Rev. 2.1
Feb-04

Model 20
Meter-Master Flow Sensor

Operating Instructions

Contents

F. S. Brainard & Company
5 Terri Lane, Unit 9 P.O. Box 366 Burlington, NJ 08016
TEL: (609) 387-4300/ 888-388-FLOW (toll free) FAX: (609) 387-4304
www.meter-master.com

Section One

INTRODUCTION

1.1 About The Meter-Master Model 20

The submersible METER-MASTER MODEL 20 Magnetic Signal Converter is an externally powered flow monitor that converts a meter's magnetic drive signal to a digital output, which, in turn, is available for input into data logging, SCADA, and telemetry equipment. It is compatible with almost all water meters, small enough to fit inside any meter box, easy to set up, and suitable for permanent or portable applications.

The Model 20 uses a patented sensor to pick up the magnetic pulses generated by a meter's drive magnets. No electrical or mechanical connection or adapter is required for most meters (gear-driven meters, Hersey MHR meters, and Invensys Compound meters require available adapters). The pulse output frequency can be divided by 2, 4, 8, 16, 32, 64, 128, or 256 when required for compatibility with external hardware.

Meter-Master set-up in the field is simple, requiring only velcro straps to secure the sensor in position. Typically, the sensor is placed on the side of the water meter's register with the sensor cable going straight up or down. A small number of meters have different sensor locations (see Section 2.2). There are two built-in signal output options; external power can be any voltage between 6 and 40 volts.

Meter-Master products are durably built for long, accurate service in accordance with military quality standards. Each unit is manufactured at our factory and shipped ready for operation.

F. S. Brainard & Co. reserves the right to modify its designs at any time in order to supply the best products possible. All instruments are warranted for two years from either the date of purchase or the date of manufacture (see Section 4.2). Maintenance agreements are available following the initial warranty period.

1.2 Logger And Power Cable Connections

The Meter-Master model 20 connection cable has five color coded leads for connections to external equipment. This section describes the function of each of these leads to assist with installation. Refer to the diagram below.

GREEN and BLUE. Both of these leads are common (ground) leads and are interchangeable. The two leads are provided as a convenience when connecting a power source that is separate from the external equipment to which the Model 20 output is to be connected. If the Model 20 receives power from the equipment to which the Model 20 output is connected, then either one of these leads can be connected to the external device's common (or ground) and the other can be left unconnected. If desired, both leads can be connected to the external equipment's common (or ground) terminal.

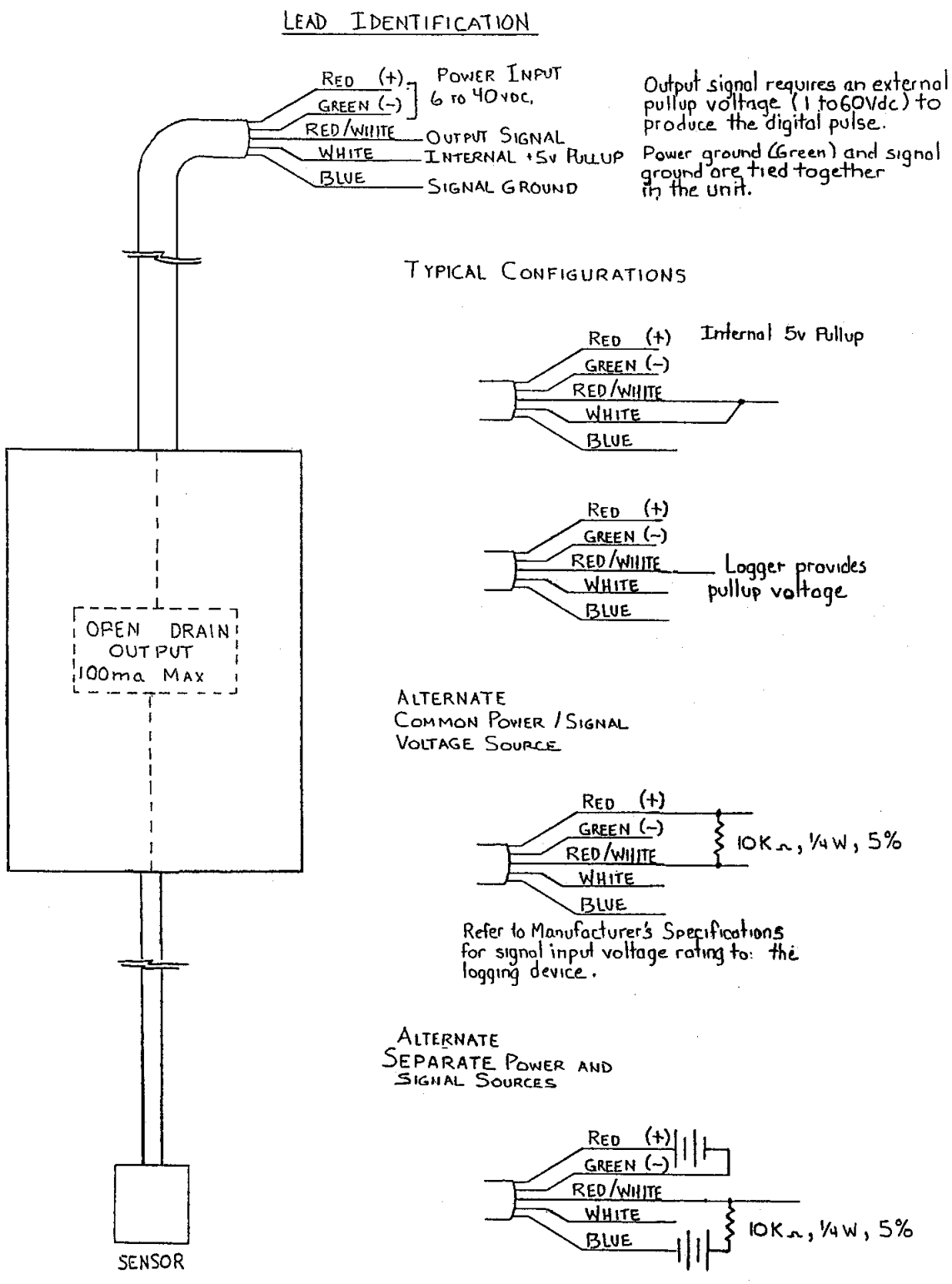
RED. This lead provides the power to the Model 20. A positive voltage between 6VDC and 40 VDC should be connected to this lead. This can be from a separate power source or from the external pulse collection equipment.

RED/WHITE. This is the signal output lead from the Model 20. It connects to an open drain of a MOSFET transistor internal to the Model 20. This can be considered the same as an open contact switch for equipment that has a positive voltage pull-up resistor. This output will handle any standard industrial pull-up circuit. Voltages as low as one volt and as high as 60 volts can be handled. It can sink up to 100 milliamps.

WHITE. This is an optional low source current pull-up internal to the Model 20 for situations (rare) where the external equipment does not provide signal pull-up. It is compatible with 5 Volt CMOS and LS logic inputs. It has been set at a low current level for situations where the Model 20 is operated from its own battery source.

When the Model 20 is powered separately by its own battery source, use the external equipment for signal pull-up in order to conserve the Model 20's battery charge. In exceptional situations when the external equipment does not provide signal pull-up but there is a DC voltage source available (the logger itself or some other source), conserve the Model 20's external battery charge by using the DC source for external pull-up. Use a 10K ohm pull-up resistor (1/4 watt, 5%) between the DC source and the Red/White signal wire, as indicated in the diagram.

Signal Options	Signal, Positive	Signal, Ground	Power, Positive	Power, Ground
Internal 5 volt pull-up	Red/White + White	Blue	Red	Green
External 1 thru 60 volt pull-up	Red/White	Blue	Red	Green


LEAD IDENTIFICATION
RED (+)
GREEN (-)
POWER INPUT
6 TO 40VDC.
RED/WHITE
OUTPUT SIGNAL
WHITE
INTERNAL +5V PULLUP
BLUE
SIGNAL GROUND
Output signal requires an external pullup voltage (1 to 60Vdc) to produce the digital pulse.
Power ground (Green) and signal ground are tied together in the unit.
TYPICAL CONFIGURATIONS
RED (+)
GREEN (-)
RED/WHITE
WHITE
BLUE
Internal 5v Pullup
RED (+)
GREEN (-)
RED/WHITE
WHITE
BLUE
Logger provides pullup voltage
OPEN DRAIN
OUTPUT
100ma MAX
SENSOR
ALTERNATE
COMMON POWER / SIGNAL
VOLTAGE SOURCE
RED (+)
GREEN (-)
RED/WHITE
WHITE
BLUE
10K Ω, 1/4W, 5%
Refer to Manufacturer's Specifications for signal input voltage rating to the logging device.
ALTERNATE
SEPARATE POWER AND
SIGNAL SOURCES
RED (+)
GREEN (-)
RED/WHITE
WHITE
BLUE
10K Ω, 1/4W, 5%

1.3 MM20 Specifications

- **Size:** 4.4” x 3.2” x 1.2” (111mm x 71mm x 21mm).
- **Weight:** 1.25 lbs. (.8 kg).
- **Case:** Submersible, ABS/polycarbonate blend.
- **Integral Sensor And Signal/Power Cables.**
- **Square Wave Output To Data Logger/SCADA/Telemetry:** Square wave with approximately 50% duty cycle. One digital pulse output for each magnetic pulse input. (Each North-South pole combination generates one pulse.)
- **2 Built-In Output Signal Configuration Options:** Internal 5 volt pull-up and external 1 through 60 volt pull-up. Internal 5 volt pull-up draws 0.5 mA; external pull-up draws 0.4 mA.
- **External Power:** Anything between 6 and 40 volts DC. An AC power plug is available as an accessory.
- **Logger/Power Connection:** Flying wire with tinned leads.
- **Strap-On Magnetic Sensor:** Fastens to outside of water meter with velcro straps provided.
- **Pulse Output Frequency Reduction:** Pulse output frequency can be divided by 2, 4, 8, 16, 32, 64, 128, or 256 when required for compatibility with external hardware. Must be specified at time of order placement.

Section Two

OPERATION

2.1 Installation

1. Connect MM20 To Data Logger/SCADA/Telemetry And Power

If you have not pre-installed the MM20 leads into connector(s), see Section 1.2, "Logger Cable Connection", for color code of wire leads. The 2 power leads (red and green) may be attached either to the logger (if it has power available) or to a battery. After applying power, allow 3 minutes for signal to begin.

2. Attach Sensor To Meter

Attach the MM20 sensor to the meter with the velcro strap(s) provided (tape may also be used). The sensor is typically placed on a side of the meter register that is not over the pipe; however, the best location varies, especially for large meters. When placed on the side of the register, the sensor cable should extend either straight downward or upward. For more detailed information on positioning the sensor, see Section 2.2, "Pointers for Positing the Sensor", and Appendix A.

3. Check Sensor Location

Check the sensor location by referring to output signal of data logger. Each digital pulse output equals one North-South pole combination. Accordingly, each revolution of a 2-pole magnet will create one pulse, and each revolution of a 4-pole magnet will create two pulses. If the sensor signal does not flash regularly or in proportion to the flow rate, try the sensor in other locations. Before checking the pulse rate, make sure you have allowed time for the electronics to settle: if you just moved the sensor, wait 10 seconds; if you just applied power to the MM20, wait 3 minutes. For more information, see Section 2.2, "Pointers for Positioning the Sensor".

2.2 Pointers For Positioning The Sensor

BEFORE YOU BEGIN

The METER-MASTER senses the magnetic pulses generated by the magnets which couple the register of a water meter to the meter body. An adapter for gear-driven meters is available as an accessory.

Know your meters

Attaching the MM20 sensor is straightforward for most meters, especially positive displacement meters. However, it is strongly recommended that, before taking the MM20 out into the field, you bench-test the MM20 on samples of the meter makes, models, and sizes from which you plan to gather data. Appendix A describes the suggested sensor locations for almost all meters used in the U.S. Use your meter test-bench to experiment with different sensor locations. The "sweet spot" on some meters is larger than on others. By experimenting on your meter test-bench, you may avoid searching for an alternative sensor location under less favorable conditions in the field. You may also use this initial experimentation period to familiarize yourself with the MM20 operation.

Testing the sensor by itself

Even without water flowing, you can create magnetic pulses by flipping the sensor over and back again continuously with your hand (like a pancake) which causes the MM20 to sense the earth's magnetic field.

Special adapters

Invensys SRH and SRM compound meters require the Invensys Compound Adapter. This adapter may also be used with Kent (U.S. models) and Schlumberger/Neptune turbine meters to increase the resolution of the recorded data from these meters by a factor of 12, which is significant when identifying and defining leakage rates.

In Appendix A, some Hersey turbine meters have been noted as requiring a modified gear train in order to attain compatibility with the MM20. These gear trains are available as accessories.

POSITIONING THE SENSOR

Appendix A describes the location of the sensor for almost all meters used in the U.S. and can be used as a guide for other meters with similar construction (meters with “similar construction” have their drive magnets in similar locations). Refer to the pictorial representations of the suggested sensor locations located at the end of Appendix A.

In general, the four most important points in positioning the sensor are:

Sensor attachment

1. Position Sensor At Meter’s Sweet Spot.

- **Positive Displacement Meters:** Place the sensor on a side of the meter register that is not over the pipe, unless otherwise indicated in Appendix A and the sensor location diagrams in this manual.
- **Turbine Meters:** Check the sensor location diagrams in this manual for a meter of similar construction to the current one and try the indicated location first. If that location proves unsatisfactory, try other locations. Move the sensor to the other side of the meter, place the sensor flat on top of the register, etc. When you move the sensor, remember to wait ten seconds to allow the electronics to settle before initiating a sensor test.
- **Shielded Registers:** If no signal is detected when the sensor is placed on the side of the register because of shielding on the side of the register, place the sensor flat on top of the register. Note that when the sensor is placed flat on top of the register, a 4-pole magnet will typically generate a 2-pole signal (half as many pulses).

- **Drive Magnets Integral To Turbine Rotor:** If the meter's drive magnet is integral to the turbine rotor (e.g., Invensys Turbo), place the sensor on the side of the meter body with the cable extending in a *horizontal* direction. (See sensor location diagrams.)
- **Compound Meters With Two Registers:** Position the sensors on the sides of both registers such that the sensors are physically located as far away from the other register as possible. In the case of a Schlumberger/Neptune TRU/FLO compound, it is recommended that you use either a Invensys Compound Adapter or a plastic/wood spacer to position the sensor on the turbine side even further away from the PD side.
- **Insulated Meters:** Because it is not necessary for the MM20 sensor to make direct contact with the meter housing, it may not be necessary to remove insulation when it covers a meter. Test the sensor pick-up from the outside of the insulation before removing any meter insulation.

2. Do Not Cock Sensor Or Sensor Cable.

The sensor itself should be positioned flat against the meter casing or register with the velcro on the outside, away from the meter. It is not necessary for the sensor to touch the meter. If the sensor is on the side of the register, position the sensor such that the sensor cable extends straight up or straight down toward the ground. If the sensor is on the side of the meter body (Invensys Turbos, Hersey MHR 2"-3", and Badger Recordall Compounds–turbine side), position the sensor such that the cable extends in a horizontal direction.

3. Secure The Sensor As Tightly As Possible.

Velcro straps come with the Meter-Master. The straps will stretch slightly over time, so test each attachment to ensure that the sensor will resist any effort to move it. The velcro is provided in 2 lengths which may be secured together to create one extended length. If desired, tape can also be used to keep the sensor in place.

4. Wait For The Electronics To Settle Before Checking The Pulse Rate.

If you have just moved the sensor, attached the sensor cable, or turned on the power to the MM20, make sure you have allowed sufficient time for the electronics to settle before checking the sensor location. The circuit takes 10 seconds to stabilize when the sensor is moved, 1 minute when the sensor is connected, and 3 minutes when power is initially applied to the MM20.

UNDERSTANDING THE DIGITAL PULSE OUTPUT

The internal magnet and gearing configurations vary from one meter manufacturer to the next, and some magnets spin much faster than others. Accordingly, the same size meters from different manufacturers rarely generate the same number of magnetic pulses per unit of liquid measure. Moreover, some meters have 4-pole magnets, which generate 2 pulses per magnet revolution, and others have 2-pole magnets, which generate 1 pulse per magnet revolution. However, note that the sensor typically detects a 2-pole signal from a

4-pole magnet when the sensor is placed flat on top of the register. A 2-pole magnet will always generate a 2-pole signal.

Positive displacement meters should always provide a high frequency output signal as long as there is water flowing and the equipment is working properly. Turbine meters vary greatly in pulse frequency. In order to correlate the digital output with the flow rate of large meters, it is strongly recommended that you contact a meter manufacturer for information about magnet revolutions per unit of liquid measure as well as the number of poles on the magnet. Alternatively, contact us for meter pulse factors for individual meters.

If required, the MM20's pulse output frequency can be divided by 2, 4, 8, 16, 32, etc. in order to achieve compatibility with external hardware.

ELECTROMAGNETIC INTERFERENCE (EMI)

Place the sensor farthest from any nearby equipment which may generate electromagnetic interference (EMI). Typical examples are motors, burglar alarms, and generators. Because the MM20 is designed to pick up the magnetic signal generated by a water meter, you may encounter a circumstance in which the location of the meter is so close to other electromagnetic sources that pulses are detected from equipment other than the water meter when no flow is occurring. Unless you can deactivate or shield the source of EMI, an accurate record may not be possible.

Section Three

TROUBLESHOOTING

3.1 List Of Topics

3.2 Recommended Action

GENERAL

(1) Insulated Meter

- Sensor does not need to be touching meter and can be located on outside of insulation if distance from magnets does not result in too weak a signal.

(2) Sensor Does Not Seem To Be Working

- Make sure power is on to the MM20.
- Repeatedly turn sensor over and back again (flip like a pancake) to cause sensing of earth's magnetic field. Flipping sensor over and back will create pulses.
- Alternatively, attach sensor to a PD meter with active flow and check sensor operation.
- Make sure that the MM20 is compatible with and correctly wired to your external hardware (see Section 1.2).

SENSOR TEST

(3) No Digital Output At All

- Make sure that MM20 is properly connected to the external hardware and power is on.
- Make sure that there is adequate flow to cause pulses.
- Make sure sensor is in correct location for current meter.
- Make sure sensor is working (see above).

(4) Data Logger Shows A Very Rapid Pulse Rate

- Normal for many PD meters and some turbines at medium and high flow rates.
- May indicate an electromagnetic noise interference area. To test for magnetic interference, remove the sensor from the meter and check the signal in various locations around the meter (wait 10 seconds before initiating a test). Check for switching equipment, transformers, motors, alarm systems, generators, etc. in close proximity. If you determine that there is magnetic interference, try moving the sensor to the side of the meter away from the noise source; try aiming the sensor in a slightly different direction. Test may not be possible at this location.

(5) Pulse Rate is Erratic

- When you move the sensor, make sure you wait ten seconds to allow the electronics to settle before initiating a sensor test.

- The pulses may not be evenly spaced around the dial; however, each dial revolution should provide the correct number of flashes.
- Make sure sensor is properly positioned for meter and not cocked (see Section 2.2 and Appendix A). When the sensor is not cocked, the sensor cable will extend straight down or straight up (or horizontally for some turbine meters).
- With some turbine meters, the sensor may pick up an irregular pulse count because the register magnet is not coupling smoothly with the drive magnet. If this occurs, move the sensor away from the magnetic coupling area, e.g., slide the sensor further up the register if Appendix A indicates a register location.
- Try the sensor in other locations until the signal becomes regular.

(6) Pulses Are Regular But Not At The Expected Rate

(E.g., two of the same type of meter give a different pulse rate per equal register volumes.)

- Meters with change gears may have discrepancies of as much as 15%.
- On certain meters, the MM20 may sense either a 2-pole or a 4-pole signal, depending on variations in the manufacture of the meters themselves (2-pole vs. 4-pole magnet) or on sensor location. Data is accurate; however, the pulse factor may be different (half or double).
- In some cases, the meter's own magnetic coupling may not be smooth causing a phase differential and additional (false) pulses. Find a better sensor location by sliding sensor away from area where magnets couple.
- If pulse rate is more than 3 times what it should be, there may be electromagnetic interference. Check for switching equipment, transformers, motors, alarm systems, generators, etc. in close proximity. Try moving sensor to side of meter away from noise source. Test may not be possible at this location.
- The signal may simply be weak where the sensor is located due to peculiar magnet characteristics, location of magnets within the meter, or shielding material in the meter. Try the sensor in other locations.

Notes On Specific Meters

(7) Dual Register Compound Meters

- Position the sensors on the sides of both registers such that the sensors are physically located as far away from the other register as possible. Plastic or wood spacers may be used to extend sensor distance from each register if registers are very close to each other. See special instructions for Schlumberger (Neptune) TRU/FLO compound below.

(8) Compound & Turbine Meters With Change Gears

- *Meters with Change Gears:* Some large meters, e.g., Neptune Trident turbine and Hersey MCT, MFM, MCTII, MFMII, and MHR meters, use change gears for calibration. Different change gear combinations will cause variations (typically less than 15%) between the total volume per register and that per Meter-Master because change gears alter the relationship between the drive magnets and the register's odometer.

(9) Invensys (Sensus, Rockwell)

- *SR:* If the sensor pick-up appears weak, place the sensor flat on top of the register. These meters use 2-pole magnets, which provide a 2-pole signal regardless of sensor location.
- *Turbo (W-3500, W-5500):* Because of the distance of the magnet from the sensor, you may not be able to use a Meter-Master with a low-sensitivity sensor circuit configuration. Accurate positioning of the sensor is more critical than with smaller Invensys turbos. Sensor should be centered on side of meter body.
- *Compound (SRH, SRM):* Invensys Compound Adapter required. Call your sales representative.

(10) Schlumberger (Neptune)

- *T-8 & T-10 (5/8", 3/4", 1"; including TRU/FLO PD side).* Place the sensor flat against the side of the register with the top of the sensor flush with the top of the register. In the case of small Schlumberger meters, a sensor located on the side of the register close to the plane of the meter's magnetic coupling area will frequently generate half as many pulses (2-pole signal) as a sensor placed high on the side of the register (4-pole signal). Because a 4-pole signal can convert to a 2-pole signal during high flow periods even with the sensor located high on the side of the register, the sensor may, alternatively, be placed flat on top of the register, which typically provides a 2-pole signal at all flow rates. These alternatives have been provided because experience on small Neptune meters can differ between versions of the same meter.
- *T-8 and T-10.* Registers may be (inadvertently) interchanged. Look at model information marked on register and on body to make sure they are the same.
- *Turbine (including TRU/FLO & Protectus):* The Invensys Compound Adapter may be used to increase the pulse frequency and resultant data resolution by a factor of 12. For example, without the Invensys Compound Adapter, each pulse generated by a 6" Trident turbine equals 43.1 U.S. gallons; with the adapter, each pulse equals 3.6 U.S. gallons, which enables more accurate flow rate calculations.
- *TRU/FLO:* Because the registers are close together on a TRU/FLO meter, it is possible for the magnetic field generated by the PD side to be sensed by the sensor on the turbine side when flow is occurring only on the PD side. To avoid this problem, locate a spacer (wood, plastic, etc.) between the sensor and the register on the turbine side, which will increase physical separation. Alternatively, install the Invensys Compound Adapter on the turbine side in order to increase physical separation. A low-sensitivity sensor circuit configuration can also be purchased which diminishes the potential for interference.

(11) Badger

- TC-ER: The positive displacement (small) side has two (2) different magnetic couplings occurring at different rotation speeds which diminishes the signal's accuracy.

(12) Hersey

- *MHR (4"-10"):* Modified gear train is required. Call your sales representative. (Gear train part numbers: P/N B0600 for 4" and 8"; P/N B0610 for 6"; P/N

B0620 for 10".) The gear train is a standard Hersey part with an added gear, shaft, and magnet. It may be installed without any service interruption.

- *MVR:* Some sensor locations on/beside the register may provide a better signal than others.
- *MCT & MFM (Mag 1):* A minority of MCT and MFM turbine meters require a modified gear train (P/N B3100) for pickup due to location and size of magnet. The same gear train is generic to all MCT and MFM meter sizes. MCTII & MFMII (Mag 2) never require a modified gear train. Because some Mag 1 meters use 2-pole magnets and some use 4-pole magnets, the Meter-Master data may show either one-half or twice the volume anticipated. Some MCT PD side registers have a different gearing; the difference is typically about 30%. Gearing differences are more common with these meters than others.
- *All Models:* Some Hersey remote reading registers have an additional magnet in the register as a component of the remote reading system. This additional magnet can distort the magnetic field generated by the drive magnets and make accurate reading difficult. In such cases, a register without the remote reading system should be used temporarily if a high degree of accuracy is required.

(13) ABB/Kent

- C-700: There are two 5/8" models with different magnet rotation speeds. The older was produced until 1993. The newer has been produced since 1993.
- *T-3000:* Because of the large registers (U.S. version), slow magnet speed, and poor pulse resolution, it is sometimes difficult to verify that the Meter-Master is working accurately. It is highly recommended that the Invensys Compound Adapter be used with Kent turbines (U.S. version) in order to enhance the data resolution by a factor of 12. Without the adapter, the data resolution is inadequate for accurately determining low and high flow rates.

(14) Precision

- *All Models:* There is a magnetic shield on the side of some registers. The sensor may have to be located flat on top of the register.

(15) Water Specialties

- *ML-03 & TM:* According to the manufacturer, meters with rate-of-flow indicators as registers may not provide the desired signal.

(16) Master Meter

- *All Models:* Because the magnet is very small in all Master Meter models, the Meter-Master must be purchased with the high-sensitivity sensor circuit configuration. In all cases, center the sensor flat on top of the register so that the sensor is as close to the meter's magnets as possible. If the meter register has a raised lens, it may not be possible to pick up an accurate signal even with the high-sensitivity circuit configuration.

Section Four

SERVICE AND SUPPORT

4.1 Customer Service

Should you experience any problems with your Meter-Master product, fax or call our Customer Service Department between 8 A.M. and 5 P.M. (Eastern U.S. Time) or email us at service@meter-master.com. Phone and fax numbers are shown on the front page of these instructions. Explain the problem, and we may be able to solve it via phone, fax, or email. If not, we will provide a Return Material Authorization Number (RMA#). Be sure to include: a packing slip with the RMA#, the serial number of the unit, a description of the problem, and a contact person including phone number and address. Pack the equipment in a solid cardboard box secured with adequate packing material. Ship prepaid and insured to the address shown on the cover of this manual.

4.2 Two Year Limited Warranty

F. S. Brainard & Co. (FSBCO) warrants to the original consumer purchaser that this Meter-Master product shall be free from defects in materials and workmanship for a period of two years from either the date of purchase, provided a proof-of-purchase is presented, or alternatively, if proof-of-purchase is not presented, the date of manufacture. During the two year warranty period, liability shall be limited to replacing or repairing, at FSBCO's option, any defective product. Product which has been subjected to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation is not covered by this warranty. FSBCO shall have the right of final determination as to the existence and cause of defect. As to product repaired or replaced, the warranty shall continue in effect for the remainder of the warranty period, or for ninety (90) days following date of shipment by FSBCO of the repaired or replaced product, whichever period is longer.

No liability is assumed for expendable items. No warranty is made with respect to custom equipment or products produced to buyer's specification, except as specifically stated in writing by FSBCO and contained in the contract. FSBCO liability arising out of its warranty shall be limited to a refund of the purchase price. In no event shall FSBCO be liable for costs of procurement of substitute products or services, loss of profits, or for any consequential, incidental, indirect, and/or other damages of any kind however caused and on any theory of liability, arising out of this warranty. Other products, not manufactured by FSBCO but distributed by FSBCO, such as computers, software, and accessories, are offered as third party products. As such, these products are not warranted by FSBCO. Requests for warranty or nonwarranty repairs of third party

products should be addressed directly to the manufacturers of such products. Should your FSBCO product require nonwarranty repair, please contact FSBCO for available repair information.

Index