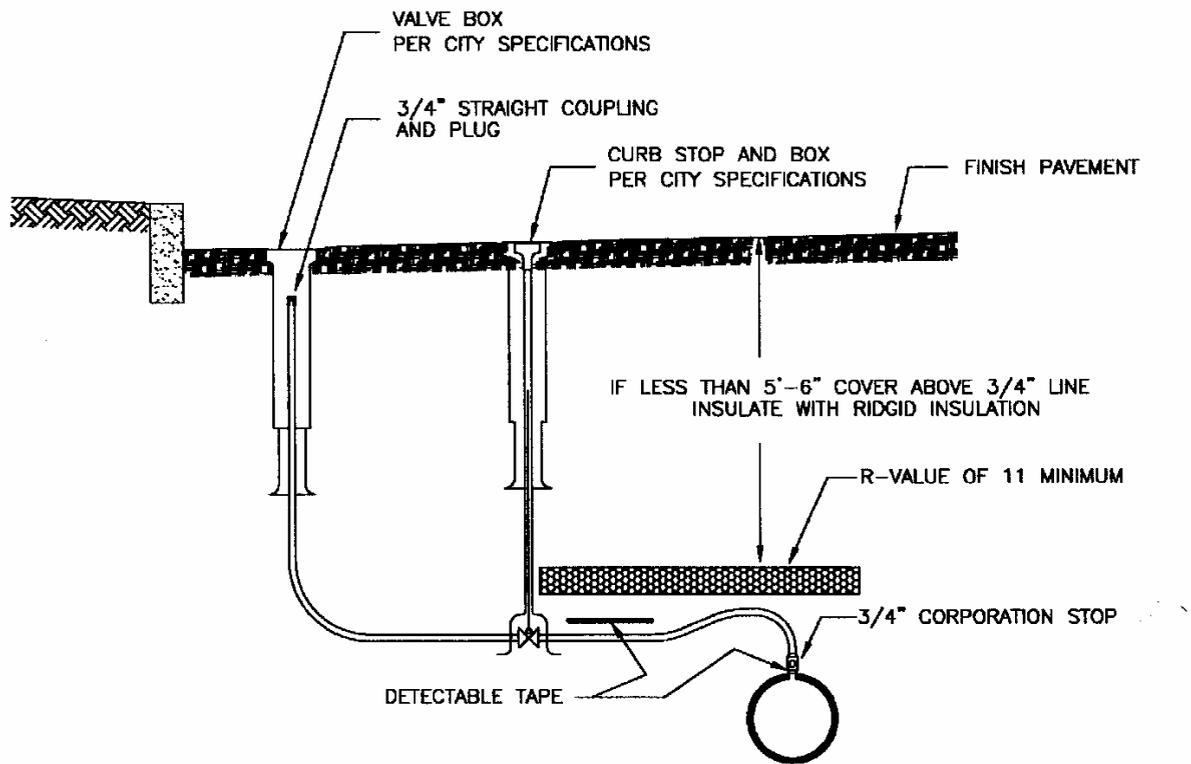
NOTE: HYDRANT DRAIN SHALL BE PLUGGED  
 THRUST BLOCK SIZED FOR SOIL BEARING CAPACITY

**City of Franklin**  
**Municipal Services Department**  
**43 West Bow Street**  
**Franklin, NH**  
Service Connection Detail



City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH

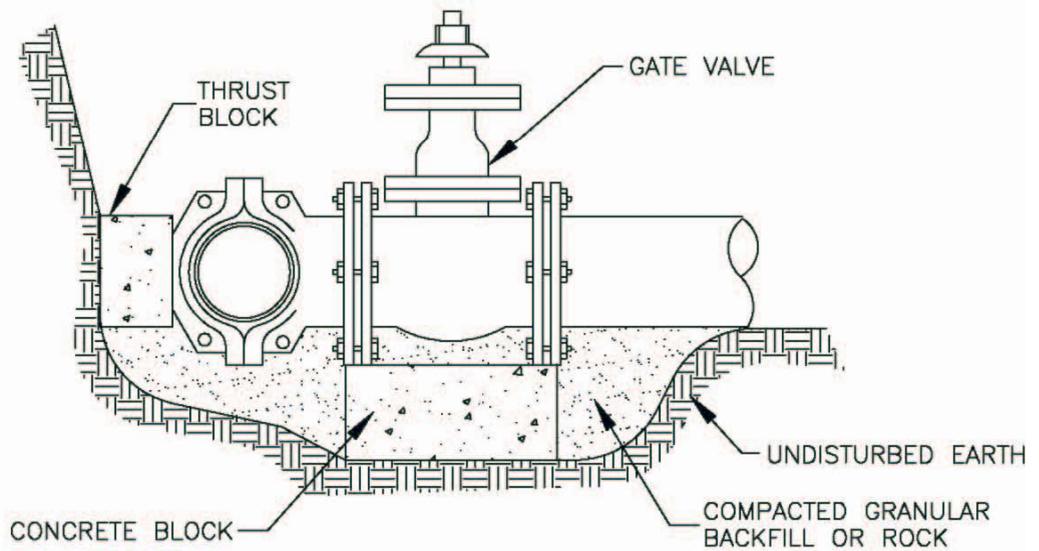
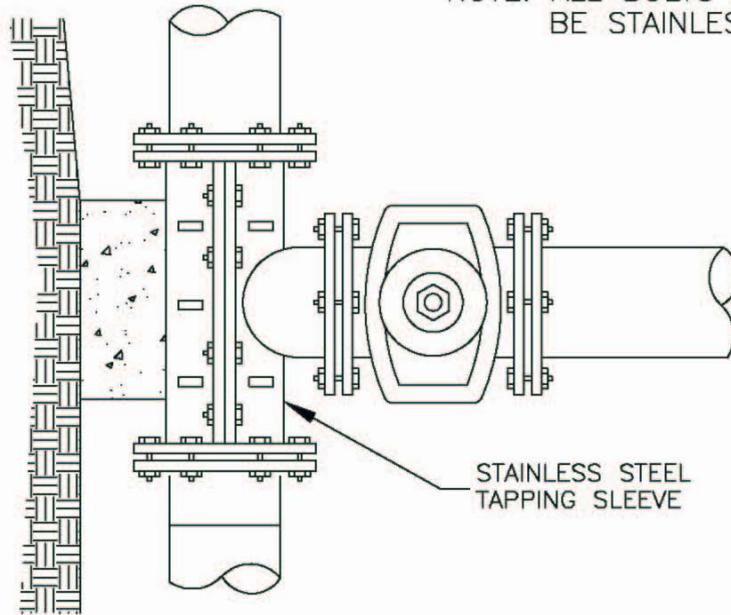
Air Release Valve



**City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH**

Water Main Wet Tap

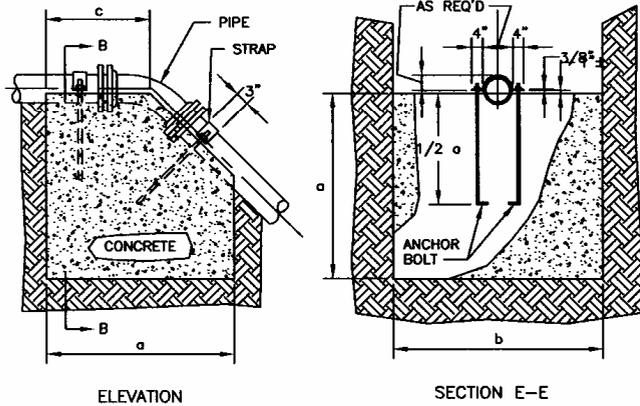
NOTE: ALL BOLTS MUST  
BE STAINLESS STEEL.



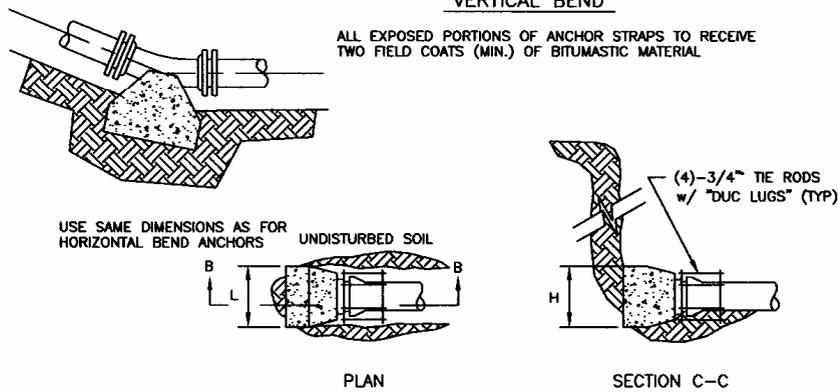
**City of Franklin**  
**Municipal Services Department**  
**43 West Bow Street**  
**Franklin, NH**  
Vertical Thrust Block

Mechanical Restraint shall be used on all fittings, thrust blocks shall only be used with special permission from City of Franklin

VERTICAL ANCHOR DIMENSIONS													
UP TO 150 P.S.I. WORKING PRESSURE													
PIPE SIZE	45° BEND				22 1/2° BEND				11 1/4° BEND				
	DIMENSION			ROD DIA.	DIMENSION			ROD DIA.	DIMENSION			ROD DIA.	
	a	b	c		a	b	c		a	b	c		
4"	3'-0"	3'-0"	2'-0"	3/4"	2'-6"	2'-3"	1'-6"	3/4"	2'-0"	2'-0"	1'-6"	3/4"	
6"	3'-0"	3'-0"	2'-0"	3/4"	2'-6"	2'-3"	1'-6"	3/4"	2'-0"	2'-0"	1'-6"	3/4"	
8"	3'-6"	3'-6"	2'-6"	3/4"	3'-0"	3'-0"	1'-9"	3/4"	2'-6"	2'-6"	1'-3"	3/4"	
10"	4'-3"	4'-0"	3'-0"	3/4"	3'-6"	3'-3"	2'-0"	3/4"	2'-9"	2'-9"	1'-6"	3/4"	
12"	4'-9"	4'-6"	3'-3"	3/4"	4'-0"	3'-9"	2'-6"	3/4"	3'-3"	3'-3"	1'-9"	3/4"	



VERTICAL BEND



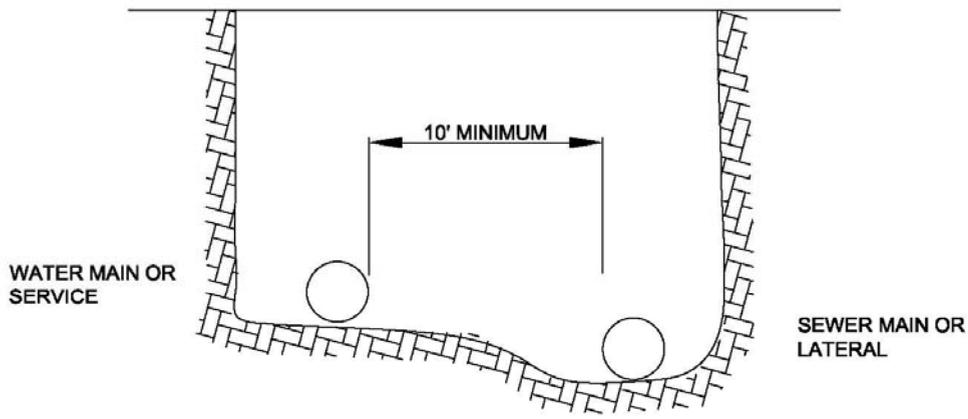
RESTRAINED PLUG OR CAP

NOTE: SEE CHART "HORIZONTAL ANCHOR DIMENSIONS"  
TIE RODS TO BE PROVIDED IN LIEU OF THRUST BLOCK

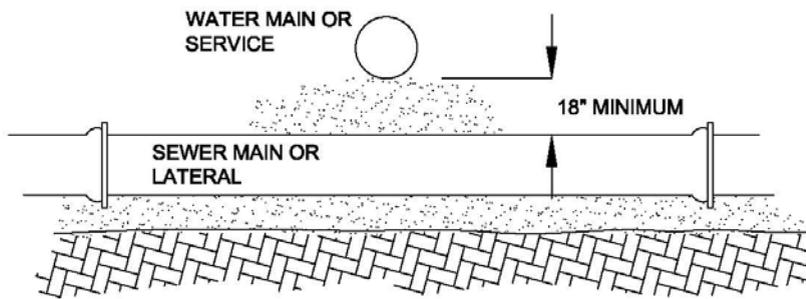


**City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH**

Water Sewer Separation



PARALLEL INSTALLATION

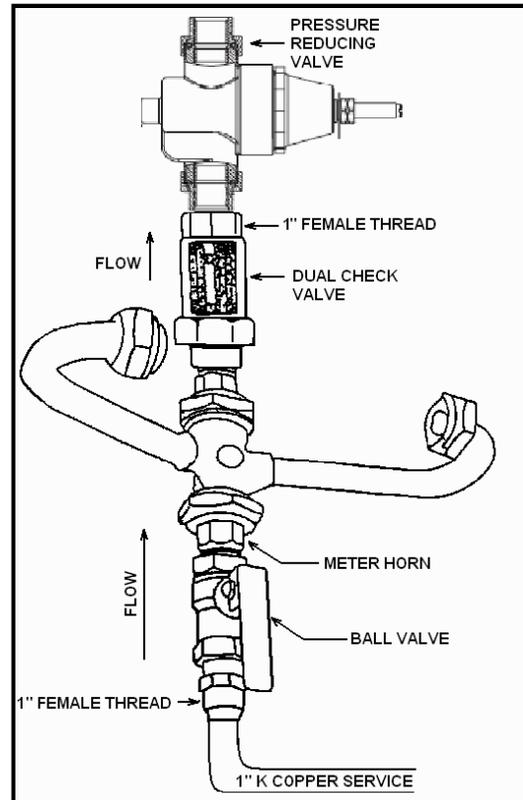
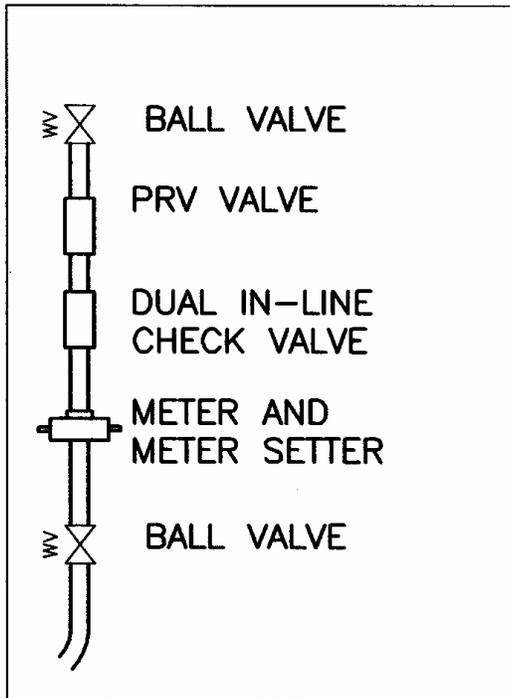


MAIN CROSSING

**City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH**

**METER DIAGRAM 5/8" and 1" Residential Meter  
FOR HIGH PRESSURE ZONES – 60psi Greater**

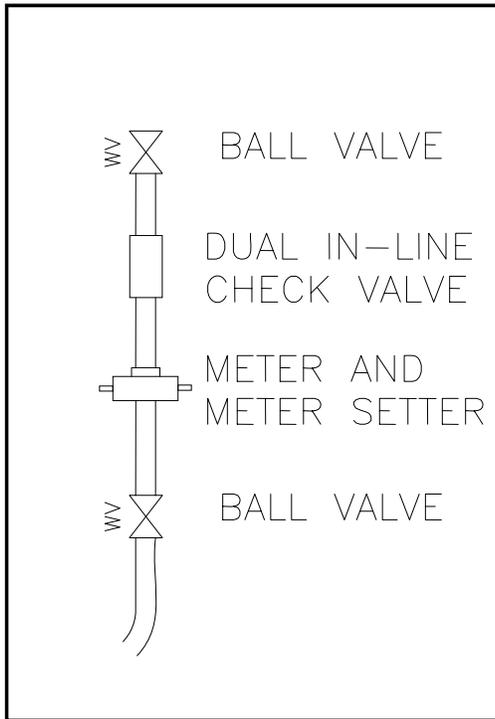
- All backflow prevention devices and all pressure reducing valves must be connected after the meter assembly.
- Minimum floor clearance: 2'-4" / Minimum wall distance: 6"
- 1" K Copper or Polyethylene ASTM D 2239, pressure rated at 200 psi, from curb box through wall to meter yoke, must be inspected by the Municipal Services Department.
- Thermal Expansion Tank near hot water heater on cold water side (recommended but not required).
- Dual Check valve shall be Watts #7 or approved equal.
- Water Meter shall be Sensus ARM
- Distance between valves and meter shall be approved of by the City of Franklin
- Existing 3/4" service: Meter Yoke shall be Ford Kornerhorn KH-1; Dual Check Valve shall be Ford KH-HHCH-1 or #7 Watts; Ball valve shall be KHBV-1



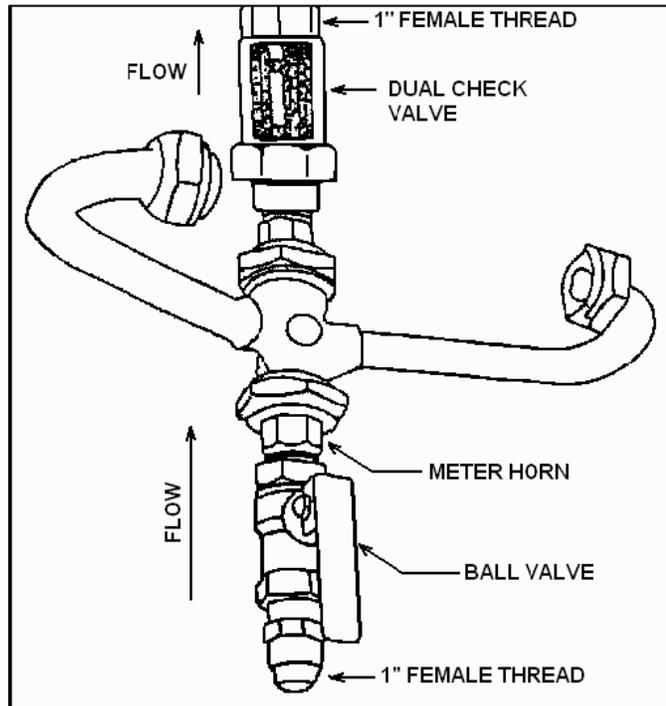
**City of Franklin  
Municipal Services Department  
43 West Bow Street  
Franklin, NH**

**METER DIAGRAM 5/8" and 1" Residential Meter**

- All backflow prevention devices and all pressure reducing valves must be connected after the meter assembly.
- Minimum floor clearance: 2'-4" / Minimum wall distance: 6"
- 1" K Copper or Polyethylene ASTM D 2239, pressure rated at 200 psi, from curb box through wall to meter yoke, must be inspected by the Municipal Services Department.
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- Existing 3/4" service: Meter Yoke shall be Ford Kornerhorn KH-1; Dual Check Valve shall be Ford KH-HHCH-1 or #7 Watts; Ball valve shall be KHBV-1



**Meter Installation Less than 70 psi**



**Meter Equipment for Less than 60 psi**