# APPENDIX A

# DESIGN AND CONSTRUCTION OF WATER METERS AND APPURTENANCES AT NEW ARMY FACILITIES

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**DESIGN AND CONSTRUCTION OP WATER METERS AND APPURTENANCES AT NEW ARMY FACILITIES**

## 1. BACKGROUND

Currently there is no Army-wide requirement for the installation of metering devices on water supply lines in new construction projects. However, Public Law 102-486, entitled Energy Policy Act of 1992, Section 123, "Energy Conservation Requirements for Certain Lamps and Plumbing Devices" now requires that energy conservation and water management provisions be included in new design and construction projects nationwide. Water utility metering is a simple, efficient and inexpensive method to better manage critical water resources. Water metering at individual building connections or within water system zones can provide the means for establishing water conservation guidelines and help determine areas of excess demand caused by water consumption or leakage. Therefore, water meters will be included in new Army construction in accordance with the requirements of this ETL.

## 2. PURPOSE

This ETL has been prepared to provide engineers with standards for design and construction of water metering devices in new Army construction, and will be used as interim guidance until TM 5-813-5 is updated and revised to include such guidance. The purpose of this ETL is to establish policy for metering requirements in water supply and distribution systems for all new Army projects. As a secondary purpose, this document will also serve as a quick overview of industry standards for water meters and will furnish design guidance that may be used in preparing designs and project specifications for the construction of new water meters and appurtenances.

## 3. APPLICABILITY

The requirements of this ETL will apply to all new Army projects designed by, or under the authority of, the Corps of Engineers. In the absence of criteria, some Army installations have established local policy on the design and construction of water meters. This ETL will not take precedence over such local criteria in the event local policy is more stringent than the policy set forth herein. In any event, this ETL will establish minimum requirements with respect to the number, type, and location of water meters on all new Army construction projects where design start is after the final publication of this guidance.

## 4. METER INSTALLATION REQUIREMENTS

4.1 The following design policy is established for water meter installations:

4.1.1 New Construction. For new construction, except family housing, a water meter will be required at all buildings or facilities where it is estimated that potable water demand, as determined by TM 5-813-1, will exceed 380,000 liters (100,000 gallons) per year. ***Each building*** where water demand is estimated to exceed 380,000 liters (100,000 gallons) per year will require a meter. However, in the event that a group of buildings are required in a project where no individual building exceeds the 380,000 liter (100,000 gallon) per year criteria, but the total demand for the group does, then one meter may be installed for the entire group. If one meter can not serve the facility because of the distribution piping layout, such as with a looped water system, then consideration will be given to multiple meter installations for zones to adequately monitor water usage for the new facilities. Priority shall be given to the hydraulics of the distribution system to supply adequate quantity and pressure, and the metering shall be adapted to conform to the distribution system layout. It is better to provide multiple meters than to limit looped piping where needed.

4.1.2 New Family Housing. A water meter will be required for each group of family housing units consisting of (a) at least five but no more than 20 single family, detached housing units, duplex units, or townhouse units, or (b) at least 25 but no more than 50 multi-family apartment or hotel type units. In any event, a water meter will be required for any new family housing project where the total daily water demand, as defined by TM 5-813-1, is expected to exceed 95,000 liters (25,000 gallons). Because the exact configuration of the water supply system may not facilitate the installation of meters for the above number of units in every case, this criteria will serve only as a guide and extraordinary efforts will not be taken to meet the criteria precisely. MIL HANDBOOK 1035 requires that individual utility meters be provided on ***all new detached single family units*** and other types when required by local jurisdictions, ie., Director of Public Works (DPW), Army MACOMS, etc.

4.2 In addition, water meters will be equipped with electronic or radio frequency (RF) transmitters for remote monitoring. The method of remote monitoring via RF transmitters must be coordinated with the installation UMCS/EMCS system. Remote monitoring will be coordinated with the individual installation and local requirements will take precedence. To have <u>all</u> water

meters reading back to a central location would be expensive and is not justified. The designer will consider the placing of selected or zoned water meters in the UMCS/EMCS system. The above guidance will be interpreted as meaning ***remote reading to a nearby location*** as in the case of water meters located within buildings, basements, or generally inaccessible areas. Such installations will provide remote reading capabilities to a convenient location outside the building or structure to simplify the reading of the meter.

4.3 A water meter will also be furnished for any facility or activity requiring special metering by the installation. Non-Appropriated Funds (NAF) projects, or projects involving tenant activities are examples of facilities where the installation may have special needs regarding water use monitoring.

4.4 In addition to metering at buildings and points of use, meters will also be installed on new feeder mains, major supply lines, pumping station discharge, reservoir outlets, and connections to other utility systems. The number, type, and location of meters will be as required by the particular project.

4.5 Water meters will also be furnished where required by national or local codes such as in fire pump installations or areas served by municipal water systems where the local water authority requirements govern. The designer will consult appropriate codes and coordinate with the installation DPW and local agencies having jurisdiction to insure compliance with all applicable requirements.

## 5. TYPES OF METERS

5.1 The primary purpose of a water meter is to measure and display the quantity or volume of liquid passing through it. Various types of water meters are available for specific applications. Meters commonly used in water systems include the following types which can be classified as small-flow meters, large-flow meters, or combination large-small flow meters:

I. Small-Flow Meters

Positive Displacement Meters (AWWA C700)
a. Piston type
b. Nutating type (disc meter)

II. Large Flow Meters

1. Current Meters (also called Velocity Meters)
   a. Turbine (Class I and Class II) (AWWA C701)
   b. Propeller (AWWA C704)
   c. Venturi
   d. Orifice (or Insertion Type)
   e. Electronic (Magnetic or Ultrasonic)

2. Proportional Meter
   Fire Service Meter (AWWA C703)

3. Detector-check Meter

III. Combination Large-Small Flow Meters

Compound Meters (AWWA C702)

5.2 A detailed discussion of each type of flow meter will not be presented in this ETL. There are many sources of information which describe each type of meter in detail. Publications by various manufacturers and the American Water Works Association should be consulted prior to commencement of design. It is recommended that the designer become familiar with AWWA publications such as Introduction to Water Distribution, AWWA Manual M6, Water Meters--Selection. Installation. Testing & Maintenance, AWWA Manual M22, Sizing Water Service Lines and Meters, and the various AWWA standards for water meters and related equipment. These publications discuss meter characteristics and installation and will aid the designer in proper meter selection and sizing process based on a specific application.

## 6. METER SELECTION AND SIZING

6.1 Meter Type. The designer shall select meter type based on the following considerations:

- Location
- Type of installation, ie., interior/exterior, pipe material, etc.
- Expected range of flowrates
- Allowable pressure losses
- Desired level of accuracy

- Durability
- Ease of repair
- Availability of spare parts
- Cost

6.1.1 There is no hard and fast rule for selecting the type and size of meter for a particular service. The range of flowrates is one of the most important aspects of meter selection, for both type of meter and correct sizing. Initial selection of the meter type is usually based on the expected range of flowrates and should conform to the meter classifications shown in paragraph 5.1. The most common type of meter for measurement of flow to buildings through service lines [small flows--less than 3 liters/sec (50 gpm)) is a positive displacement meter. Propeller meters and turbine meters are other common types of meters used for larger flows on Army Installations. Turbine and propeller meters shall be used for main-line flow measurement where rapid changes in flowrates are not expected and low flow accuracy is not of prime importance. Both types of meters are useful in measuring high flows with low friction loss. Propeller meters are covered by AWWA Standard C704 and are primarily used where accuracy is less stringent. Compound meters are routinely used where demand varies considerably such as at schools, hospitals, and office buildings. Compound meters shall be used where there is a requirement to meter all flows and accurate low flow measurement is needed.

6.1.2 The other types of meters mentioned in paragraph 5.1 are also used in special applications. Large flows will generally be measured by current meters for lines 80 mm (3 in.) and larger. Electronic meters, while classified as current meters for large flows, have also been used successfully for small flows when properly designed and sized. However, they are relatively expensive and should only be used when there is a special application. Venturi meters or orifice meters are commonly used in fire pump installations. Detector-check meters are used where normal use is metered, but emergency bypass such as fire flow is allowed through without measurement.

6.1.3 Some situations may require the installation of a manifolded system with two or more meters in parallel. Usually, positive displacement type meters are used with a backpressure valve on their outlets. During low flow only one meter operates, thereby ensuring the best accuracy. As the flow increases the

backpressure valves open permitting flow to the other meters. A manifolded system is used for the following reasons:

- One meter can be removed, while the others are left in service.
- Meters can be added to the manifold in the future.
- With all meters the same size, parts inventory can be simplified.
- For indoor installation, the manifold can be wall mounted to conserve floor space.

6.2 Meter Sizing

6.2.1 Most small metering services will be provided by a positive displacement meter as covered by AWWA Standard C700. Positive displacement meters are generally available in sizes from 18 mm (5/8 inch) up to 150 mm (6 inch). The use of smaller meters up to 80 mm (3 inch) is more common due to their excellent sensitivity at low flows. As a rule of thumb the meter size should be one size smaller than the service line. However, actual pressure loss data available from AWWA standards and from manufacturer's catalog data shall be considered. The AWWA standard lists the various meter sizes and the corresponding safe maximum operating capacity. The recommended maximum rate for continuous operations is one half the maximum operating capacity.

6.2.2 For large metering services, the meter size will depend on the type meter chosen, the low, average, and peak flowrates, and the desired accuracy. To maintain sufficient accuracy, meter sizes will often be one or two sizes less than the water line. Again, the appropriate standards and manufacturer's data will be consulted in the sizing of the meter for a particular application.

6.3 Materials of Construction. For those meter types covered by AWWA specifications, the acceptable materials of construction are contained in the specification. The designer will list any special requirements in the project specifications. For meters not covered by AWWA specifications, such as electronic meters, the designer will consult industry data to determine the best selection of materials for the application. It is suggested that the Navy Guide Specification, NFGS 13321, Flow Measurement Equipment for Water and Sewage, be consulted for the preparation of specifications regarding meters not covered by AWWA standards.

## 7. METER INSTALLATION

7.1 The following AWWA recommendations are required for an acceptable water meter installation:

! Water meter enclosure will be leaktight.

! Provide an upstream shutoff valve of high quality and with low pressure loss. (Upstream and downstream valves shall be used as needed.)

! Position the meter in the horizontal plane for optimum performance.

! Meter shall be reasonably accessible for service and inspection.

! Provide for easy reading either directly or via a remote-reading device.

! Meter shall be reasonably well protected against frost, mechanical damage, and tampering.

! Meter shall not be an obstacle, or hazard to customer or public safety.

! Large meters should be supported sufficiently to prevent stress on the piping.

! A bypass or multiple meters shall be used on large installations.

7.2 Interior Installation. Meters will sometimes be installed indoors in basements or mechanical rooms. Care will be taken in preparing details of the meter installation to allow for adequate access space for reading and servicing.

7.3 Exterior Installation.

7.3.1 Small Meters. Small meters will be installed in a meter box to protect the meter and allow easy access for reading and servicing. Prefabricated meter boxes locally available and conforming to the requirements of Corps of Engineers Guide Specification, CEGS 02660, Water Lines, should be used wherever possible to provide acceptable installations at least cost. The designer should also consider the use of meter yokes to cushion the meter against stress and strain.

7.3.2 Large Meters. Large meter installations must be individually designed for specific requirements and preferences. Drawings will be prepared showing the details of construction for the vault, piping, and meter setting. In general, large meters will be installed in reinforced concrete vaults with hinged or removable aluminum covers. The vault will be sized to maintain 50 cm (20 inches) minimum clearance to vertical walls and 60 cm (24 inches) minimum clearance from the highest point on the meter to the vault cover. Provisions will be made for interior drainage and the prevention of rainwater or ground water accumulation within the vault. The meter, piping, and valves will be adequately supported. A Dresser-type coupling will be installed in flanged piping systems within the vault to enable assembly and disassembly. Appropriate pipe sleeves will be provided for pipe passing through concrete walls. Vaults should be sized with usage increase in mind, allowing extra space to install a larger meter.

7.4 The manufacturer's recommendations concerning installation will be followed to ensure accuracy and satisfactory service. Of particular importance are the recommendations concerning piping and devices in the vicinity of the meter.

7.5 Testing. The project specifications will require field testing prior to installation to ensure the accuracy of the meter and that there has been no shipping damage.

## 8. WATER METER ACCESSORIES

8.1 By-pass Piping. The designer will consider the installation of by-pass piping at large meter installations. By-pass piping may be permanent or fittings and valves may be installed for temporary by-pass piping. The by-pass piping may be installed outside the meter box as a cost saving measure.

8.2 Strainers. AWWA Standard C700 requires that small meters contain screens or be self-straining. On larger meters, screen type strainers will be installed immediately upstream of the meter where it is determined debris may effect the meter service life or where recommended by the meter manufacturer. Generally, it is recommended that screens be installed for larger meter applications.

## 9. METER READING

9.1 Direct Reading. Direct reading meters will record the flow of water in units suitable to the using service. Where no specific requirements are given, flow units will be U.S. gallons. Meters will be direct reading unless remote reading is required.

9.2 Remote Reading. Remote reading can increase reading efficiency and eliminate missed readings from inaccessible meters. Several manufacturers offer remote meter reading equipment. This equipment is divided into two categories; generator remotes that provide a visual display of the quantity registered on a remote counter, and encoder systems that read the meter electronically and transfer the data for storage and interrogation to an acquisition device.

9.2.1 Generator remotes use a self-powered pulse generator/register at the meter, a two wire conductor, and a remote visual totalizer. The remote totalizer is read visually and the reading is manually recorded. These are covered by AWWA Standard C706.

9.2.2 Encoder-type remote systems use a remote receptacle directly connected to the encoded meter reading at the register. Readings are obtained by inserting a probe that either displays the meter reading visually and/or records the meter reading and meter identification number on magnetic media for automatic data processing. Manufacturers of encoder remote systems offer the complete system including recorders for data acquisition and terminals for data transmission to central computers. These are covered in AWWA Standard C707.

9.2.3 Another type is an automated remote wireless water meter reader which sends signals to stationary receivers and then relays the data over telephone lines to a central computer.

## 10. REFERENCES

10.1 American Water Works Association (AWWA), 6666 West Quincy Ave., Denver, CO 80235, or 1401 New York Ave., NW, Suite 640, Washington, DC 20005:

a. AWWA MANUAL M6-86, Water Meters--Selection, Installation, Testing and Maintenance.

b. AWWA MANUAL M22-75, Sizing Water Service Lines and Meters.

c. AWWA PUBLICATION, Introduction to Water Distribution, date.

d. AWWA STANDARD C700-90, Cold-Water Meters--Displacement Type, Bronze Main Case, First Edition, Addendum C7OOA, 1991.

e. AWWA STANDARD C701-88, Cold-Water Meters--Turbine Type, for Customer Service.

f. AWWA STANDARD C702-92, Cold-Water Meters--Compound Type.

g. AWWA STANDARD C703-86, Cold-Water Meters--Fire Service Type.

h. AWWA STANDARD C704-92, Propeller-Type Meters for Water-works Applications, Second Edition.

i. AWWA STANDARD C706-91, Direct-Reading, Remote Registration Systems for Cold-Water Meters.

j. AWWA STANDARD C707-82, Encoder-Type, Remote-Registration Systems for Cold Water Meters.

10.2 Energy Policy Act of 1992, Public Law (P.L.) 102-486, Section 123, XX U.S.C. XXXX.

10.3 Military Handbook (MIL-HDBK) 1035, Family Housing, Commander, Naval Facilities Engineering Command, 200 Stovall Street, Alexandria, VA 22332-2000, 15 June 1989.

10.4 Technical Manual (TM) 5-813-1, Water Supply: Sources and General Considerations, Headquarters, Department of the Army, Washington DC, 4 June 1987.

10.5 Technical Manual (TM) 5-813-5, Water Supply: Water Distribution, Headquarters, Department of the Army, Washington DC, November 1986.