WATER SYSTEM DESIGN

WATER SYSTEM DESIGN MANUAL
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1.0 GENERAL

1.1 Introduction

This chapter of the Middletown Design Manual outlines the policies, minimum design criteria and design procedures for the preparation of feasibility reports and construction plans and specifications for Town-maintained and on-site water system improvements. Developers and/or Design Engineers shall check with the Town Office of Planning and Zoning to determine the availability of water at the site of a proposed subdivision.

1.1.1 Town Policy

a. Town-Maintained Facilities

The parts of the water supply system which are considered as the property and responsibility of the Town of Middletown are the water mains, appurtenances and that portion of the water services up to and including the curb stop or valve just inside the property line. The water supply and distribution system within the Town's rights-of-way and easements for Middletown is maintained by the Town of Middletown.

b. On-Site Facilities

The parts of the water services which lie within private property are the responsibility of the owner and are constructed and maintained by the Owner.

c. Requirements for Water Service

1. All properties will be connected to the water system of Middletown.
   a.) Each building shall be serviced by a separate water tap.
      (1) Multiple dwelling units such as an apartment dwelling, duplex or residential unit with apartment(s) may be served by a single water tap but will be billed quarterly water and sewer fees based on the number of dwelling units in the building.

(2) Buildings with offices or commercial enterprises will be billed for each common male/female restroom for use of leasees. If any unit has private facilities in addition to the common facility(s), additional billing will be made for each private facility.

(3) Property owners are responsible for all fees assessed to rental properties if not paid by the tenant or leasee.

b.) If an additional building is constructed on an existing lot which has a water tap, the new structure must be provided with an additional water tap.

c.) If a lot containing more than a single structure is subdivided to provide separate lots for each structure, the lot(s) without water tap(s) must provide these taps as a condition of subdivision.

d.) If a lot containing a single structure is subdivided, each structure erected upon the new subdivided area must procure a water tap prior to obtaining a building permit.

1.1.2 Definitions

a. Service Connections: Water mains connecting the distribution mains to individual homes, buildings, or facilities for both consumptive use and fire protection.

b. Distribution Mains: Water mains connecting the transmission mains to the service connections. The distribution mains provide area-wide fire protection. Generally, the distribution mains will be in a grid or branched configuration.

c. Transmission Mains: Large diameter mains connecting the treatment plant with the distribution mains.

d. Average Day Demand: Average day demand is the volume of water used in the year divided by 365.

e. Average Day Rate (Average Day): Average day rate is the average day demand volume divided by a one-day period, expressed in gallons per minute (gpm) or million gallons per day (MGD).

f. Maximum Day Demand: Maximum day demand is the largest volume of water used in one day during the year.

g. Maximum Day Rate (Max. Day): Maximum day rate is the water used during the maximum day divided by a one-day time period expressed in gpm or MGD.

h. Peak Hour Demand: Peak hour demand is the largest volume of water used in one hour.

i. Peak Hour Rate (Peak Hour): Peak hour rate is the peak hour demand volume divided by 60 minutes, expressed in gpm; or multiplied by 24 hours, expressed as MGD.

j. AWWA: American Water Works Association.

k. Town: Burgess of Commissioners of Middletown.

2.0 DESIGN CRITERIA

2.1 General

For the Engineer's guidance, below are listed major elements constituting the design of a Water Main Utility Design project:

a. Pipe size and alignment

b. Profile, with all elevations

c. Property data (lot dimensions, all sides of affected properties, liber/folio number, owner)

d. Rights-of-way

e. Specifications and notes

f. Cost estimate

2.2 Demands

a. The sizing of major components of the Town water supply system such as major transmission mains, storage facilities, and booster pumping facilities, are the responsibility of the Town and beyond the scope of this manual. The Town may require developers to design these facilities as well as finance and construct them. Should this be the case, the Town must be consulted for specific design criteria.

b. The design engineer who is responsible for the extensions of distribution mains shall follow the guidelines in this manual for the derivation of design flows. The calculation of water demands will usually require extension of the average daily rate for the facility, application of a peaking factor to derive the maximum daily rate, then addition of the fire flow requirement.

c. Generally, the design engineer will be selecting distribution mains of 12-inch diameter and smaller, and often will be required to provide the minimum size mains, which are listed later in this Chapter.

2.2.1 Residential Demands

Studies have shown that the quantity of average daily water use and peaking factor for residential areas are related to lot size. This is due to increases in persons per dwelling unit, per capita consumption, and greater lawn sprinkling as the lot sizes increase. The information in Appendix A shall be used to derive residential demands and peaking factors.

2.2.2 Commercial and Industrial Demands

The estimation of average daily water consumption and peaking factors for commercial demands are greatly dependent on the type of facility. With the exception of industries using process water, the fire demand generally is the major component of the design used to size distribution main extensions and service connections to buildings having sprinkler systems. The design engineer shall refer to the Frederick County plumbing code for derivation of building design flows if the number of fixture units is known. If the type of business is known, but a specific fixture count is not known, use Appendix D to estimate water demand. For undeveloped land, use Appendix A to derive Commercial and Industrial water demand according to zoning.

2.2.3 Fire Flow Rates

Residential: [1]	
Single Family	1,000 gpm at 25 psi residual
Townhouses	1,500 gpm at 25 psi residual
Garden Type Apartments	2,000 gpm at 25 psi residual
High Rise Apartments	2,500 gpm at 25 psi residual
Commercial: [1]	
Regional Shopping Centers	3,000 gpm at 25 psi residual
Industrial: [1]	3,000 gpm at 25 psi residual
Institutions: [1]	
Hospitals	2,500 gpm at 25 psi residual
Schools	2,500 gpm at 25 psi residual
Office Building Complex: [1]	3,000 gpm at 25 psi residual

[1] Above fire flows to be used in the absence of site specific data from fire underwriters or construction plans which would permit a determination of fire flow requirements using insurance industry standards (Insurance Services Office -ISO). Consideration will be given to reducing the requirement where proposed construction includes sprinkler system; refer to current ISO recommendations.

2.3 Hydraulic Computations

2.3.1 General

The hydraulic design of water mains shall be in accordance with the requirements of the American Water Works Association or Pipeline Design for Water and Wastewater, ASCE, 1975, and the additional guidelines and criteria in this Chapter.

2.3.2 Design Flows and Residual Pressures

a. Service connections, distribution mains and transmission mains shall be sized based on the following design flow rates and residual pressures:

Maintain a minimum of 25 psi at ground level anywhere in the system under all conditions.

or

Normal working pressure 60 psi and not less than 35 psi residual pressure at the service connection during peak hourly rate.

.....Whichever is more critical.....

b. In some locations, the main size will be determined by the flow rate required to refill a storage facility which may be more critical than the above requirements. The Town will identify this requirement, if applicable.

2.3.3 Flow Velocities

Although the flow velocities and direction may vary considerably in distribution mains, there are upper and lower velocity bounds that indicate to the design engineer that design weaknesses may exist. The following are useful guidelines:

a. Velocities greater than 7 fps at design flow

This condition may produce large friction losses and high potential for valve and joint damage due to water hammer.

b. Velocities less than 0.5 fps at design flow

This condition indicates that the main may be oversized. Future maintenance problems may result from siltation at valves and there may be water quality degradation.

2.3.4 Hazen-Williams "C" and Minor Losses

a. The total head loss at the point of discharge for design flows shall be the sum of both friction and minor losses. The elevation difference between the source and discharge point shall be algebraically added to the total head losses.

b. Head losses for new pipes shall be computed using the nomograph in Appendix C and the following coefficients:

Type	Pipe Diameter	Hazen-Williams "C"
Service Connections		
Copper	3/4 inch - 3 inch	130
DIP	3 inch	100
Distribution Mains		
DIP	4 inch - 8 inch	100
DIP	10 inch - 12 inch	110
DIP	16 inch - 24 inch	120
Transmission Mains		
DIP	16 inch - 20 inch	120
DIP	24 inch and larger	130

c. Minor losses due to fittings and valves shall be included as equivalent lengths of pipe as shown in Appendix E or as fractional losses in velocity head as described in Pipeline Design for Water and Wastewater, ASCE, 1975, or other hydraulics texts.

2.4 Distribution System Layout and Sizing

2.4.1 General

Extensions of distribution mains will normally be on a grid basis with interconnecting nodes at street intersections.

2.4.2 Residential Subdivision (New and Existing)

The water distribution system for residential areas where fire protection is to be provided shall meet the following criteria:

a. Minimum size of water mains shall be 8-inches.

b. All water mains shall be looped, except where capped for future extension to adjoining property. A fire hydrant shall be placed at the end of the main and may be relocated at the time the main is extended, if approved by the Office of Planning and Zoning.

c. A fire hydrant shall be placed within ten (10) feet of the terminus of all dead end mains.

2.4.3 Commercial and Industrial Areas

The water distribution mains for Commercial and Industrial areas where fire protection is to be provided shall meet the following criteria:

a. Minimum size shall be 8-inches.

b. All water mains shall be looped, except where capped for future extension to adjoining property. A fire hydrant shall be placed at the end of the main and may be relocated at the time the main is extended, if approved by the Office of Planning and Zoning.

c. A fire hydrant shall be placed within 100 feet of the terminus of all dead end mains.

d. Where design flow rates exceed 1500 gpm, hydraulic computations shall be provided.

2.5 Service Connections

2.5.1 General

House connections for water shall be built to the meter vaults near the property line for all lots within a proposed development. All 2" and smaller meters will be installed into the water meter vault and settings by Town staff. All adjacent improved lots which are not part of the proposed development, but which may be served by the waterline, shall be shown on the contract drawing.

2.5.2 Location

On the plans, indicate service connections 15 feet from the property line on the high end of the lot or at a location desired by the homeowner if the lot is already developed. Meter vaults shall be placed near the property lines and shall not be constructed in the curb, sidewalk or driveway.

2.5.3 Sizing

a. Service connections must be no smaller than 1". Twin house connections will not be permitted.

b. For other than a residential dwelling, determine the water supply demand pursuant to the criteria in Section 2.2. The velocity in the service connection must not exceed 8 fps.

2.5.4 Cover

Cover over service lines must be a minimum of 3 feet 6 inches or as required by the Frederick County Plumbing Code, whichever is greater.

2.5.5 Clearances

Water house services shall be placed 7 feet horizontally from sewer house connections and a minimum of 1 foot clear above the sewer house connection or as required by the Frederick County Plumbing Code.

2.5.6 Materials

Piping material must be Type 'K' copper for residential service lines and ductile iron or copper for larger sizes.

2.5.7 Cross Connections

No cross connections where contamination can enter the potable water supply are permitted. No cooling water or condensate may be returned to the potable water supply line. All interconnections shall be approved by the Town and other appropriate reviewing authorities.

2.6 Appurtenances for Service Connections

2.6.1 Meters (Location)

Meters shall be located outside the house in a vault with a radio transmitter also located in the vault. The vault will be located just inside the property line.

a. Only Sensus meters are permitted.

b. All meters must be purchased from the Town. Town staff will install the meter into the setter in the meter vault after payment is received and on a certain schedule.

2.6.2 Meters (Sizing)

Meter types for Commercial, Industrial and Institutional applications shall be determined by the Town or authorized agent. Meters shall be installed to record all water usage, including fire flow.

a. Valves

A valve or corporation cock shall be provided on the water main side of each meter installation.

b. Backflow Prevention Device

Reduced pressure backflow prevention devices shall be required on all services to commercial/industrial or individual facilities and shall be located immediately adjacent to the outlet side of the water meter, fully accessible. Refer to AWWA, Cross Connection and Backflow Prevention for additional design criteria.

2.6.3 Installation

Installation of all service connections and appurtenances shall be in accordance with latest AWWA standards or manufacturer's recommendations. Such requirement shall be noted in specifications and on contract drawings.

2.7 Distribution Mains

2.7.1 Description

Distribution mains are 12 inches and smaller in diameter. For larger mains, design engineer should consult with the Town regarding special design criteria.

2.7.2 Location

a. In new subdivisions

Lay water mains 7 feet from the centerline of the road right-of-way, generally on the side of the road toward high ground (on opposite side of road from the sanitary sewer). Locate mains within the pavement area, wherever possible, no less than 5 feet from curb or proposed curb. Water mains shall not be located under curb or sidewalks, except where the water main crosses in a perpendicular fashion.

b. In existing developments with curbs

Generally, location must be the same as in new subdivisions. The location of other existing and proposed utilities must be fully considered.

c. In existing developments with pavement and no curbs

Generally, location must be the same as in new subdivisions. An alternative location with the approval of the Town will involve locating the main 2 feet outside the edge of pavement on the opposite side of the

road from the sanitary sewer, except that the main must not be laid under a future curb. The location of other existing and proposed utilities must be fully considered.

d. Where utilities are extended to accommodate development, they shall be extended across the full frontage of the property being serviced.

e. In parks and public rights-of-way, where location of a water main would require removal of trees, the design engineer shall obtain approval of the Town for tree removal.

f. Distribution mains may be designed on a curved alignment to reduce the number of bends. Along curves, the water main may be deflected at each joint within the limits given in the Appendix.

g. All water utility easements outside of road right-of-ways shall be 20 feet minimum width. No other utilities will be allowed in the water easement without the Town's written approval.

2.7.3 Size

a. Distribution Mains

Shall be 8-inch minimum size and shall be interconnected at all intersecting streets, with valves on all mains at the intersection. Where the required flow exceeds the capacity of an 8-inch main or of the existing system, larger mains will be required.

b. Distribution mains shall be sized to provide the required design flow rate and residual pressures as detailed herein.

c. Transmission Mains

Sizing shall be based on a computerized network analysis performed by the design engineer or as provided by the Town, if available.

2.7.4 Materials

a. All distribution and transmission mains and fittings shall be Ductile Iron, double cement lined (latest AWWA C-151) with standard mechanical joints or push-on joints.

b. At bridge crossings, 16-inch and smaller ductile iron pipe shall have fiberglass insulation with vapor jacket wrapped by a full metal jacket for all exposed piping.

c. Expansion joints, insulated couplings and rollers shall be provided as required.

2.7.5 Installation

Installation of all service connections and appurtenances shall be in accordance with latest AWWA standards or manufacturer's recommendations. Such requirement shall be noted in specifications and on contract drawings.

2.7.6 Cover Over Pipe

a. Normal cover over water mains shall be 4 feet except at crossing over other utilities, where a minimal cover of 3 feet or a maximum cover of 9 feet may be allowed.

b. In new subdivisions

Cover shall be measured from finished grade of road or as specified by the Town. Roads shall be graded to subgrade before water mains are laid.

c. In existing or ungraded roads

Established grades of roads shall be obtained from the Town and are generally the proposed future finished grade. If such grades are not available, the design engineer shall submit proposed grades for approval by the Town. If established grade is at or below existing surface, cover shall be measured from established grade. If established grade is above existing surface, cover shall be measured from existing surface. In no case, however, shall the cover deviate from the minimum or maximum cover indicated in 2.7.6.

2.7.7 Clearances

a. Clearances shall be measured between outside of pipes.

b. Crossing Sanitary Sewer

Water main shall have minimum clearance of 18 inches above sewer. This vertical separation shall be maintained horizontally for a distance of 10 feet or as required by the Maryland Department of the Environment.

c. Parallel to Sanitary Sewer

A horizontal distance of at least 10 feet shall separate water main and sewers or as required by the Maryland Department of the Environment.

d. Crossing Other Utilities

Water mains shall have minimum clearance of eighteen inches where crossing utilities.

EXCEPTIONS: When specified clearance is not physically possible between sewer and water in a new subdivision or in locations where sewer is built along roads having existing water mains, the sewers shall be designed according to Sewer Design Standards of Frederick County. If sewers already exist in a road, and water main cannot be built to specified clearances, ductile iron pipe with mechanical joints or other approved safety joints shall be used for the water mains. These installations shall be pressure tested to assure water tightness before backfilling. The Town shall be consulted to discuss the use of concrete encasement of the sewer and/or water main. The Developer or Engineer shall propose options to the Town for approval to ensure all possible measures are considered and implemented to avoid possible contamination of the water supply.

2.7.8 Structural Considerations

a. Buttresses and Anchors

Buttresses and anchors shall be required at all fittings which achieve a change in pipeline direction, such as tees, fire hydrants, bends and dead ends, thrust restraint is necessary. Buttresses and/or anchorage blocks are the two means of achieving thrust restraint. The design engineer shall decide what is appropriate for each particular situation based on an analysis of such factors as soil conditions, clearance requirements, constructability, future expansion and cost. Buttresses and Anchorage blocks are concrete placed against undisturbed soil designed for restraint of thrust forces in pressurized piping systems. The Town reserves the right to require a soils analysis.

b. Restrained Joints

If the soils at the project site are unusually poor, or other factors such as cost, space limitations, or future construction so indicate, restrained pipe joints shall be designed. The joint restraint may be either harnesses or mechanical joints with retainer glands for mains up to 16-inch diameter.

Restrained joint types for larger mains shall be approved by the Town prior to proceeding with design. The design shall account for test pressures, soil frictional resistance and effect of groundwater as a minimum. The Town reserves the right to require a soils analysis.

c. Jacking and Tunneling

Where mains are being designed to cross railroads, state highways, or other roads, on which service cannot be interrupted, the water main shall be installed in a sleeve, tunneled or jacked under the road. The sleeve size and material and the method of tunneling or jacking shall be approved by the owner of the road or the railroad being crossed.

The sleeve diameter shall be sufficient to permit the proper positioning of the water main within the sleeve. Water mains installed in sleeves shall have restrained joints throughout the length of the sleeve. The annular void between the main and the sleeve shall be completely filled with grout.

Water mains installed in sleeves shall be equipped with sufficient valves to shut-off all flow through the sleeved section. In the case of dead end main, one valve upstream will be sufficient; in other cases, a valve at each end is required.

d. Design Loads and Pipe Design

In cases where deemed necessary by the Town, the design engineer shall submit all calculations necessary to support the selection of the type and class of pipe indicated on the Contract Drawings.

The calculations may account for the following:

Vehicle or railroad loads (H-20, E-80, etc.);
Pipe loading factors (dead, live, impact);
Internal pressure (static, dynamic, surge);
Installation trench configuration.

e. Corrosion Protection

If soil tests or inspection of existing utilities in the project area reveals evidence of, or potential for, corrosion, the Town shall be notified of the condition. Should the Town deem it necessary, the design engineer shall design suitable galvanic and/or cathodic corrosion protection measures using AWWA Controlling Corrosion Within Water Systems, 1978. The Town reserves the right to require a soils analysis for corrositivity.

f. Deflection of Pipe

The maximum deflection allowed shall be as shown in Appendix B of this Manual.

2.8 Appurtenances for Service Mains

2.8.1 Valves

a. Size and Type

Mains 4-inches to 16-inches shall have valves of the same size as the main. Valves shall be resilient seat gate valves with non-rising stem. All valves 16-inches and larger shall have bevel gears and an enclosed gear case.

b. Location

Valves shall be installed on the loop or network at such places as to isolate the branch sections as may be necessary with a maximum spacing of 1500 feet. They shall be installed on all fire hydrant leads as close to the water main as is feasible. A valve shall be placed on all branch lines, regardless of size, near the main. Valves at intersections shall be placed on projection of road right-of-way lines. In no case shall the valve be placed in the sidewalk or less than ten feet (10') from another valve.

2.8.2 Tapping Sleeves and Valves

Where Used: Tapping sleeves and valves on ductile iron mains to serve as line valves shall be used for all connections 6-inches and larger to any existing main 12-inches or larger where more than 10 domestic services would be shut off during installation of a standard tee. The main being tapped may be the same size as the proposed main or tapping valve, but the tapping cutter shall be 1/4-inches or more undersized.

2.8.3 Fire Hydrants

a. Size and Type

Hydrants shall be a minimum of 6-inches. The engineer shall submit to the Town a scale map 1 inch = 200 feet showing area streets, water mains and proposed location of fire hydrants for the Town's use and for transmittal to the Fire Department. Fire hydrants shall be Mueller, Model A-423 or Kennedy Model K81. Each hydrant shall have one (1) 4½ inch diameter pump nozzle and two (2) 2½ inch hose nozzles, nozzle gaskets,

5¼ inch valve, 1½ inch pentagonal operating nut, open left. Both the hose nozzles and pumper nozzle shall have National Standard Thread. Hydrants shall be designed for 4½ foot bury and 6 inch mechanical joint inlet.

b. Location

Hydrants shall be located in a pattern approved by the Town Engineer or his duly authorized representative and shall be located so as to provide vehicular clearance from the street. Hydrants not at intersections shall be located in relation to property lines in order to avoid interference with future driveways.

c. Spacing

Hydrant spacing in residential areas composed of detached or semi-detached one- and two-family dwellings shall be at each street intersection and at 500-foot maximum intervals between intersections. Hydrant spacing in other residential areas and all other uses of property shall be at each street intersection and at 300-foot maximum intervals between street intersections.

2.8.4 Air and Vacuum Release Valves

a. The proper ventilation of distribution and transmission mains is often overlooked by design engineers. Trapped air pockets can significantly reduce the capacity of the mains as well as cause increased pumping heads and corresponding higher pumping costs. The following guidelines shall be used to locate air and vacuum release valves:

Peaks in profiles
Abrupt increase in downward slope
Abrupt decrease in upward slope
Long ascents - 1500 ft to 3000 ft intervals
Long descents - 1500 ft to 3000 ft intervals
Long horizontals - 1500 ft to 3000 ft intervals
Pumps - on the discharge side of pump having suction as close to the check valve as possible

b. In general, fire hydrants shall be placed at all high points along the main and at the terminus of dead end mains.

2.8.5 Valve Vaults

a. Mains 12-Inches and Smaller

For valves and for tapping sleeves and valves, use the Frederick County Standard Roadway Valve Box.

b. Mains Larger than 12-Inches

For valves, except butterfly-type, use reinforced concrete vaults as approved by the Town. For tapping tees and valves, use concrete vaults as approved by the Town.

2.9 Testing and Disinfection

The contract documents shall provide for hydrostatic testing of newly laid mains as described in the Frederick County Standard Specifications. Hydrostatic tests shall be performed for pressure retention and leakage. Disinfection shall be in accordance with AWWA C-651.

2.10 Abandonment Procedures

Abandoned service connections shall be cut and plugged at the service main, and the meters removed and salvaged if their condition permits reuse. Distribution mains that are to be abandoned shall be plugged at the point of abandonment and on each side of any existing valves, and the valves and hydrants removed and salvaged if their reuse appears practicable. Any necessary buttresses or anchorage required shall be designed in accordance with Frederick County Standard Details.

2.11 Water Pumping and Treatment

A detailed presentation of design criteria for pumping and treatment facilities is beyond the scope of this manual. The Town will specify the exact requirements to be met by the design of these facilities.

2.12 Water Storage

2.12.1 General

A water system must be able to meet the peak hour demand during the maximum demand day to be effective. However, it is not economically feasible for domestic water systems to provide sufficient supply capacity to meet these peak demands. Therefore, to stabilize pressure and also to provide the necessary reserve capacity to meet peak demand period, it is the usual practice to provide storage reservoirs as an integral part of any distribution system.

During periods of peak demand, such as fire conditions, the required volumes of water that cannot be provided from the system's supply source are taken from the system's distribution storage. During periods of low demand, the excess water from the supply source returns to storage until the facilities are again full, completing the cycle.

The criteria used to determine the proper size of storage facilities can best be understood in terms of the functions which storage facilities are intended to perform. These functions may be summarized as follows:

a. To provide an equalizing reserve.

b. To provide a fire reserve.

c. To provide an emergency reserve.

2.12.2 Equalizing Storage

The equalizing reserve is the quantity of water needed to even out or "equalize" the system demands during a day's operation. By providing this reserve, the storage facilities make it possible to operate the treatment facilities and pumping stations at a relatively uniform rate. When the system demand is higher than the supply rate, water is withdrawn from the storage facilities. Conversely, when the system demand is below the supply rate, water is returned to storage to ensure that an adequate quantity is available for the next period of high demand. In general, systems which have an equalizing reserve equal to 20% of their maximum daily demand operate satisfactorily.

2.12.3 Fire Reserve

The size of the fire reserve is indirectly set by the Insurance Services Office (ISO), formerly known as the National Board of Fire Underwriters. This agency sets standards for the amount of fire flow that should be available at various points in a community.

2.12.4 Emergency Reserve

The emergency reserve is included as a safeguard against disruptions in the supply source, ruptured water mains, well-pump interruptions, or other circumstances which would exert an additional demand on the storage facilities. Normally, the quantity allotted for emergencies is 25% of the total effective storage volume.

2.13 Repaving of Roads

2.13.1 General

a. All Town construction contract specifications shall include a "patch-pave" requirement as follows:

Properly compacted borrow aggregate backfill shall be placed and compacted from 3 inches below the pipe to the bituminous pavement subgrade. The pavement replacement shall consist of a base course of asphaltic concrete of at least a thickness equivalent to the original pavement section, the original wearing course cut back two-feet on all edges of the excavation and a new asphaltic concrete wearing course of at least a thickness equivalent to the original wearing course. Other road pavement sections will receive similar treatment. The base course shall be a minimum of 4-inches, and the wearing course shall be a minimum of 2-inches.

b. Patch-paving as outlined above is to be accomplished whether the roadway is to be re-paved or not.

c. House connection installations will require the same specifications for patch-paving.

d. All paving/repaving work will be accomplished in accordance with the Town Road Specifications or Design Manual. A "road cut" permit must be obtained from the Town when excavating within an existing Town maintained roadway.

e. Pavement patch in County or State roads shall comply with the requirements of the jurisdiction.

2.13.2 Timing of Patch-paving and/or Repaving

a. Specifications will provide that patch-paving shall be accomplished immediately after backfilling and achieving specified compaction for connection and small extension contracts; and at no greater than seven (7) calendar day intervals for larger projects. Temporary "cold patch" shall be required for patches not immediately patch-paved. The Town must be consulted if immediate patch-paving cannot be accomplished. Cold patching must be maintained by the Developer to the Town's satisfaction. The placement of steel plates over trenching may be approved by the Town on a case-by-case basis.

b. Repaving shall be specified to be accomplished in one continuous effort to best assure economy and consistency of quality work.

2.13.3 Traffic Control

All water utility construction projects shall have an approved traffic control plan, using requirements of the Manual on Uniform Traffic Control Devices.

3.0 CONTRACT DRAWINGS AND DOCUMENTS

3.1 Reports

For mains larger than 12-inches, three copies of a preliminary report shall be submitted to the Town. The report shall include a sketch of the preliminary layout and a summary of the design data.

3.2 Design Computations

a. Design engineers shall submit three copies of design data and calculations for all water projects. The computations shall be in accordance with methods presented in this manual.

b. The design data and computations shall include: average and peak demands, fire demand, and future requirements.

c. Design computations for all special structures shall be submitted. Where information pertinent to design, such as borings, has been collected, this information shall be submitted to the Town. The locations of borings shall be shown on the plan sheets, and the boring logs shall be included in the Contract Documents. See Appendix F for Geo-Technical Requirements. In addition, the Town reserves the right to require borings and geotechnical information.

3.3 Specifications

Contract specifications shall utilize the Town of Middletown Specifications or, in the absence of Town Specifications, the Frederick County Specifications will apply.

3.4 Contract Drawings

3.4.1 Preparation

Water main contract drawings shall be prepared on drawings separate from drawings detailing the road design. Separate drawings shall be used for each street.

3.4.2 Plan

a. Scale: 1 inch = 50 feet.

b. Method of Indicating Location

Generally, water mains and structures shall be located in Plan by dimensions from property markers or other well defined physical features. However, in areas where physical features are not available, coordinates of structures and bearings of water mains based on the Maryland Coordinate System NAD 83/91 shall be used.

c. Fittings

A list of all valves and fittings required shall be shown on each drawing.

d. Contract drawings shall include the property line surveys and all lot dimensions of the land bordering water extensions and shall indicate the names of the present owners of such property with the recording reference number of the deed, lot numbers, house numbers, subdivision names and block numbers, as well as existing rights-of-way or easements. When rights-of-way must be obtained, a right-of-way drawing for each property shall be provided, accompanied by a written description of each right-of-way.

3.4.4 Profile

Profiles shall be shown for all water mains. Profile shall be on same sheet as the Plan.

a. Scale

Scale of all profiles shall be 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical. Water main profiles on straight streets

shall be shown to correct scale. On curved streets, horizontal distances between structures shall be plotted using length of street centerline between radial projections to structures. The true length between structures shall be shown by figures.

b. Road Grades

Approved established grades shall be obtained from the Town. When such grades are not available, they shall be established by the design engineer and submitted to the Town for approval.

The established grade (noted as top of curb or centerline) shall be shown. Where water main is located in present or proposed pavement or shoulders, the existing centerline grade of road shall be shown. Where water main is outside pavement or shoulders for a length greater than 50 feet, existing ground over water main shall be shown and labeled.

c. Water Main on Fill

Where water main is to be constructed on fill, a profile of the undisturbed earth (at water main location) shall be shown.

3.4.5 Other Utilities

Other existing and proposed utilities shall be shown accurately and clearly in Plan and Profile.

3.4.6 Location and Design Information

A Location Plan showing well known streets at a scale of 1 inch = 200 feet shall appear on the first drawing of each set of Contract Drawings. A schematic layout of the proposed extensions to the water system and adjacent existing lines shall be shown. The location of existing valves which must be shut off when the new line is connected must be shown. Existing and proposed fire hydrants shall also be shown.

3.4.7 Special Details

Structures or details not included in the Standard Details shall be detailed clearly on the Contract Drawings, preferably where the detail is located in Plan.

3.4.8 One (1) copy of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

3.5 Estimate of Project Costs

The engineer shall submit an estimate of project costs for each contract, including contingent items and a 50% contingency based on the total cost of the project.

APPENDIX

WATER SYSTEM DESIGN MANUAL

APPENDIX A

BASIS FOR RESIDENTIAL WATER DEMAND PROJECTIONS FOR UNDEVELOPED OR PARTIALLY DEVELOPED AREAS

Zoning	Projected Population per Acre	Projected Dwelling Units per Acre	Projected Demand Per Acre Based on 200 GPD/dwelling	Avg Day Peaking Factor	Maximum Day Demand GPD/Acre
A	2.8	1.0	200	1.6	320
R-1	5.5	2.0	400	1.6	640
R-2	8.0	2.9	580	1.6	928
R-3	12.1	4.4	880	1.6	1408
R-4	40.0	14.5	2900	1.6	4640

Zoning	Projected Flow per Acre	Avg Day Peaking Factor	Maximum Day Demand GPD/Acre
COMMERCIAL (COMM) B-0, B-1, B-2, 0S	*500	1.4	700
LIGHT INDUSTRIAL LI, LIP	*500	1.3	650
HEAVY INDUSTRIAL GI	*1000	1.1	1100

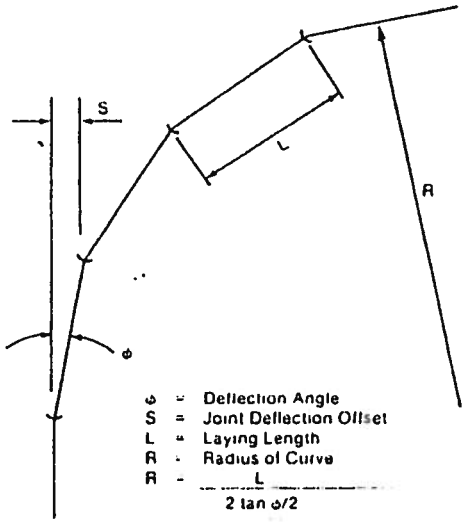
*Use Appendix D when the specific type of development is known. Use Frederick County Plumbing Code when a specific fixture count is known.

APPENDIX B
MAXIMUM JOINT DEFLECTIONS FOR PIPE

Maximum Joint Deflection Full-Length Pipe—Push-On Type Joint*

Nominal Pipe Size *in*	Deflection Angle - θ *deg*	Maximum Offset *S*† *in (m)* 18 ft (5.5 m) *L*†	Maximum Offset *S*† *in (m)* 20 ft (6.1 m) *L*†	Approx. Radius of Curve - *R*† Produced by Succession of Joints *ft (m)* 18 ft (5.5 m) *L*†	Approx. Radius of Curve - *R*† Produced by Succession of Joints *ft (m)* 20 ft (6.1 m) *L*†
3	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
4	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
6	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
8	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
10	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
12	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
14	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
16	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
18	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
20	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
24	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
30	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
36	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
42	2°	7½ (0.19)	8 (0.20)	510 (155)	570 (174)
48	2°	7½ (0.19)	8 (0.20)	510 (155)	570 (174)
54	1½°	5½ (0.14)	6 (0.15)	680 (207)	760 (232)

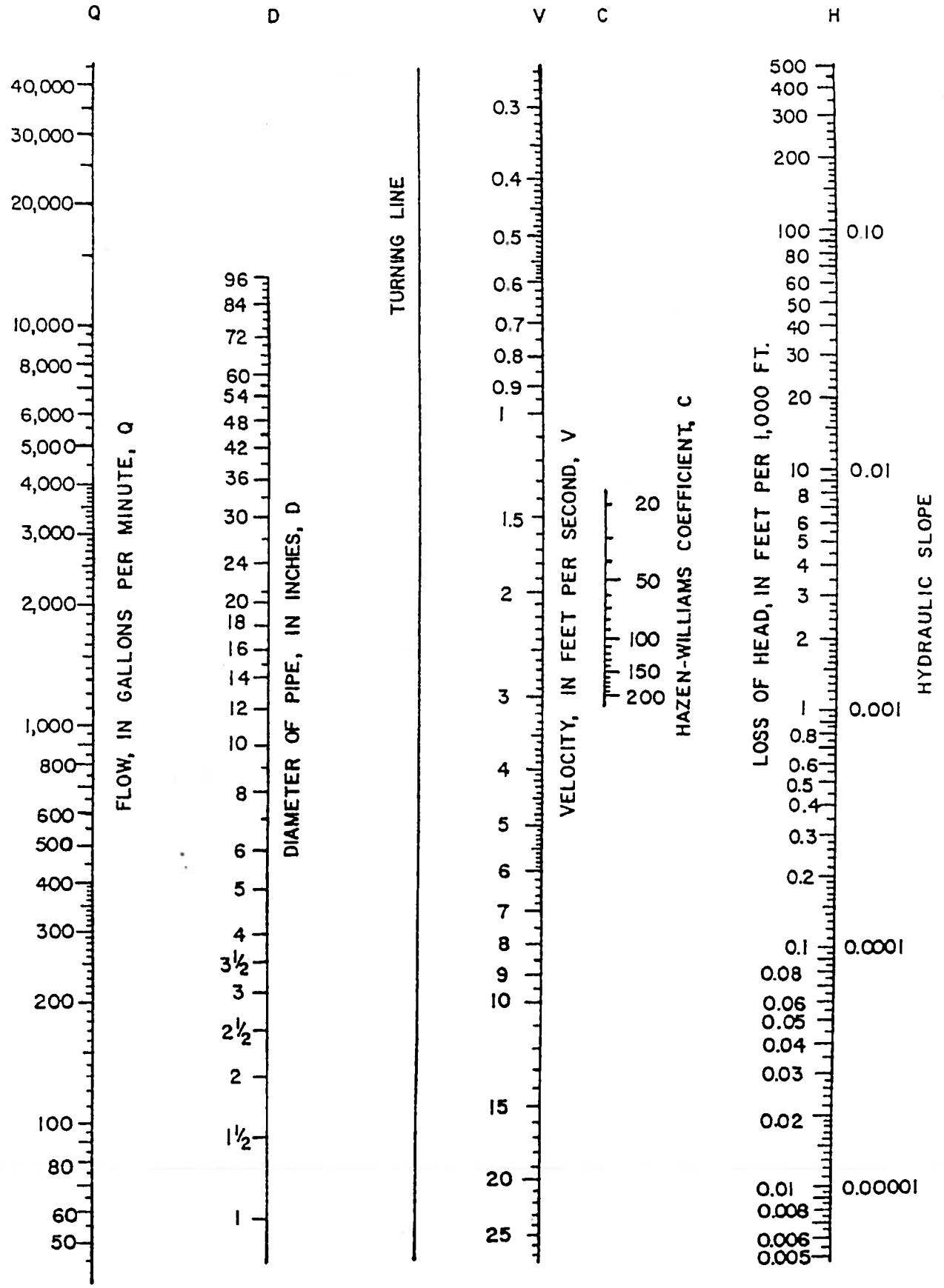
*For 14-in and larger push-on joints, maximum deflection angle may be larger than shown above. Consult manufacturer.
†See Figure 4.



Maximum Joint Deflection Full-Length Pipe—Mechanical-Joint Pipe

Nominal Pipe Size *in*	Deflection Angle θ *deg*	Maximum Offset *S** *in (m)* 18 ft (5.5 m) *L**	Maximum Offset *S** *in (m)* 20 ft (6.1 m) *L**	Approx. Radius of Curve *R** Produced by Succession of Joints *ft (m)* 18 ft (5.5 m) *L**	Approx. Radius of Curve *R** Produced by Succession of Joints *ft (m)* 20 ft (6.1 m) *L**
3	8-18	31 (0.79)	35 (0.89)	125 (38)	140 (43)
4	8-18	31 (0.79)	35 (0.89)	125 (38)	140 (43)
6	7-07	27 (0.69)	30 (0.76)	145 (44)	160 (49)
8	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
10	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
12	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
14	3-35	13½ (0.34)	15 (0.38)	285 (87)	320 (98)
16	3-35	13½ (0.34)	15 (0.38)	285 (87)	320 (98)
18	3-00	11 (0.28)	12 (0.30)	340 (104)	380 (116)
20	3-00	11 (0.28)	12 (0.30)	340 (104)	380 (116)
24	2-23	9 (0.23)	10 (0.25)	450 (137)	500 (152)
30	2-23	9 (0.23)	10 (0.25)	450 (137)	500 (152)
36	2-05	8 (0.20)	9 (0.23)	500 (152)	550 (167)
42	2-00	7½ (0.19)	8 (0.20)	510 (155)	570 (174)
48	2-00	7½ (0.19)	8 (0.20)	510 (155)	570 (174)

APPENDIX C
HAZEN-WILLIAMS NOMOGRAPH



APPENDIX D

GUIDELINES FOR DEVELOPING WATER DEMAND PROJECTIONS FOR COMMERCIAL ESTABLISHMENTS OR PUBLIC BUILDINGS

Office Buildings	Gross Sq. Ft. x 0.09 = gpd
Medical Office Buildings	Gross Sq. Ft. x 0.62 = gpd
Warehouses	Gross Sq. Ft. x 0.03 = gpd
Retail Stores	Gross Sq. Ft. x 0.05 = gpd
Supermarkets	Gross Sq. Ft. x 0.20 = gpd
Drug Stores	Gross Sq. Ft. x 0.13 = gpd
Beauty Salons	Gross Sq. Ft. x 0.35 = gpd
Barber Shops	Gross Sq. Ft. x 0.20 = gpd
Department Store with Lunch Counter	Gross Sq. Ft. x 0.08 = gpd
Department Store without Lunch Counter	Gross Sq. Ft. x 0.04 = gpd
Banks	Gross Sq. Ft. x 0.04 = gpd
Service Stations	Gross Sq. Ft. x 0.18 = gpd
Laundries and Cleaners	Gross Sq. Ft. x 0.31 = gpd
Laundromats	Gross Sq. Ft. x 3.68 = gpd
Car Wash without Wastewater Recirculation Equipment	Gross Sq. Ft. x 4.90 = gpd
Hotels	Gross Sq. Ft. x 0.25 = gpd
Motels	Gross Sq. Ft. x 0.23 = gpd
Dry Goods Stores	Gross Sq. Ft. x 0.05 = gpd
Shopping Centers	Gross Sq. Ft. x 0.18 = gpd
Hospitals (per bed space)	350 Gallons/per bed space/day = gpd
Nursing homes (per bed space)	125 Gallons/per bed space/day = gpd
Restaurants (per seat)	5 Gallons/seat/day = gpd
Schools:	
Boarding	00 Gallons/per person/day = gpd
Day, without gyms, cafeterias or showers	15 Gallons/per person/day = gpd
Day, with gyms, cafeterias and showers	.25 Gallons/per person/day = gpd
Day, with cafeterias but without gyms or showers	.20 Gallons/per person/day = gpd

APPENDIX E

MINOR LOSSES OF HEAD IN EQUIVALENT LENGTHS

Nature of Resistance	Loss in Pipe Diameters
Angle Valve	
Open	170
Check Valve	
Swing Type, Open	80
Gate Valve	
Wide Open	7
¼ Closed	40
½ Closed	200
¾ Closed	850
Globe Valve	
Open	340
Standard Elbow	32
Long Swing Elbow	20
45-Degree Elbow	15
Tee	
Flow Through Run	20
Flow Side to Run or Run to Side	
No Throat	66
With Throat	45
Lateral	45
Sudden Contraction	
d/D = ¼	15
d/D = ½	12
d/D = ¾	7
Sudden Enlargement	
d/D = ¼	32
d/D = ½	20
d/D = ¾	7

APPENDIX F

GEO-TECHNICAL REQUIREMENTS FOR UTILITY DESIGN AND CONSTRUCTION INSPECTION

PURPOSE

The following is intended to provide guidance to the engineer and contractor in their pursuit of the project and not to specifically dictate their activities.

DESIGN PHASE

Geotechnical services provided during water utilities design shall include the selection of boring and test pit locations, and the selection of sample types and intervals, the selection of field and laboratory test procedures, and the preparation of a geotechnical report. At a minimum, the report shall include the following:

1. Project overview.

2. Types of measures that will be needed to check stabilization of excavations and provide values of design parameters (lateral earth pressure distribution, allowable slopes).

3. Need for dewatering systems that may be needed and provide description of groundwater conditions over project limits of work.

4. Foundation preparation measures to be used.

5. Allowable bearing pressures, anticipated total and differential settlement, pipe bedding requirements, etc., to support design loads.

6. Backfill material characteristics required.

7. Estimated volumes of borrow.

8. The level of compaction needed to satisfy design criteria and methods of achieving this compaction through appropriate combinations of compaction equipment, water contents, and lift thicknesses.

9. Pavement design considerations.

10. Pavement reconstruction considerations - address need for road reconstruction around excavations.

11. The basis that will be used for field evaluation of material suitability, adequacy of compaction, acceptability of shoring, etc.

12. The potential sources and magnitudes of uncertainty in geotechnical conditions.

13. Guideline construction specification with respect to geotechnical requirements.

14. Potential for encountering sink holes and mitigation measures for avoidance.

15. Soil boring logs within area of construction and stormwater management facilities.

16. Impact on nearby wells and springs and mitigation measures to assure full compliance with Middletown Wellhead Protection Ordinance.

CONSTRUCTION PHASE - FIELD IMPLEMENTATION OF GEOTECHNICAL REPORT RECOMMENDATIONS

Implementation of geotechnical report recommendations and design requirements is critical to satisfactory completion of the project. The following guidelines are to be followed by the project inspector.

1. The design phase geotechnical engineer should be involved during construction. (Depending on the size of the project, this involvement could range from telephone consultation to on-site inspections. However, geotechnical expertise should be available during construction.)

2. A qualified testing laboratory should be engaged.

3. The geotechnical report prepared during design should be provided to the inspector prior to construction. Both the inspector's office and field personnel should be familiar with all aspects of the report, including, but not necessarily limited to the following:

    a. Existing conditions.
    b. Feasibility of using materials from trench for backfill.
    c. Appropriate compaction methods for excavated materials.
    d. Procedures for selecting and approving borrow sites.
    e. Appropriate compaction methods for borrow materials.
    f. Recommendations for when select materials should be used.
    g. Appropriate methods for compaction of select materials.
    h. Appropriate methods for monitoring 'c', 'e', and 'g' above:
        (1) Sampling.
        (2) Laboratory testing.
        (3) Field testing.
    i. Location of sink hole prone areas and mitigation measures for avoidance.

    The inspection personnel must have a sound working understanding of the geotechnical report in order to effectively implement its recommendations. Therefore, this responsibility should be clearly defined in the scope of services for inspection.

4. In consultation with the design geotechnical consultant, the resident inspector should develop a written plan for implementation of the recommendations of the geotechnical report. This plan should include the following:

a. Identification of the person responsible for insuring adherence to geotechnical report recommendations in the field. Because immediate field decisions are usually required at some time during construction, this person should be well grounded in the subject of backfill materials, methods and compaction, and at least knowledgeable enough to recognize field conditions that do not conform with the geotechnical report and to seek necessary assistance.

b. Establishment of general criteria for use by the field representative in meeting the requirements of the geotechnical report:
   (1) Frequency of standard Proctor determinations.
   (2) Frequency of soil density determinations.
   (3) Criteria for using visual characteristics and soil consistency for spot determinations of backfill material suitability without consulting geotechnical experts.
   (4) Criteria for using visual characteristics and soil consistency for spot determinations of compaction suitability without soil density determinations.

c. Establishment of procedures for detailed record-keeping using a daily inspection report form. This form would require that each of the following be addressed:
   (1) Conditions encountered.
   (2) Help sought from supervisors, geotechnical engineer, etc.
   (3) Location of field tests.
   (4) Weather conditions.
   (5) Notations on visual and manual observations.
   (6) Exceptions to geotechnical report recommendations (field decisions).

AS-BUILT DRAWING

I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

_____

ENGINEER DATE P.E. NO.

	AS-BUILT DRAWING STATEMENT	TOWN OF MIDDLETOWN

BURGESS AND COMMISSIONERS OF MIDDLETOWN
PUBLIC WORKS POLICY
WATER AND SEWER TAP FEES

1. All subdivision lots must be served by community water and community sewerage systems as required in the Town subdivision regulations.

2. The allocation of water and sewer taps shall only be awarded as follows:
   (a) by the approval and recording of a final subdivision plat, or
   (b) by the approval of a site development plan, or
   (c) to those existing lots of record predating the subdivision regulations.

3. Firm commitment for water and sewer taps shall be reserved on a first come, first serve basis for those properties meeting the criteria of #2 above and by the payment in full of the required tap fees. However, the Town of Middletown reserves the option to repurchase in full and reallocate committed taps if not utilized as evidenced by an approved building permit within twelve (12) months of the date of commitment.

4. No more than 20 taps may be allocated to a single developer or user within a period of twelve (12) months unless otherwise specified in an Annexation Agreement.

5. Residential taps will be based on an average daily flow of 300 gallons per day (gpd). One (1) tap shall be required per residential dwelling unit. Commercial, industrial, and institutional taps will be allocated according to 300 gpd equivalent units based on Fredreick County Water and Sewer Department fixture unit values.

THE ABOVE WATER AND SEWER ALLOCATION POLICY IS IN CONFORMANCE WITH AUTHORITY GRANTED IN ARTICLE IV, SECTION 4.3 OF THE MIDDLETOWN SUBDIVISION REGULATIONS.

RATES ARE ESTABLISHED BY AUTHORITY SET FORTH IN SECTION 4-2603 OF THE CODE OR ORDINANCES, TOWN OF MIDDLETOWN, MARYLAND.

NOTE: Land requesting annexation for the purpose of present or future subdivision may be assessed a per unit Improvement Fee in addition to standard connection (tap fees) as part of the Annexation Agreement. This fee must be paid along with standard connection fees (prior to the issuance of a building permit) at the current rate. Following annexation, no additional Impact Fees may be assessed per unit where the per unit Improvement Fee has been agreed upon as part of the annexation agreement. This does not preclude other special and/or general assessments agreed upon in the Annexation Agreement for special improvements peculiar to the particular site being annexed or to provide adequate public facilities or a portion of those facilities required by Adequate Public Facilities Ordinances.

Impact Fees may be assessed upon a subdivision on a site already within the municipal boundaries during the Planning Review Stage of the subdivision process in addition to the current standard connection (tap fees). These per unit fees must be paid prior to issuance of a building permit.

Revision Adopted: ~~July 8, 1991~~ 9/12/95

RESOLUTION NO. 99 - 05

A RESOLUTION TO REPEAL RESOLUTION 95 -01 AND TO SET NEW RATE SCHEDULES FOR WATER AND SEWAGE CONNECTION FEES (TAP FEES)

WHEREAS: The Burgess and Commissioners of Middletown have incurred considerable public debt for the purpose of improving and upgrading the water supply and sewage treatment infrastructure of the Town. The cost of the new water treatment and distribution system was approximately $1.55 M of which $1.35 M is financed by a 20-year loan from the Maryland Department of Housing and Community Development Infrastructure Bond Program. The total cost of implementing the new waste water treatment facility will be approximately $3.7 M, to be financed by a 20-year loan from the Maryland Department of Environment Water Quality Financing Administration.

WHEREAS: Because a significant portion of the benefits derived from the new waste water treatment plant will accrue to future developers, it is appropriate that a new rate schedule for tap fees be implemented that will provide a cash flow from future land development sufficient to ensure repayment for the WQFA loan and to restore a cash reserve in the Town's Water and Sewer Account to cover future facility expansion and state-mandated changes to the water and sewer systems.

WHEREAS: Section 4-2603 of the Code of Ordinances of the Town of Middletown authorizes the Burgess and Commissioners to set or modify by resolution a rate schedule for water and sewer usage and for connection to the Town water and sewer system.

NOW, THEREFORE, BE IT RESOLVED BY THE BURGESS AND COMMISSIONERS OF MIDDLETOWN:

1. Resolution 95-01, August 14, 1995, is hereby repealed. As of the effective date of this Resolution, the rate and fee schedules delineated in the paragraphs to follow are applicable and shall be charged to and paid by any landowner, developer, or applicant applying for a connection to the Town's water and sewer system.

2. In the event that any landowner, developer or applicant for water and/or sewer connection to the Town's system enters into a Public Works Agreement with the Town by May 10, 1999, then the rates to be charged to such landowner, developer or applicant shall be as follows:

Water Connection Fee:	$2,000.00
Sewer Connection Fee:	$2,000.00
Water/Sewer System Improvement Fee:	$2,000.00
Total Tap Fee	$6,000.00

3. The Public Works Agreement referred to in Paragraph 2, above, shall be on the terms and conditions as agreed upon between the Town and the landowner, developer or applicant **and** shall guarantee that the $6,000.00 total tap fee shall be paid up front for at least 90% of all the units to be built, in advance of the issuance of the first building permit.

4. In the event that no such agreement can be reached by May 10, 1999, the landowner, developer or applicant shall be subject to the following rates per building unit:

Water Connection Fee:	$2,500.00
Sewer Connection Fee:	$2,500.00
Water/Sewer System Improvement Fee:	$3,000.00
Total Tap Fee	$8,000.00

5. Landowners or Applicants with four or less building sites will continue to be charged the fees indicated in paragraph 2.

6. The above rates will remain in effect until January 1, 2004. As of that date, the Town will review and revise the tap fee rates based on future infrastructure needs.

NOW BE IT FURTHER RESOLVED, that this resolution is effective this

_____ day of _____, 1999.

ATTESTED:

BURGESS AND COMMISSIONERS OF MIDDLETOWN, MARYLAND

_____
Andrew J. Bowen, Town Administrator

_____
William M. Thompson, Burgess

100W+

Water Communication Module

The 100W+ communication module is the latest addition to Itron's portfolio of advanced metering devices for water utilities. Featuring a compact design, industry-leading battery life and technology designed to adapt and grow with your business, the 100W+ module can help you streamline your operations and maximize your resources today and into the future.

The 100W+ communication module represents the fourth evolution in Itron's line of 100 series water communication modules. This latest release includes a new message called SCM+ with more information than previous generation messages. Additionally, the 100W+ offers industry leading capabilities in security, fixed network performance and improved meter consumption resolution to 9 dials (1/100th gallon).

» 100W+ communication modules are available in two housing designs, supporting both water pit and remote installations. They are identified as follows:

» 100W+ is to be utilized with encoder registers in a pit environment

» 100WP+ for pulser registers in a pit environment

» 100W-R+ for encoder registers in remote applications

» 100WP-R+ for with pulser registers in remote applications

These communication modules offer advanced two-way meter data collection designed specifically for Itron collection systems using handheld, mobile, fixed network and hybrid solutions. 100W+ communication modules differentiate themselves from other devices on the market by providing true two-way communications capabilities with walk-by, drive-by and fixed network collection systems. Engineered from the ground up to leverage the benefits of ChoiceConnect™ collection systems, 100W+ communication modules enable easy migration from mobile to fixed network operations as your business needs evolve. With Itron's complementary communications technology, fixed and mobile network systems can be deployed side-by-side in hybrid configurations to ensure maximum efficiency and reliability in both high and low-density meter populations.

SCM+

SCM+ is a new message for Itron's electric, gas and water endpoints. This message transmits more information than previous generation messages, including:

» All tampers and alarms (including extended tampers and low battery alarm)

» Up to 1/100th gallon resolution of water meters that support 9 dials

Itron Security Manager

The 100W+ offers optional enhanced security with the addition of authentication and encryption. In parallel to the 100W+ release, Itron released the Itron Security Manager (ISM) solution. ISM represents the initial launch of a new security application that will provide the cryptographic and key management services for Itron's Fixed Network, Field Deployment Manager (FDM) and Field Collection System (FCS) solutions. The ISM application, working in concert with these data collection systems will provide a new application layer of security. This enables authentication of commands and encryption of data communications from the reading applications to new 100 Series communication modules. These enhanced security services will provide added confidentiality, data integrity and availability that utilities require to secure their communications. Every 100W+ will ship with embedded security keys to support utilities current and future requirements for enhanced secure communications. To enable enhanced security, utilities will need Itron Security Manager v1.0, FDM Endpoint Tools Enhanced v3.3 and 100W+ security keys (part number SEC-0000-002).

GeoMode

In order to continually improve our fixed network performance, the 100W+ has added the GeoMode feature. GeoMode is a valuable tool used to read 100W+ communication modules that are installed in RF-unfriendly environment as well as modules installed on the fringe of network coverage. This tool will allow a 100W+ that is not being heard by the fixed network to transmit its NIM (Network Interval Message) via a neighboring 100W+ that has an established link to FN. GeoMode will not impact the 100W+ industry-leading battery performance. Using the GeoMode feature requires Network Software v5.0. Modules in GeoMode may still be read by Itron handheld and mobile systems.

Water Meter Compatibility

The 100W+ communication module is compatible with water meters from all major manufacturers such as Badger, Elster AMCO, Hersey, Master Meter, Neptune and Sensus, enabling water utilities to consolidate all their water meters under a single reading system. Powered by proven, advanced lithium battery technology; the module is designed for 20 years of battery life in both fixed network and mobile modes.

Data Logging

The 100W+ stores 40 days of hourly consumption information, which can be collected by the fixed network system to leverage real time data collection or can be read by mobile or handheld systems. This data is presented in four basic use cases:

» A reading from any hour within the last 40 days

» A set of 24 consecutive hourly readings

» A set of 40 daily readings

» A set of 40 days of hourly interval data are available even in mobile mode

Superior Performance

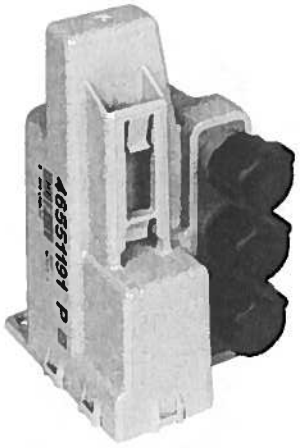
The 100W+ communication module utilizes 120 radio channels in fixed network and 50 radio channels in mobile and handheld modes, randomly selecting one channel for each data message. Itron's unique multi-channel solutions maximize the use of all available bandwidth, allowing more data to flow through the network and enabling faster drive-by speeds. The 100W+ will transmit the fixed network consumption message at peak radiated power greater than 1Watt.

Reliability

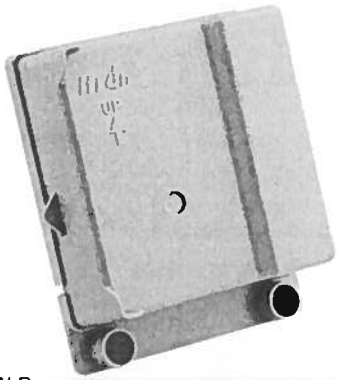
100W+ communication modules feature a circuit assembly and battery pack that are fully encapsulated within a specially-formulated potting material to completely protect internal components from water, contaminants, corrosion, rough handling and temperature cycling. With their straight forward, rugged design, 100W+ communication modules use substantially fewer components than most competing products, resulting in greater reliability. The advanced, integrated antenna operates effectively in a wide range of meter box installations. The 100W+ offers peace of mind with a 20 year limited warranty.

Lower Cost of Ownership

100W+ communication modules feature industry-leading battery life , ensuring your meter data collection investment achieves substantially better financial returns than competing products with batteries that typically last only ten or twelve years. When one considers the advancements in leak, reverse flow (absolute encoder version only) and tamper detection, 100W+ communication modules necessitate fewer field investigations and substantially lower expenditures for installation, meter reading, customer service and field service. And with a low battery alarm, these modules help utilities better plan and manage the replacement of units in the field.



100W+



100W-R+

Leak Management

Water loss management is critical to any water utility's success. 100 Series modules can be paired with Itron's advanced acoustic Leak Sensor. The Leak Sensor collects and analyzes changes in pipe acoustics that indicate probable leaks in the distribution system environment to detect both new and pre-existing leaks automatically. Leak Sensor technology, coupled with the module's internal customer-side leak detection algorithm and the option to use data from groups of 100W+ communication modules (District Metering) provide the utility with a highly accurate picture of the overall health of the water distribution system.

Leak Data

The 100 Series collects and stores the data from the Leak Sensor. The Leak Sensor samples the pipe conditions every 22.5 minutes or 64 times daily. The 100 Series stores the 8 quietest analyses daily and will hold 20 days worth of data. This data is picked up during normal meter reading operations and seamlessly transfers the data to our hosted web based solution (mlogonline).

100W+ COMMUNICATION MODULE SPECIFICATIONS

The 100W+ can be identified by new part number ERW-1300-3XX and units have a + signifier.

Functional

» Power Source: Two "A" cell lithium batteries warranted for 20 years

» Operating temperature: -
- -40°C to +70°C for remote applications
- -20°C to +60°C for pit applications

» Storage temperature: -40°C to + 75°C for maximum of 1,000 hours

» Humidity limits: 0 to 100% (submersible)

» Maximum register cable dimension: 300 feet with Itron-approved cable and splice connectors

» Meter compatibility: See Water Module Meter Compatibility Guide (PUB-0063-002)

Transmission Parameters

» Data message: Multiple RF channel transmissions of meter register value, cut cable and or communication error tamper(s), reverse flow (encoder version only) and system leak status messages, as well as low battery indicator is transmitted every ten seconds in mobile mode. All this information and last 7 time synchronized consumption intervals is transmitted every six minutes along with a contingency SCM+ (Standard Consumption Message) every 60 seconds in fixed network mode

» Transmitter frequencies:
- 908 - 924MHz (Standard Power) in mobile mode
- 923 – 926.8MHz (High Power) in fixed network mode

» Operates in bubble-up mode and does not require a license from the Federal Communications Commission (FCC) or Industry Canada (IC)
- FCC Part 15.247
- Industry Canada RSS-210

Approved Network Reading Systems

» Network system: Itron Fixed Network 100 Collectors and Repeaters (CCU 100 and Repeater 100) which offer full two-way communication capability.

» ChoiceConnect Fixed Network software v4.1 or higher

» If using enhanced security, Itron Security Manager (ISM) v1.0 or higher, is also required

Approved Mobile Reading Systems for SCM+ alone

» Mobile data collection hardware when used with software listed below:
- Any MC3 radio with Mobile Collection Software 3.4 or higher
- Any MC Lite radio
- Any FC200 handheld computer with SRead radio
- Any FC300 handheld computer with SRead radio

» Mobile data collection software:
- Multi-Vendor Reading System (MV-RS) v8.3 or higher
- Field Collection System (FCS) v2.4 or higher

Approved Mobile Reading Systems for Data Logging Reads

» Mobile data collection hardware when used with software listed below:
- Datalogging capable MC3 radios with Mobile Collection Software 3.4 or higher
- Datalogging capable MC Lite radios
- FC200 handheld computers with Datalogging capable SRead radio
- Any FC300 handheld computer with SRead radio

» Mobile data collection software:
- Multi-Vendor Reading System (MV-RS) v8.3 or higher
- Field Collection System (FCS) v2.5 or higher

Approved Mobile Reading Systems for Enhanced Security Reads

» Mobile data collection hardware when used with software listed below:
- Datalogging capable MC3 radios with Mobile Collection Software 3.5 or higher
- Datalogging capable MC Lite radios
- FC200 handheld computers with Datalogging capable SRead radio
- Any FC300 handheld computer with SRead radio

» Mobile data collection software:
- Field Collection System (FCS) v2.5 or higher
- Itron Security Manager (ISM) v1.0 or higher

Approved Programming Systems

» FC200SR handheld computers

» FC300SR handheld computers

» 900 MHz Belt Clip Radios

» Field Deployment Manager (FDM) v3.3 or higher

» If using enhanced security, Itron Security Manager (ISM) v1.0 or higher, is also required

The 100W encoder version does not require any programming—it automatically detects the register type within one hour of being connected.

Programmable Mode Options

» Mobile/Handheld Mode
  - This is the standard mode in which all 100W+ communication modules will be shipped. This mode should be utilized when mobile or handheld meter reading will be the primary method of collecting the SCM+ or datalogging reads.
  - The SCM+ will bubble-up in this mode every 10 seconds at standard power optimized for mobile read rate performance.
  - The battery life for this mode is 20 years

» Fixed Network (FN) Mode
  - This mode is to be utilized when fixed network will be the method of meter data collection
  - A high power Network Interval Message (NIM) will be transmitted every 6 minutes with a contingency SCM+ message transmitted every minute at standard power
  - FN mode can be programmed at the factory, during installation with an approved handheld device or through mobile application after initial installation and programming
  - The battery life for this mode is 20 years

Programmable Mode Options (cont.)

» Hard-to-Read Mobile/Handheld Mode
  - This mode should only be used when communication modules are installed in difficult to read locations where standard mobile mode is not sufficient for satisfactory reading performance
  - This mode will bubble-up an SCM+ at 30 seconds with high power output to optimize performance of these unique applications
  - The battery life of this mode is greater than 10 years

» High Power Mobile Mode
  - This mode should be used when communication modules are installed in difficult to read environments and where standard mobile mode is not sufficient for satisfactory reading performance
  - This mode will bubble-up and SCM at 60 seconds with a higher power output to optimize performance of these unique applications
  - Battery life for this mode is 20 years

100W+ & 100WP+ Pit Dimensions

» Height: 4.5 inches

» Maximum diameter:
  - Lower: 3.90 inches
  - Upper: Approx. 1.70 inches

» Weight: Approx. 9.6 oz.

» Module cable length without integral connector: 5 feet and 20 inches (for register direct mounting)

» In-line connector register cables: 5 feet and 25 feet (ordered separately)

» Pit models can be installed up to 300 Ft from meter

100W-R+ & 100WP-R+ Remote Dimensions

» Height: 4.5 inches

» Width: 5.05 inches

» Depth: 1.47 inches

» Weight: Approx. 9.6 oz.

» Module cable length 10 inches

» Remote models can be installed up to 300 ft from meter

Mounting Options

The 100W+ and 100WP+ models have a compact housing and features specifically designed for water pit mounting options

» Direct-mount for Badger, Elster and Hersey meters

» Rod-mount on a ½ inch diameter fiberglass or other non-metallic rods

» Shelf-mount for pit lid manufactures that contain recessed cavity on the underside of the pit lid

» Through-the-lid mounting with a pre-drilled 1.75 inch hole and up to 2.5-inch maximum lid thickness

» Direct-mount to any flat surface with screw kit

The 100W-R and 100WP-R models are designed for remote mounting applications

» Wall-mount for installation to the side of residence or building using screw kit

» Pipe-mount for installation on pipe sizes from ¾ inch up to 4 inch

» Direct-mount for Badger and Elster meters

» Direct-mount for Badger and Elster meters

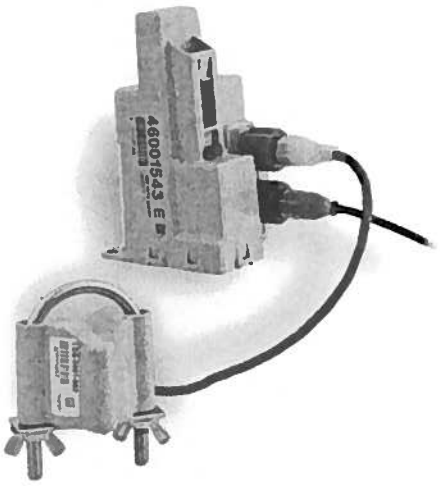
Itron

Itron is a global technology company. We build solutions that help utilities measure, monitor and manage energy and water. Our broad product portfolio includes electricity, gas, water and thermal energy measurement and control technology; communications systems; software; and professional services. With thousands of employees supporting nearly 8,000 utilities in more than 100 countries, Itron empowers utilities to responsibly and efficiently manage energy and water resources.

Join us in creating a more resourceful world; start here: **www.itron.com**

CORPORATE HEADQUARTERS
2111 N Molter Road
Liberty Lake, WA 99019
USA

Phone: 1.800.635.5461
Fax: 1.509.891.3355



100W + Leak Sensor

The American Society of Civil Engineers estimates that seven billion gallons of water go unaccounted for every day in the U.S. alone. This can be attributed, in part, to the accuracy of the water meters in older systems. But more commonly, a good portion of this unaccounted for water is the result of leaking pipes and aging infrastructure.

With Itron's 100W ERT® module + Leak Sensor, utilities now have a new approach to distribution system maintenance at their fingertips. The 100 ERT module, when deployed with an integrated Leak Sensor, monitors the utility's entire distribution system around the clock, acoustically surveying the integrity of the system. The 100W + Leak Sensor helps utilities find small leaks before they become large, costly leaks for the utility.

Integrated Technology

The 100W ERT module offers advanced capabilities such as full two-way communications to the meter and time-synchronized interval meter data. Itron's data collection technology provides utilities with absolute flexibility, whether deployed in an Advanced Metering Infrastructure (AMI) environment, an Automated Meter Reading (AMR) environment, in walk-by situations or in environments where a hybrid solution makes the most sense depending on what best fits the utilities business needs.

The 100W ERT module connects to a Leak Sensor via an in-line connector and is completely waterproof. Leak detection data can be gathered using either an FC300SR for walk-by downloading of data, Mobile Collector 3 (MC3) or Mobile Collector Lite (MCLite) for mobile AMR, or via Itron AMI fixed networks.

The level of flexibility with the 100W + Leak Sensor means it can be used as a stand-alone leak detection system unattached to a water meter in either AMI fixed network, or AMR mobile environments.

Leak Data

The 100W ERT module collects and stores the data from the Leak Sensor. The Leak Sensor samples the pipe conditions every 22.5 minutes or 64 times daily. The 100W stores the eight quietest analyses daily and will hold 20 days worth of data. This data is picked up during normal meter reading operations and seamlessly transfers the data to our hosted Web-based solution, mlogonline.

Revenue Protection

Implementing a Water Loss Program gives a utility the ability to find revenue that is lost through leaks in their system. Finding and repairing these leaks provides real revenue savings by reducing the amount of water the utility either has to pump or buy.

With the 100W + Leak Sensor system, utilities can protect their water revenues, with the potential to save hundreds of thousands of dollars each year.

Water Meter Compatibility

The 100W + Leak Sensor is compatible with industry-leading water meters from Itron–as well as those from all major manufacturers, enabling water utilities to consolidate all their water meters under a single system.

Superior Performance

The 100W + Leak Sensor utilizes 120 radio channels in fixed network mode and 50 radio channels in mobile and handheld modes, randomly selecting one channel for each data message. The 100W ERT module will transmit the Fixed Network consumption messages at peak radiated power greater than 1 Watt.

Reliability

100W ERT modules feature a circuit assembly and battery pack that are fully encapsulated within a specially-formulated potting material to completely protect internal components from water, contaminants, corrosion, rough handling and temperature cycling.

Lower Cost of Ownership

100 Series devices feature industry-leading 20 year battery life, ensuring your meter data collection investment achieves substantially better financial returns than competing products with batteries that typically last only 10 or 12 years.

BENEFITS

The 100W + Leak Sensor solution delivers unprecedented leak detection capabilities including:

» Advanced acoustic leak detection monitoring and meter data collection in a compact form for easy field installation and lower cost of ownership

» Automated capture and data transmission of actual vibration recordings to the utility for advanced analysis and applications, rather than simple yes/no flags

» Historical leak detection data for interpretation, prioritization and leak mitigation

100W SPECIFICATIONS

100 Series ERT Module

The 100W ERT module is available in two housing designs, supporting both water pit and remote installations.

» 100W is to be utilized with encoder registers in a pit environment

» 100WP for pulser registers in a pit environment

» 100W-R for encoder registers in remote applications

» 100WP-R for with pulser registers in remote applications

Functional

» Power Source: Two "A" cell lithium batteries warranted for 20 years

» Maximum meter register pulse frequency (pulse version only): 4 Hertz

» Operating temperature:
- -40°C to+70°C for remote applications
- -20°C to+60°C for pit applications

» Storage temperature: -40°C to + 75°C for maximum of 1,000 hours

» Humidity limits: 0 to 100% (submersible)

» Maximum register cable dimension: 300 feet with Itron-approved cable and splice connectors

» Meter compatibility: See Water Endpoint Meter Compatibility Guide (PUB-0063-002)

Transmission Parameters

» Data message:
Multiple RF channel transmissions of meter register value, cut cable and or communication error tamper(s), reverse flow (encoder version only) and system leak status messages, as well as low battery indicator is transmitted every nine seconds in mobile mode. All this information and last eight time-synchronized consumption intervals are transmitted every five minutes along with a contingency SCM (Standard Consumption Message) every 60 seconds in fixed network mode

» Transmitter frequencies:
- 908–924 MHz (Standard Power) in mobile mode
- 923–926.8 MHz (High Power) in fixed network mode
- Operates in bubble-up mode and does not require a license from the Federal Communications Commission (FCC) or Industry Canada (IC)
  - FCC Part 15.247
  - Industry Canada RSS-210

Approved Reading Devices for Collecting Datalogging Reads

» Network system: Itron Fixed Network 100 Collectors and Repeaters (CCU 100 and Repeater 100) which offer full two-way communication capability

» Drive-by system:
- MC3 with MV
- RS v8.0 or higher and FCS with v2.2 or higher
- MCLite with MV
- RS v8.1 or higher and FCS with v2.3 or higher

» Walk-by system:
- FC300 with SRead handheld computers with MV-RS v8.1 or higher and FCS with v2.3 or higher
- FC200SR (part number FC2-0005-004 or FC2-0006-004 will support datalogging) handheld computer with MV-RS v8.1 or higher and FCS with v2.3 or higher

Approved Reading Applications

Multi Vendor Reading System (MV-RS) version 8.1 or higher software can read the 100W Standard Consumption Message (SCM) and Datalogging with the following reading devices:

» MC3 version 3.3 or higher

» Multi Vendor Reading System (MV-RS) version 8.2 or higher software can read the 100W Standard Consumption Message (SCM) and Datalogging with the following reading devices: MC3 version 3.3 or higher, FC200SR, FC300SR and MCLite

» Field Collection System (FCS) version 2.2 or higher software

» 900 MHz Belt Clip Radio with Field Deployment Manager (FDM) version 1.1 or higher software

Approved Programming Devices

» FC200SR with Field Deployment Manager (FDM) version 1.1 or higher software

» FC300SR with Field Deployment Manager (FDM) version 1.1 or higher software

» 900 MHz Belt Clip Radio Field Deployment Manager (FDM) version 1.1 or higher software

The 100W encoder version does not require any programming—it automatically detects the register type within one hour of being connected. 100W ERT modules do not require a FCC license.

Programmable Mode Options

» Mobile/Handheld Mode
- This is the standard mode in which all 100W ERT modules will be shipped. This mode should be utilized when mobile or handheld meter reading will be the primary method of collecting the Standard Consumption Message (SCM) or datalogging reads
- The SCM will bubble-up in this mode every 9 sec. at standard power optimized for mobile read rate performance
- The battery life for this mode is 20 years

» Fixed Network (FN) Mode
- This mode is to be utilized when fixed network will be the method of meter data collection
- A high power Network Interval Message (NIM) will be transmitted every 5 minutes with a contingency SCM message transmitted every minute at standard power
- FN mode can be programmed at the factory, during installation with an approved handheld device or through mobile application after initial installation and programming
- The battery life for this mode is 20 years

» Hard-to-Read Mobile/Handheld Mode
- This mode should only be used when communication modules are installed in difficult to read locations where standard mobile mode is not sufficient for satisfactory reading performance
- This mode will bubble-up an SCM at 30 seconds with high power output to optimize performance of these unique applications
- The battery life of this mode is greater than 10 years

» High Power Mobile Mode
- This mode should be used when communication modules are installed in difficult to read environments where there is a high concentration of unfriendly RF and where standard mobile mode is not sufficient for satisfactory reading performance
- This mode will bubble-up and SCM at 60 seconds with a higher power output to optimize performance of these unique applications
- Battery life for this mode is 20 years

100W & 100WP Pit Dimensions

» Height: 4.5 inches

» Maximum diameter:
- Lower: 3.90 inches
- Upper: Approx. 1.70 inches

» Weight: Approx. 9.6 oz.

» Module cable length without integral connector: 5 feet and 20 inches (for register direct mounting)

» In-line connector register cables: 5 feet and 25 feet (ordered separately)

» Pit models can be installed up to 300 Ft from meter

100WR & 100WP-R Remote Dimensions

» Height: 4.5 inches

» Width: 5.05 inches

» Depth: 1.47 inches

» Weight: Approx. 9.6 oz.

» Module cable length 10 inches

» Remote models can be installed up to 300 ft. from meter

LEAK SENSOR SPECIFICATIONS

Mounting Options

The 100W and 100WP models have a compact housing and features specifically designed for water pit mounting options.

- Direct-mount for Badger, Elster and Hersey meters
- Rod-mount on a ½ inch diameter fiberglass or other non-metallic rods
- Shelf-mount for pit lid manufactures that contain recessed cavity on the underside of the pit lid
- Through-the-lid mounting with a pre-drilled 1.75 inch hole and up to 2.5-inch maximum lid thickness
- Direct-mount to any flat surface with screw kit
- The 100W-R and 100WP-R models are designed for remote mounting applications
- Wall-mount for installation to the side of residence or building using screw kit
- Pipe-mount for installation on pipe sizes from ¾ inch up to 4 inch
- Direct-mount for Badger and Elster meters

*Hardware/Software upgrades/updates may be required

Sensing

- Sensitivity: 1V/g
- Range: Up to ±300 linear feet of pipe of any size
- Bandwidth: 10Hz – 1,000Hz Power
- Source: Powered by the 100W ERT module

100W Functional Specifications

- 100W Power Source: Two "A" cell lithium batteries warranted for 20 years
- Maximum meter register pulse frequency (pulse version only): 4 Hertz
- Operating temperature:
  - -40°C to +70° C for remote applications
  - -20°C to +60° C for pit applications
- Storage temperature: -40°C to + 75°C for maximum of 1,000 hours
- Humidity limits: 0 to 100% (submersible)
- Maximum register cable dimension: 300 feet with Itron-approved cable and splice connectors
- Meter compatibility: See Water Module Meter Compatibility Guide (PUB-0063-002)

Leak Sensor

- Operating temperature: -10° to +50° Celsius
- Operating humidity: Up to 100% relative humidity
- Product identification: Numeric and bar-coded serial number
- Exposure rating: Sealed, water proof and submersible IP68
- Housing: Molded glass-filled polycarbonate
- Weight: 1.5 ounces (45g)
- Dimensions: 1.2 x 1.5 (diameter) inches (3.0 x 3.8 cm)
- Installation options: Sensor is installed permanently either indoors or outdoors on the water service pipe, usually near a water meter with a u-bolt, back plate and wing nuts

Itron

At Itron, we're dedicated to delivering end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Our company is the world's leading provider of smart metering, data collection and utility software systems, with over 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water.

To realize your smarter energy and water future, start here: **www.itron.com**

CORPORATE HEADQUARTERS
2111 N Molter Road
Liberty Lake, WA 99019
USA

Phone: 1.800.635.5461
Fax: 1.509.891.3355

RadioRead™

Meter Transceiver Unit (MXU)

SENSUS

Description

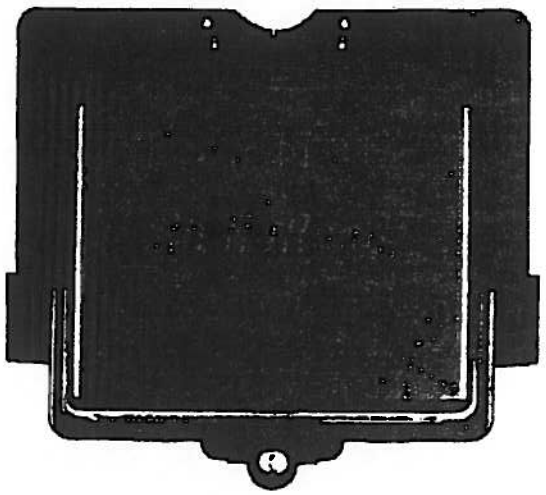
Application: The Sensus RadioRead Meter Transceiver Unit (MXU) is a radio signal interface device which permits off-site meter reading via radio signals. The MXU interfaces any compatible absolute encoder equipped utility meter with a Sensus RadioRead interrogation device. The MXU is used for both inside and pit-set utility meter installations to provide safe, off-site meter reading. It eliminates a number of meter reading problems such as lockouts, entering unsafe meter vaults, "curb side" reading estimates, estimated billing and errors associated with manual meter reading methods.

The Sensus MXU Model 505 provides the industry's only two-port radio interface device. In addition to the two-port design, the Model 505 is compatible with the Sensus MultiRead™ Module that permits up to four or eight meter connections per MXU port. This feature provides enhanced cost effective AMR where multiple meter installations exist.

RadioRead Operation: When used with a Sensus handheld or vehicle interrogation unit, the Sensus RadioRead system provides two-way communications between the reading unit being used and system equipped utility meters. The MXU connected to the meter receives an activation wake up signal from the interrogation unit. The MXU then obtains the meter's absolute encoder identification number and meter reading which are transmitted back to the interrogation device. Diagnostic data such as battery strength is also transmitted. After the interrogation unit receives valid data it transmits an acknowledgment signal back to the MXU which returns it to the power down mode. This helps maintain battery life and also optimizes the efficiency of the system by eliminating unnecessary radio transmissions.

RadioRead Integrity: When interfaced with an absolute encoder, RadioRead system meter reading is virtually free of errors. The readings are made from the actual positions of the encoder's odometer wheels at the time the reading is made to ensure valid up-to-date readings. Any errors or nonreads are immediately indicated on the meter reading equipment. This information can also be generated on management reports when the data is downloaded at the end of the reading cycle. In addition, high/low reading parameters can also be verified during the meter reading process.

Programmability: For special meter reading applications such as commercial routes and multi-utility installations, the MXU can be programmed to only respond to utility defined class and password codes. The MXU can also be reprogrammed to transmit in one-way mode for use in some fixed base systems.

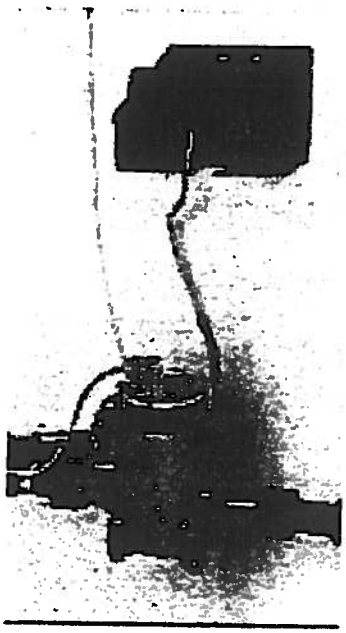


RadioRead MXU

Specifications

Service:	Wall mounted or pit-set installation interfacing utility meter to the RadioRead Meter Reading System.
Physical Characteristics:	6.00" (152.4mm) W x 3.18" (81mm) H x 5.05" (128.27mm) D
Weight:	1 lb. (0.4536 Kg.)
Power:	Lithium Maganese Dioxide battery
RF Transmitter:	Direct Sequence Spread Spectrum with synthesized channels, crystal controlled
RF Receiver:	SAW stabilized super regenerative
FCC Compliance:	Complies with Part 15
Operating Temperature:	- 22 °F to + 140 °F - 30 °C to + 60 °C
Humidity:	100% condensing. Water immerseable
Compatibility:	Sensus ECRII, Schlumberger ARB VI (Proread) water and gas encoders, Landis & Gyr AMR Electric Meters, Sensus encoder indexes for Equimeter and American (Canadian) Gas Meters, and MultiRead Modules for four or eight meters.

MXU installed in meter pit



MXU mounted on wall in mounting bracket

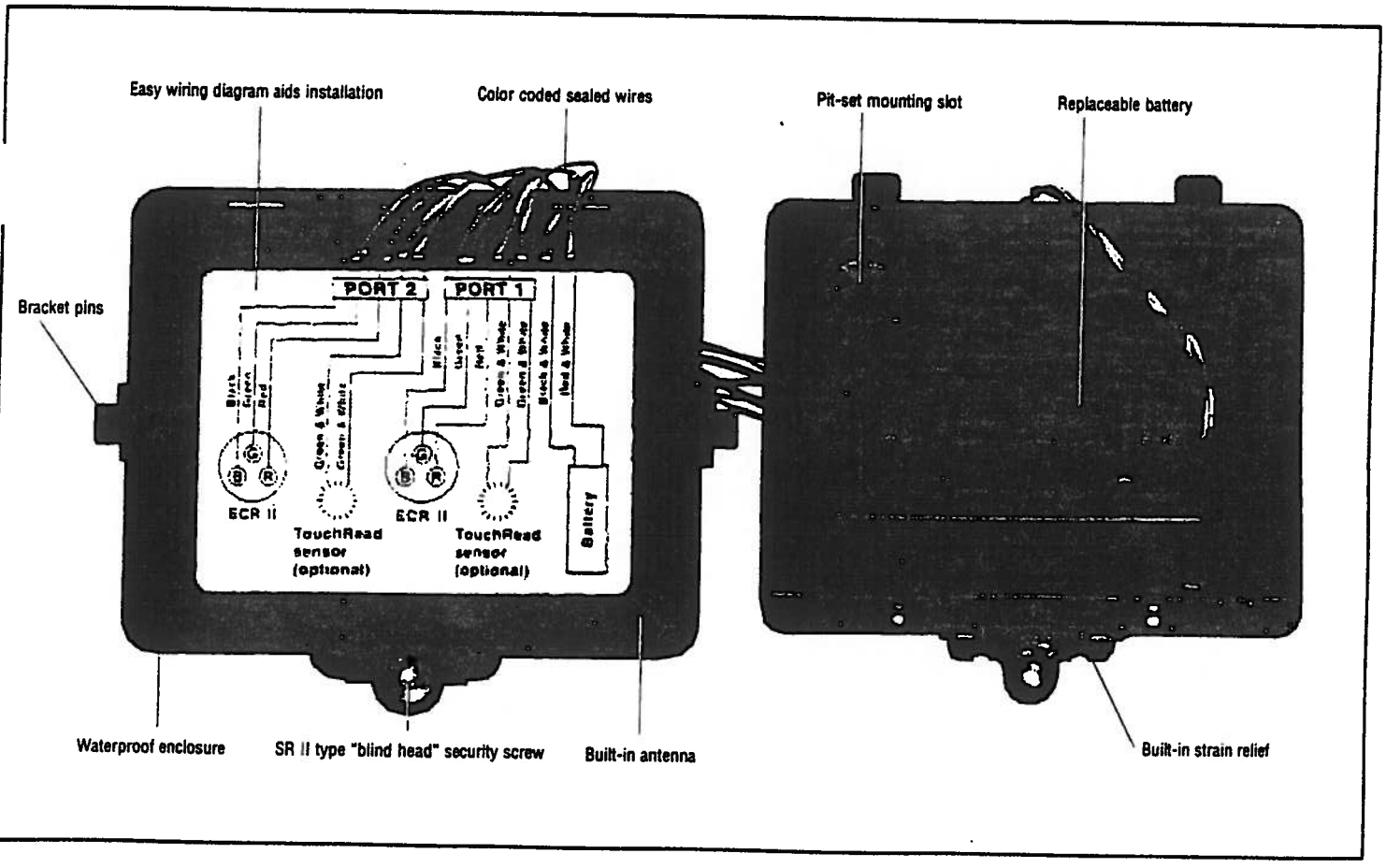
Meter Transceiver Unit (MXU)

TouchRead System: The MXU has built-in connections for optional hookup to TouchRead System sensors. Use the TouchRead options as a reading back-up or for making visual readings, if desired. The hookup is not compatible for use with the Schlumberger Proread protocol.

Replacement Battery: The lithium maganese dioxide batter provides long service and is the industry's first replaceable battery cartridge system. This design provides fast, easy battery replacement. The battery is made of materials shown to have significantly less toxicity compared to those used in other brands to minimize the environmental impact of used battery disposal.

Installation: The MXU can be installed in either meter pits or vaults, or inside buildings. A mounting bracket is available for installations requiring mounting on vertical walls. Wire connections are made using 3M gel cap splicing kits to ensure dependable MXU operation in damp, wet conditions such as inside meter pits or vaults which may be subject to flooding.

MultiRead™ Module: A compatible module that permits up to four or eight meter connections per MXU port.



SENSUS TECHNOLOGIES, INC.

450 N. Gallatin Avenue
Uniontown, PA 15401-2494

TOLL FREE HOTLINE
1-800-METER-IT
1-800-638-3748

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SPECIFICATIONS FOR AUTOMATIC METER READING SYSTEM METER TRANSCEIVER UNIT (MXU)

GENERAL

The following specification describes the requirements for a radio based automatic meter reading system. The specification will cover the meter transceiver unit (MXU). If meters and other supporting equipment are included in this proposal or bid, they will be covered under separate specifications.

RADIO SYSTEM DESCRIPTION

The radio AMR system will have the ability to read meters equipped with absolute encoder registers using either a handheld interrogation unit or a mobile interrogation unit. The encoder registers will be connected to a MXU that will provide the radio link from the meter to the interrogation unit.

The radio AMR system must utilize a true two-way (interrogate and respond) communication protocol that enhances system integrity and reliability.

Upon completion of the meter reading route, the meter reading data is downloaded from the interrogation unit, using the radio AMR software. The radio AMR software will prepare and format the meter reading data for the printing of selected management reports and the transfer of the meter reading data to the billing software for customer invoicing.

FUNCTION

The MXU will be the interface between the meter and the radio interrogation unit. The MXU will power up when a valid alert signal is received from the reading interrogation unit. The interrogation unit will be either a handheld or vehicle mounted device. The MXU and interrogation device will utilize a two-way communication protocol. Following the alert signal from the interrogation unit and transmission of meter reading data, the interrogation unit will signal to the MXU that valid reading parameters were met and will instruct the MXU to power down.

The MXU must have the capability of utilizing a reading cycle code which is an element of the transmission protocol. The reading cycle code is utility controlled and changes with each reading cycle. Once a MXU has been successfully interrogated and powered down using a specific reading cycle code, the MXU will not alert again until the code is changed.

MXU FUNCTION (Cont'd)

The MXU will have a fixed factory set non-programmable identification number to insure absolute identity of the MXU within the radio AMR system.

In addition, the MXU will have the capability of storing a utility defined programmable class code. The class code will be used to separate different classes of meters and differentiate the MXU in multi-utility installations.

The MXU will also provide for optional connection of a remote reading touch pad as a secondary meter reading source.

The MXU must have the capability, in terms of range and operation, of migrating to a fixed based radio AMR network in the future, without the need to physically alter the unit.

FCC REGULATIONS

All equipment must comply with current Federal Communications Commission (FCC) requirements which include proper labeling of the MXU. The Bidder must have supporting documentation available upon request to verify compliance.

MODULATION

The radio frequency transmission from the MXU to the interrogation unit must utilize direct sequence spread spectrum, operating in the non-licensed 902 - 928 MHz band. It shall alert using the 956 MHz from the interrogation unit.

HARDWARE

The MXU will be housed in a two-piece UV stable molded plastic housing. The enclosure must house the complete MXU unit which includes electronics, battery compartment, and wire connections. The MXU will also have an internal antenna. The housing must have the option of being wall mounted or mounted in an underground meter box. Any special mounting hardware should be supplied with the MXU. The enclosure will provide protection for the electronic components and wire connections and be capable of being submersed in a water filled meter box without damage.

The halves of the MXU enclosure will be secured by means of a tamper-resistant locking screw so that the enclosure cannot be opened by non-utility personnel. The internal parts of the MXU can only be accessed by utility personnel using a manufacturer supplied field tool. The field tool must not be commercially available. Seal wiring or a frangible head seal screw is not acceptable.

HARDWARE (Cont'd)

The MXU must have a field replaceable battery cartridge. The battery must be made up of a chemistry and design which is available and appropriate for consumer use and be of low toxicity. The battery cartridge must be date stamped for ease of age identification for warranty purposes.

The MXU must contain wiring diagram labels within the unit to aid in and simplify installation. All wires must be color coded and easily identifiable.

INSTALLATION AND TRAINING

Complete installation and operating instructions must be included for all of the supplied hardware and software equipment. Proposal must include any additional costs for training and assistance to install and begin operation of the MXUs. The vendor will also inform the customer what pre-installation activities are to be completed and what support materials will be needed for the initial installation.

PERFORMANCE WARRANTIES

In evaluating bid submittals, warranty coverage will be considered. The vendor shall be required to state its warranty and/or guarantee policy with respect to each item of proposed equipment. The procedure for submitting warranty claims must also be provided.

As a minimum, the electronics shall be warranted for one (1) year from date of shipment for defects in materials and workmanship. Battery warranty shall be a minimum of five (5) years from date of factory shipment.

SYSTEM MAINTENANCE AND SUPPORT

In addition to warranty periods, vendors are required to supply information on required or optional maintenance programs beyond the warranty period for both hardware and software. Features of those programs shall also be included with any additional charges such as hourly rate for on-site and/or remote support. The location of and procedures for obtaining such support shall be stated.

SENSUS™

SR II® Water Meters

DISPLACEMENT TYPE MAGNETIC DRIVE COLD WATER METERS

5/8" (DN 15mm) 3/4" (DN 20mm) 1" (DN 25mm)

DESCRIPTION

APPLICATIONS: Measurement of cold water where flow is in one direction only; in residential, commercial and industrial services.

CONFORMANCE TO STANDARDS: Sensus SR II® Water Meters comply with ANSI/AWWA Standard C700-latest revision. Each meter is tested to insure compliance.

CONSTRUCTION: Sensus SR II® Water Meters consist of three basic components: maincase; measuring chamber; and sealed register. Maincases are of bronze with externally-threaded spuds. Registers are housed in a bronze bonnet, a bonnet of synthetic polymer is available as an option. Measuring chambers are of Rocksyn,® a corrosion-resistant, tailored thermoplastic material formulated for long-term performance and especially suitable for aggressive water conditions. Maincase bottom plates are available in bronze or, if frost protection is desired, in cast iron or †synthetic polymer.

REGISTER: Hermetically sealed; proven magnetic drive design eliminates dirt and moisture contamination, tampering and lens fogging problems. Standard register includes a straight-reading, odometer-type totalization display; a 360° test circle with center sweep hand; and a low flow (leak) detector. Gears are self-lubricating, molded plastic for long life and minimum friction.

No change gears are required for accuracy calibration. Generator and TouchRead System remote reading systems are available for all SR II Water Meters. (See other side of sheet for additional information.)

TAMPER RESISTANT FEATURE: A unique locking system prevents customer removal of the register to obtain free water. A special tool, available only to water utilities, is required to remove the register bonnet. When the optional plastic register bonnet is selected, a tamper detection seal is available.

MAGNETIC DRIVE: The SR II® features a hydrodynamically cushioned design that eliminates premature wear of components. The meter utilizes a positive, reliable drive coupling. (Patent pending.) The high-strength magnets used will eliminate "drive slip" in normal use and also provide adequate strength to drive remote register units.

OPERATION: Water flows through the meter's strainer and into the measuring chamber where it drives the piston. The hydrodynamically balanced piston oscillates around a central hub, guided by the division plate.

A drive magnet transmits the motion of the piston to a driven magnet located within the hermetically sealed register. The driven magnet is connected to the register gear train. It reduces the piston oscillations into volume totalization units displayed on the register dial face.

MAINTENANCE: Sensus SR II® Water Meters are engineered to provide long-term value and virtually maintenance-free operation. Simplicity of design and precise machining of components allows interchangeability of parts of like-size meters, reduced parts inventory requirements, and ease of maintenance. The register can be removed without relieving the water pressure or removing the maincase from the installation.

As an alternative to utility repair, Sensus offers maintenance programs to provide factory reconditioning of the maincase and replacement components at low fixed prices. See bulletin PD-301.

CONNECTIONS: Tailpieces/Unions for installing the meters on a variety of pipe types and sizes are available.

GUARANTEE: Sensus SR II® Water Meters are backed by the exclusive "Bronze-Clad SR II Guarantee." Ask your Sensus representative for details or see Bulletin PD-302.

SPECIFICATIONS

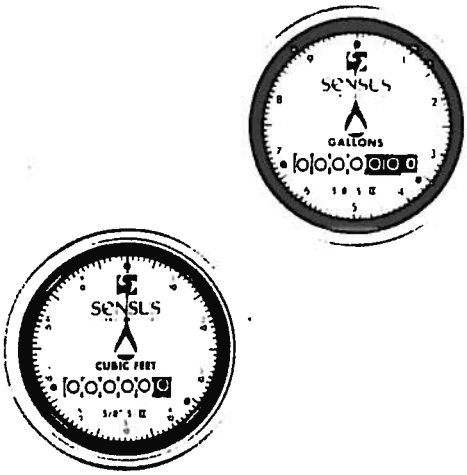
5/8" (DN 15mm) SR II® 3/4" (DN 20mm) SR II® 1" (DN 25mm) SR II®

SERVICE	Measurement of cold water with flow in one direction only.
***NORMAL OPERATING FLOW RANGE**	5/8" (DN 15mm) size: 1 to 20 gal/min. (0.25 to 4.5 m³h) 3/4" (DN 20mm) size: 2 to 30 gal/min. (0.45 to 7.0 m³h) 1" (DN 25mm) size: 3 to 50 gal/min. (0.7 to 11.0 m³h)
ACCURACY	100% ± 1.5% of actual thruput
LOW FLOW REGISTRATION	5/8" size: 95% at 1/4 gal/min. (0.06 m³h) 3/4" size: 95% at 1/2 gal/min. (0.10 m³h) 1" size: 95% at 3/4 gal/min (0.15 m³h)
MAXIMUM PRESSURE LOSS	5/8" size: 7.0 psi at 20 gal/min. (0.5 bar at 4.5 m³h) 3/4" size: 9.0 psi at 30 gal/min. (0.6 bar at 7.0 m³h) 1" size: 7.3 psi at 50 gal/min. (0.5 bar at 11.0 m³h)
MAXIMUM OPERATING PRESSURE	150 psi (10.0 bar)
MEASURING ELEMENT	Oscillating piston
REGISTER	Straight reading, hermetically sealed, magnetic drive. Remote reading unit optional.
REGISTRATION	10 gallons, 1 cubic foot or 0.1 m³/sweep hand revolution. 10,000,000 gallons, 1,000,000 cubic feet or 100,000 m³ capacity. 6 odometer wheels.
****METER CONNECTIONS**	5/8" (DN 15mm) size: 3/4" (26.44mm) threads 5/8" x 3/4" (DN 15mm x 33mm) size: 1" (33.25) threads 3/4" (DN 20mm) size: 1" (33.25 threads 3/4" x 1" (DN 20mm x 42mm) size: 1¼" (41.91mm) threads 1" (DN 25mm) size: 1¼" (41.91mm) threads (All threads are straight pipe, external type, conforming to ANSI B2.1 or ISO R228, if specified.)
MATERIALS	Maincase—Bronze Register box—Bronze (standard), synthetic polymer (optional) Measuring chamber—Rocksyn® Bottom plate—Bronze, cast iron or †synthetic polymer Magnets—Plasticized material Casing bolts—Stainless steel Strainer—Synthetic polymer

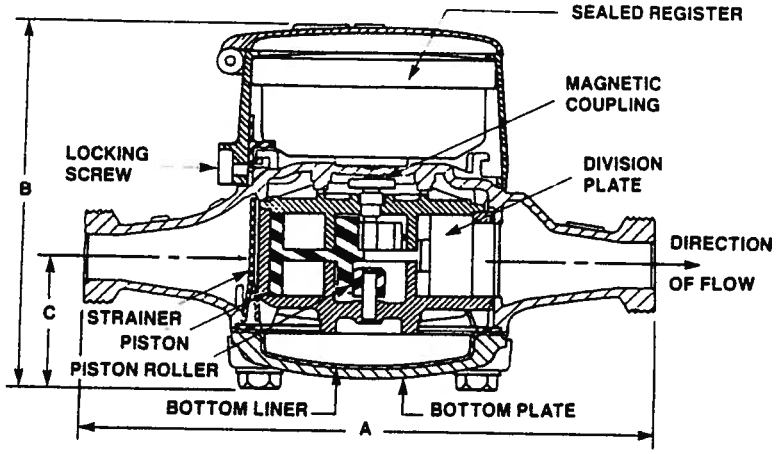
*Maximum rates listed are for intermittent flow only.
Maximum continuous flow rates as specified by AWWA are:
5/8" (DN 15mm)-10 gal/min (2.3 m³h)
3/4" (DN 20mm)—15 gal/min (3.4 m³h)
1" (DN 25mm)—25 gal/min (5.7 m³h)

**Unless otherwise noted, 5/8" size and 5/8" x 3/4" characteristics are identical. (5/8" x 3/4" designates 5/8" with 3/4" connection thread.) Also unless otherwise noted 3/4" size and 3/4" x 1" size characteristics are identical. (3/4" x 1" designates 3/4" with 1" connection thread.)
Metric designation is the nominal bore x the outside diameter.

†Synthetic polymer maincase bottom plate available on 5/8" meter only.



5/8" (DN 15mm) DIALS SHOWN



Dimensions and Net Weights

METER SIZE	A	B	C	WIDTH	NET WEIGHT*
5/8" (DN 15mm)	7-1/2" (190mm)	5.0" (127mm)	1-3/4" (44mm)	3-7/8" (98mm)	4.3 lb. (1.97 kg)
5/8" x 3/4" (DN 15mm x 33mm)	7-1/2" (190mm)	5.0" (127mm)	1-3/4" (44mm)	3-7/8" (98mm)	4.4 lb. (2.00 kg)
3/4" (DN 20mm)	9" (229mm)	5-1/2" (140mm)	2-3/16" (56mm)	4-1/2" (114mm)	6.4 lb. (2.90 kg)
3/4" x 1" (DN 20mm x 42mm)	9" (229mm)	5-1/2" (140mm)	2-3/16" (56mm)	4-1/2" (114mm)	6.6 lb. (2.99 kg)
3/4" short (DN 20mm)	7-1/2" (190mm)	5-1/2" (140mm)	2-3/16" (56mm)	4-1/2" (114mm)	6.2 lb. (2.81 kg)
1" (DN 25mm)	10-3/4" (273mm)	6-9/16" (167mm)	2-7/16" (62mm)	6-1/2" (165mm)	11.9 lb. (5.4 kg)

*with Rocksyn® measuring chamber.

Remote Systems—For use with all sizes of Sensus Water Meters

The TouchRead® Automated Meter Reading and Billing System—is a multi-purpose encoded remote system suitable for indoor and/or outdoor use. The Electronic Communications Register (ECR) uses a wired connection between the meter and an outside remote TouchPad data transfer module.

With a TouchRead PitLid (TR/PL) module, pit-set meters can be read automatically without lifting the meter box lid. The meter register, factory sealed to the PitLid module, is interrogated by touching a PitProbe to a lid mounted module to read and store meter data, even in flooded pits.

A non-remote version of the TouchRead® System is also available for pit-set meters. It uses a data transfer module factory sealed to the top of the register. The TouchRead Convertible (TRC) register can later be field converted to be compatible with centralized automatic meter reading. All versions can be read with a visual reading device, and/or a TouchRead System Interrogator/Recorder. For detailed information on TouchRead System equipment refer to bulletins RS-983, TR-984, RS-990 and TR-995.

Self Generating Remote (GTR)—In the GTR remote system a meter generates and transmits an electrical pulse via a wired connection to a remote totalizer. The meter's generator unit is submersible. See data sheet RS-966.

SENSUS TECHNOLOGIES, INC.
A BTR Company

Sensus Technologies, Inc.
P.O. Box 487
Bailey & Gallatin Avenues
Uniontown, PA 15401

TOLL FREE HOTLINE
1-800-METER-IT
1-800-638-3748

AUTHORIZED DISTRIBUTOR

WATER METER SPECIFICATIONS
FOR
COLD WATER METERS - DISPLACEMENT TYPE
WITH ECR ENCODER TYPE REMOTES
5/8" - 1" SRII SIZES

TYPE

Magnetic Drive, Sealed Register, Positive Displacement Type Oscillating Piston only.

SIZE

Must conform to American Water Works Standard C-700 as most recently revised.

LENGTH

Must conform to American Water Works Standard C-700 as most recently revised.

CASES

All meters shall have a non-corrosive Water Works bronze (minimum 75% copper content) outer case with a separate measuring chamber which can easily be removed from the case. All meters shall have cast on them, in raised characters, the size and direction of water flow through the meter. Cast iron frost bottoms, or bronze bottoms shall be provided on 5/8", 3/4", and 1" size meters. The manufacturer's serial number must be permanently affixed to the maincase to aid in identification and must be visible so that it can be read from directly above the water meter.

EXTERNAL BOLTS AND WASHERS

All external bolts and washers shall be of corrosion resistant material and be easily removed from the maincase. All threaded maincase bolt holes must be covered, to aid in removal of the bolts for repair.

ENCODER REGISTER AND REMOTES

Must conform to American Water Works Standard C-707 as most recently revised.

TOUCHREAD ECR REGISTER

The register must be of the straight reading type and have a full test dial on the face of the register. It shall read in cubic feet, gallons or metric units and be capable of direct visual reading both at the meter and by remote reading utilizing a visual interrogation device which connects through to the water meter via a TouchPad located external to the meter, and/or by a Meter Interface Unit (MIU) for use with an Automatic Meter Reading (AMR) system. All reduction gearing shall be contained in a permanently hermetically sealed, tamperproof enclosure made of a corrosion resistant material.

For indoor installations, the register is to be of a one piece configuration secured to the maincase with a locking ring as part of the register. For outdoor installations, the register shall be attached to the meter utilizing a bronze or plastic bonnet register box. The register shall be secured to the maincase by means of a tamper-resistant locking screw so that the register cannot be removed by non-utility personnel. The register must be field replaceable by utility personnel with the use of a manufacturer-supplied field tool. The field tool must not be commercially available. Seal wiring or a frangible head seal screw is not acceptable.

The meter register shall be provided with three terminal connections. The nection between the meter register and the TouchPad shall be accomplished with the use of only two terminal connections. The connection between the meter register and the MIU shall be accomplished with the use of all three terminal connections. The register shall transmit the meter reading and register identification number directly to the interrogation device through the TouchPad or to the MIU when interrogated by an AMR system.

For installations where moisture is not a concern, the terminal connections shall be protected with a dust cover on the register. The dust cover will be of a snap-on configuration not requiring screws and be equipped with seal wire holes for security. When the meter is to be installed in a vault or pit set installation, the terminal connections shall be permanently factory sealed to three wire interconnecting cable with an environmentally approved epoxy to prevent moisture penetration and eliminate the need for field sealing requirements.

The register output data format shall be 7-bit ASCII (American Standard Code for Information Interchange) digital, plus an even parity bit. Upon interrogation with a TouchPad or AMR, the register will transmit a 4-digit or 6-digit odometer reading (customer specified) and an 8-digit register

identification number.

TOUCHREAD ECR REGISTER (CON'T)

The register identification number is to be factory set and non-programmable so as to protect the integrity of the system by eliminating possible programming duplication of the identification number in the field. The 4-digit or 6-digit meter reading is to be interrogated from the register by direct contact of the register's odometer wheels to a circuit board which encodes the meter reading to the interrogation device. Data is to be positive true. The register's ASCII digital output is to be capable of interfacing directly to an AMR transponder to transmit data via cable TV, telephone, radio signal, or power lines to an AMR system.

OUTSIDE TOUCHPAD

The outside TouchPad shall be of a sturdy and tamperproof construction. The TouchPad shall be compatible with the TouchProbe, TouchGun or SmartGun of either the Solid State Interrogator or Visual Reader. The remote TouchPad shall be protected from the environment with watertight seals. The remote TouchPad shall not require a plug-in or metal to metal contact to complete a connection with the Interrogator's TouchProbe. The meter identification number and meter reading data will be transmitted to the interrogation device by touching the interfacing gun or probe to the external cover of the remote TouchPad. The TouchPad will be provided with two terminal connections to accept the two-conductor cable which connects it with the meter register. The remote TouchPad will have provisions to cover and seal the mounting screws to prevent tampering.

MEASURING CHAMBER

The measuring chamber shall be a suitable synthetic polymer and shall not be cast as part of the maincase. All piston assemblies shall be interchangeable in all measuring chamber assemblies of the same size. The measuring chamber piston shall operate against a replaceable control roller, allowing for repair to AWWA standards. The control roller shall rotate on a stainless measuring chamber steel pin, to provide added strength, wear resistance and corrosion resistance. There shall be a elastomeric seal or seals between measured and unmeasured water, preventing leakage around the measuring element.

MAGNETIC COUPLING

The motion of the piston will be transmitted to the sealed register through

the use of a magnetic coupling.

Water Meter Specifications

STRAINERS

All meters must be provided with a corrosion resistant strainer, with an effective straining area at least twice the bore diameter which can be easily removed from the meter without the meter itself being disconnected from the pipeline.

CHANGE GEARS

Change gears will not be allowed to calibrate the meter. All registers of a particular registration and meter size shall be identical and completely interchangeable. Should meters arrive with registers containing more than one gear combination, the entire shipment will be returned to the manufacturer freight collect and the next responsible bidder will receive the award.

ACCURACY AND HEADLOSS TESTS

M ·ers shall conform to current AWWA C-700, current revision, test flows, d loss and accuracy standards.

PRESSURE CAPABILITY

Meters shall operate up to a working pressure of 150 pounds per square inch (psi), without leakage or damage to any parts. The accuracy shall not be affected when operating at this pressure due to possible distortion. Accuracy shall not be affected by variations in pressure up to 150 psi.

PERFORMANCE WARRANTIES

In evaluating bid submittals, warranty coverage will be considered. All bidders are required to submit their most current nationally published warranty statements for water meter maincases, encoder registers and measuring chambers.

SHIPMENT VERIFICATIONS

A statistically controlled sample of each meter shipment will be tested by the utility to insure each shipment meets the utility performance and

materials specifications.