Chapter 4

Meter Installation

INTRODUCTION

Water meters for customer service are installed, or set, in two ways: indoor and outdoor settings. In an indoor setting, the meter is installed inside the customer's premises, usually in the basement. In an outdoor setting, the meter is installed underground in a pit or meter box, which is usually located at the curb end of the service line. Historically, indoor settings have been used primarily in northern states where severe winter weather may cause frost damage, and outdoor settings have been used in warm, temperate climates.

INDOOR VERSUS OUTDOOR SETTINGS

The advantages of outdoor settings include meter location at point of delivery to customer; elimination of a separate curb box; reduction in meter damage from water heater failure; and no need to enter the customer's home for reading, inspection, and replacement. Disadvantages of outdoor settings include high costs when frost protection is required; reading difficulty; high maintenance due to flooding or snow; damage due to vandalism; liability exposure from the public for tripping accidents; and possible pit modifications due to grade changes.

The advantages of indoor settings include potentially lower installation costs; reduced damage and maintenance through elimination of exposure to outdoor conditions; and, for some utilities, the opportunity for customer contact via the meter reader. Disadvantages of indoor settings include missed readings because of entry problems; hot-water damage; basement flooding due to frost-protective-bottom fracture or miscellaneous leaks; and consumer complaints about meter readers.

Remote Registers

The advent of inexpensive and reliable remote-meter-reading devices, which can be read manually or automatically, has added installation capabilities that modify and, in some cases, eliminate the previously accepted advantages and disadvantages of indoor versus outdoor settings. For example, it is now possible to read meters set indoors from outside the house and eliminate entry or call-back problems. It is also possible to read

outside meters installed in pits without removing meter pit lids by using aboveground, mounted remote or automatic reading devices mounted in pit lids.

With the flexibility of remote registers, the utility manager can set meters to achieve minimum installation costs as well as minimum meter-reading costs. Because of the economic advantages of bringing indoor meter readings to the outside of the house, most remote-reading devices have initially been installed in northern areas. Remote-reading devices are now offered by all domestic meter manufacturers and are described in chapter 9. These devices offer an alternative in areas where outdoor pit settings have traditionally been used. The decision can now be made on the basis of overall economics, considering initial investment, installation cost, reading cost, and maintenance expense. Elimination of pit hazards, public injury liability, and pit maintenance should also be considered.

METER INSTALLATION

In addition to special considerations for indoor and outdoor meter settings, large meter settings and turbine meter installations also have special requirements. This section includes general considerations applicable to all meter installations and their related special needs.

General Considerations

Although standard specifications exist for meters, valves, pipe, and tubing, there are no standards for meter settings; however, there are certain principles that should be observed. Specific problems and questions related to installation can best be addressed by consulting manufacturers of meters or setting and testing equipment. Over the years, a wealth of experience has been accumulated to provide meter settings that ensure optimum meter performance and service accessibility, along with ease of installation and low cost. Installation hardware is available in a wide variety of sizes, types, and materials to meet virtually any installation preferences or requirements.

Basic requirements of an acceptable meter installation are as follows:

1. Position meter in horizontal plane for optimum meter performance.
2. Locate meter so that it is readily accessible for reading, servicing, and/or testing.
3. Provide leak tight, permanent setting to ensure that the meter can be removed from service without negatively affecting customer's plumbing.
4. Provide for permanent electrical grounding that does not use the meter to prevent accidental shock to meter service personnel.
5. Protect meter from freezing and other conditions that could damage the installation.
6. Provide high-quality inlet shutoff valve to allow meter maintenance. Location of meter may also dictate a meter valve on outlet side to prevent water draining back when meter is removed.
7. Provide a minimum loss of pressure.
8. Consider public safety and design installation to prevent accidents.

To avoid future operating problems, all open connections should be capped whenever a meter is removed from its setting for any length of time. A meter idler can be used in place of caps to provide the same protection. Also, meters should be protected from heat and direct sunlight during storage and transit prior to installation or after removal.

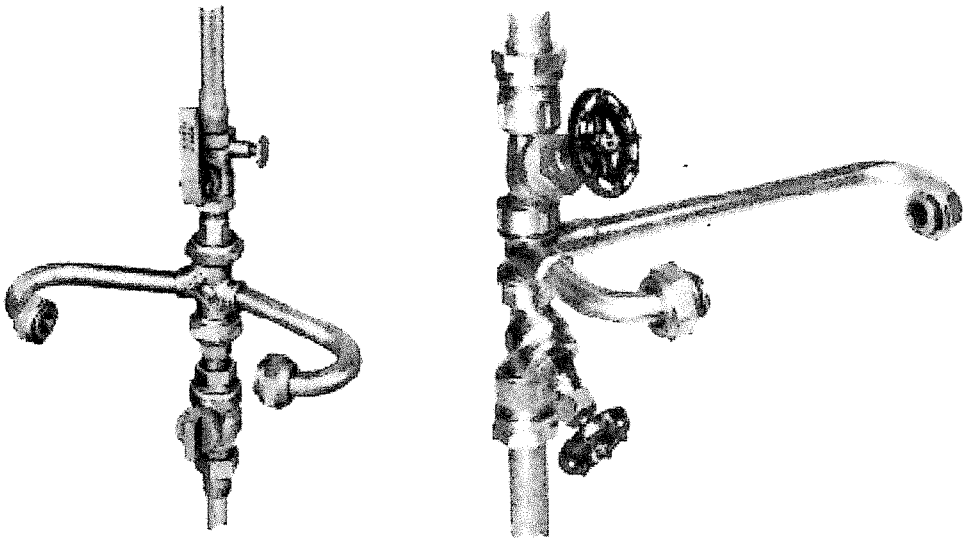


Figure 4-1 Two types of meter setters for vertical indoor piping

On all indoor settings, it is highly important that electrical continuity be maintained through the water line. Most utilities require electrical bonding around meters to prevent accidental electrocution of service personnel changing meters. If the meter setting itself does not provide a continuous electrical circuit when the meter is removed, a permanently bonded electrical grounding strap should be provided. Electrical grounding is a requirement specified by the National Electrical Code, and all service and installation personnel should be advised of this safety requirement. Most commercially available, prepared meter settings provide a continuous metallic circuit, even when the meter is removed from the line. AWWA opposes the grounding of electrical systems to pipe systems conveying drinking water to a customer's premises. Two types of commercially available meter settings are shown in Figure 4-1.

In the United States and several European countries, ample protection from backflow and backsiphonage is required in single family dwellings, as well as at commercial and industrial sites. The water supplier should be familiar with AWWA C510, *Standard for Double Check Valve Backflow-Prevention Assembly* and AWWA C511, *Standard for Reduced-Pressure Principle Backflow-Prevention Assembly* and the requirements of local, state, and federal authorities, whichever takes precedence. This ensures that proper consideration will be given to the meter installation design, thereby providing for the required backflow preventers.

Indoor Settings

The installation of a small meter in a basement or utility room is a relatively simple job. However, improper and unsatisfactory settings do occur because of the absence of applicable standards. When indoor meters are to be read directly, a drawing should be made showing basic installation requirements. This drawing should include minimum and maximum elevations above the floor, the type of recommended connections, required valving, and minimum access space required for reading and service. The drawing should specify that the meter is to be located in the supply line as near as practicable to the point where it enters the basement or building. If a holding device is not used, the drawing should require an electrical ground connection across the meter.

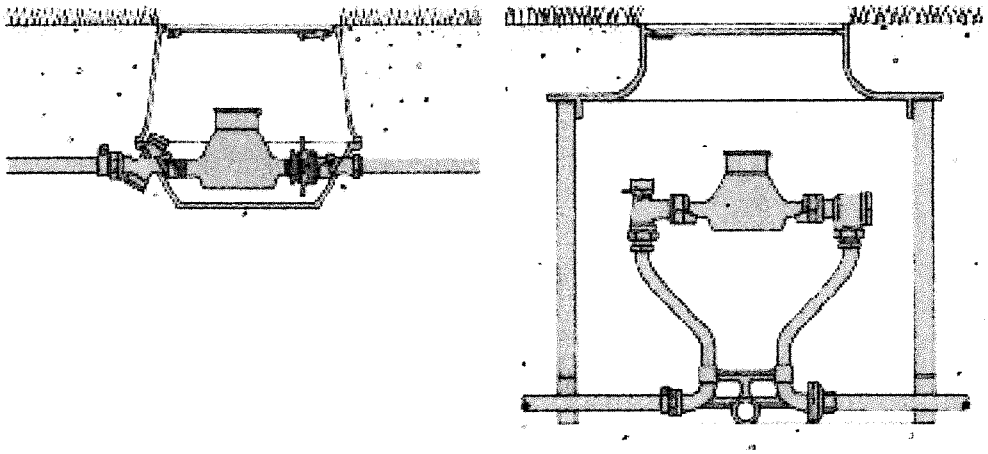


Figure 4-2 Outdoor meter settings with integral yoke (left) and meter yoke (right)

This standard drawing should be furnished to applicants for service, and compliance with the drawing should be one of the conditions for the utility's agreement to serve the premises. This type of drawing provides assurance of uniformly proper installation for the mutual benefit of the utility and the customer.

Outdoor Settings

Many factors influence the design, materials, installation details, and overall performance of an outdoor water-meter installation. Considerations include soil conditions, groundwater level, maximum frost penetration, and accessibility for ease of reading and service. Regardless of pit depth, the meter itself should be located at a depth from the surface that makes reading and accessibility convenient. It is also important to provide 2 in. (50 mm) to 4 in. (100 mm) of clearance between the service piping and the bottom of the meter pit to avoid any damage or strain that may occur if the meter box settles after installation. Consideration should also be given to the location of the curb stop or service control valve. This valve may be made an integral part of the meter setting or may be located elsewhere and housed in a separate curb box. Figure 4-2 illustrates good outdoor meter-setting practice.

The wide variation in ground frost penetration throughout the country makes it impossible to detail a universally practical outdoor setting. In areas where frost penetration is more than a few inches, serious consideration for frost protection is required. Knowledge of local conditions is necessary to select a pit of sufficient size and depth to provide frost protection. Differences in rate of frost penetration, depending on soil conditions, add considerable complications to this problem. Experience with outdoor installations under a given set of conditions is the best guide for avoiding freezing problems. Suggestions for meter pit design, including recommended size and depth, can be obtained from meter-box manufacturers.

Once sufficient experience has been established for meter-setting standards, it is recommended that a drawing be prepared as a guide for further meter settings. This drawing should specify (1) that the meter pit be located as close as possible to the utility line, which is the point of customer delivery; (2) that the lid of the pit or box be placed flush with the ground surface; (3) that no portion of the riser piping or meter be less than 1 in. (25 mm) to 2 in. (50 mm) from any portion of the meter box (more if required for frost protection); (4) the distance belowground surface where the meter spuds or

Table 4-1 Large meter installation guides for compound meters and class I and II turbine meters

Types of Fittings	Distance Upstream in Pipe Diameters	Distance Downstream in Pipe Diameters
Tees and crosses	10	5
Elbows and reducers	10	5
Tees and crosses with strainer or straighteners upstream	5	5
Elbows and reducers with strainer or straighteners upstream	5	5
Angle strainer	5	3
Basket strainer	5	3
Gate valve	1 to 3	1 to 3
Butterfly valve	5	5
Plug valve	5	5
Check valve	*	5
Pressure regulator	*	5
Test tee and plug	*	3
Saddle	*	3

* These fittings are not recommended for use upstream of a water meter. Under extreme high pressures, when it is necessary to protect the meter, pressure regulators may be considered for upstream use only after consulting with the meter manufacturer.

couplings are to be located; (5) the dimensions of the meter box to be used for each size meter; and (6) the location of the curb stop or service-control valve.

Large Meter Settings

Large meter settings, although made less frequently than small meter settings, are relatively expensive and require considerable preliminary planning. Large meters are heavy and removal for service or testing can be costly and time-consuming. Provisions for fire service must also be given serious consideration.

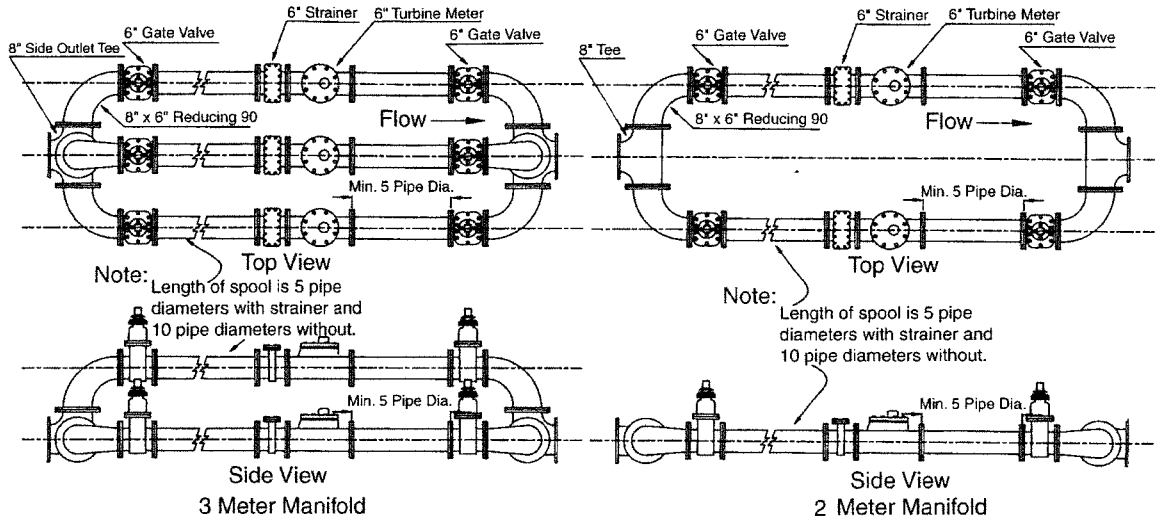
Some utilities have adopted the practice of installing meters in manifolds of two equal branches with meters one size smaller than the main line. These installations consist of compound, turbine, multi-jet, or positive displacement meters. Caution should be exercised to ensure both branches contain meters of the same size, type, model, and manufacturer so that the water flow is balanced and performance life of the meters is equal. A manifold installation provides assurance of continuous service, because a metered, alternative water flow is available during maintenance or emergency situations. Figures 4-3 and 4-4 show examples of various manifold installations using good installation practice and fire-service provisions.

If a manifold contains two or more branches or if there are meters of different types or sizes, the installation requires considerable care in its design. Flow regulating valves (not shutoff valves) are required for pressure loss adjustments to ensure proper water distribution through the various branches. The meter manufacturers or other engineering experts on hydraulics must be consulted because of the technical issues involved.

Check valves may be necessary in some manifolds to prevent recirculation or to improve the low flow registration accuracy of the manifold system. Use of check valves requires careful consideration and should be designed by a professional.

To determine minimum distance to install subject fittings from class I and/or II turbine meters, multiply the nominal pipe diameter of the installation by the appropriate number found in Table 4-1.

Custom-built meter setting devices in $1\frac{1}{2}$-in. (40-mm) and 2-in. (50-mm) sizes with built-in bypass systems and valves with locking arrangements are now available.



Typical 3 meter and 2 meter hydraulically balanced manifold.

Figure 4-3 Manifold of large meters

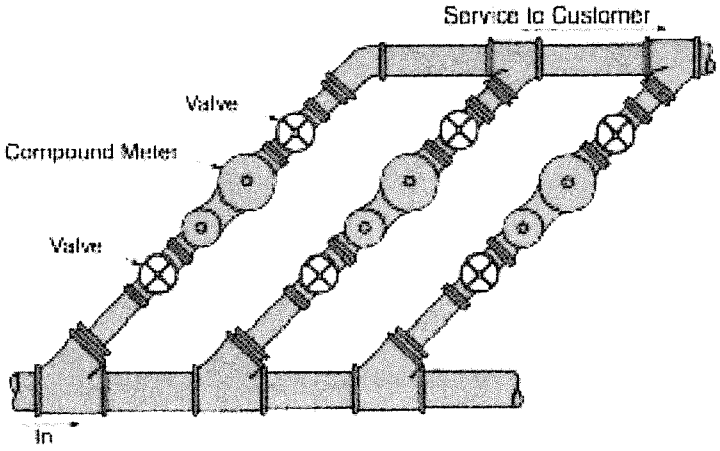
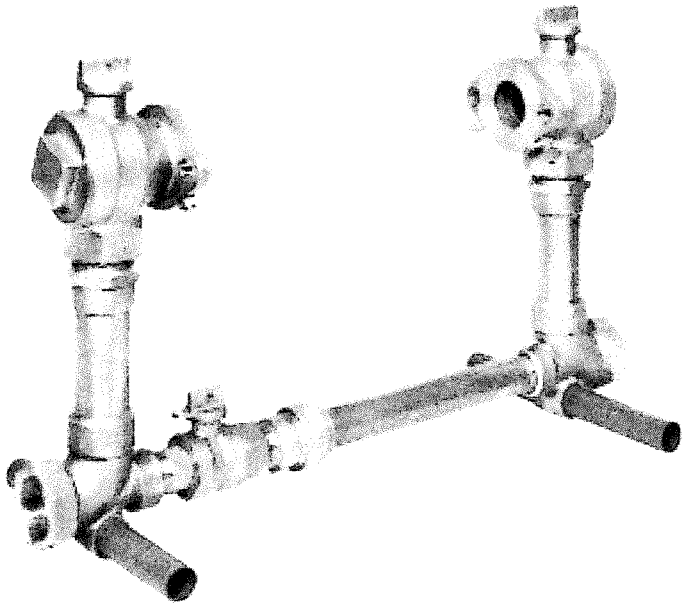


Figure 4-4 Diagram of manifold of three large meters

These devices offer a uniformity of meter settings and facilitate meter maintenance as well as save space in a typical installation. Figure 4-5 shows a typical available device.

Many utilities prefer single-unit installations for large meters and find them very satisfactory. When a single large meter is installed, a bypass circuit should be provided so that meter maintenance can be accomplished without service interruptions. When large meters are installed in a vault, provision should be made for at least 20 in. (500 mm) of clearance to the vertical vault walls and at least 24 in. (600 mm) of head space from the highest point on the meter to the vault cover. Also, when a large meter installation is planned, it is essential that practical testing requirements be carefully considered in the meter and vault layout. Test valves should be installed to permit volumetric field tests, and provisions should be made for discharging test water.

The size, type, and meter brand may have a variety of size test ports for field testing. If the test port provided on the water meter is not adequate to produce the desired test flow, downstream test tees should be incorporated into the installation.



Typical flanged water meter setter complete with angle ball valves, bypass with lockable shutoff valve, and support brackets to hold meter in place during meter gasket replacement.

Figure 4-5 Flanged water meter setter

Satisfactory large meter settings can be designed in a variety of ways, depending on specific requirements, code specifications, and individual preferences. However, it should be noted that these settings represent sizeable investments that will provide long and satisfactory service if adequate planning is done in advance. Valuable advice and installation recommendations can be obtained by contacting the meter manufacturers; this advice should be sought in the preliminary planning stages of a new or unusual installation.

Class I or Class II Turbine-Meter Installations

For optimum life and best accuracy, inferential meters work efficiently when there is a swirl-free, uniform-flow-velocity profile in the pipe immediately upstream of the meter. Because turbine meters are inferential meters, certain precautions or good practices are recommended, including the following.

Class I and class II turbine meters should be positioned horizontally. Piping should be arranged to ensure the meter remains full of water at all times. Elbows, reducers, tees, and crosses installed without a strainer upstream from the meter should be no closer than 10 pipe diameters of straight pipe of the same nominal diameter on the meter upstream and five diameters downstream. As a result of their increased flow capacity, smaller turbine meters are often used to replace larger-sized meters of other types. When pipe reducers are required in such cases, it is important that only gradual or tapered concentric reducers be used. Care should be exercised that the piping flange gaskets are centered and not protruding into the main flow stream.

Avoid installing check valves or pressure-regulating devices upstream of the meter. When check valves or pressure-regulating devices are required in the piping system, they should be installed downstream of the meter at a minimum of five pipe diameters. When backflow prevention devices are required, they should be installed downstream at a minimum of five pipe diameters. Full-opening ball or gate valves are preferred for the meter set's isolation valves. Butterfly or plug valves may also be used

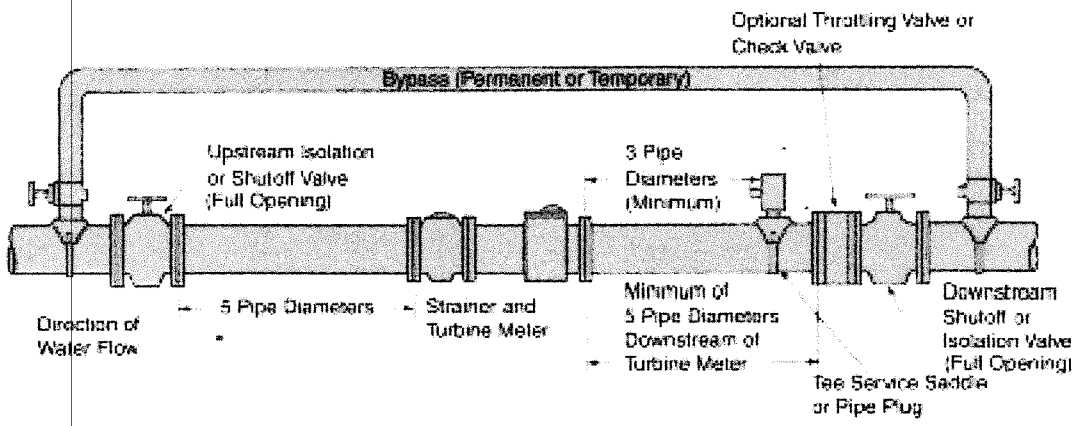


Figure 4-6 Optimum turbine meter installation

as isolation valves, if they are located at a minimum of five pipe diameters upstream and downstream of the meter. If the piping system requires a throttling valve, it should always be downstream of the meter at a minimum of five pipe diameters. It is recommended that a bypass arrangement (either permanent or temporary) be provided to permit uninterrupted customer service during periodic testing or routine maintenance in single-set meter installations. To facilitate periodic testing, provision should be made for a test tee or plug at a minimum of three pipe diameters downstream of the meter.

A rigid, flat-plate or Z-plate strainer is recommended to protect the turbine metering element from debris carried in the flow stream. The effective open area of the strainer element should be at least twice the open pipe area of the meter inlet. When angle or regular basket strainers are used, they should be installed at a minimum of five pipe diameters upstream. When the piping system is also used for fire service, only a Factory Mutual Laboratories (FM)-approved or Underwriters Laboratories (UL)-listed meter should be used. Some meters require approved fire-service strainers as part of the metering package. Fire-service-rated strainers must be installed upstream of the meter. When the piping installation, by necessity, creates a flow swirl in the upstream piping, a flow straightener should be used. At least two types are available: one type incorporates a concentric tube bundle, and the other uses a system of vanes. Either type of straightener can be installed integrally in the meter or immediately upstream. If a flow straightener is not used, the run of straight pipe immediately upstream of the meter should be increased at a minimum of 10 pipe diameters.

Caution should be exercised to avoid entrained air in the meter piping. This is most critical during meter startup when large slugs of entrained air could cause damage to the meter's internal measuring mechanism. Slowly filling the meter piping with a small bleed valve is good practice with the upstream isolation valve open and the downstream isolation valve closed. If possible, the small air-bleed valve should be located at a high point in the surrounding meter piping. The test opening, if valved, is used for this function.

The installation guidelines described are considered good practices for any meter installation and are repeated again in this section because of their importance in turbine meter installations. Figure 4-6 illustrates many of the suggested installation criteria for class I and class II turbine meters.