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# Midwest Instruments & Controls

## *Instruction and Installation Manual*

# Programmable Paddle Wheel Flow Meter withTotalizer

Oct 2006

# Index



## 1. Introduction

This manual contains specifications along with installation and operating instructions for your digital flow meter. Please read this manual carefully; hopefully, it will answer your questions and allow you to get the most from this meter.

## 2. Description

This digital meter is a paddle wheel type, microprocessor-based instrument. The compact, efficient design operates with neglible head loss. The flow meter is waterproof and battery powered. These attributes allow it to be installed outdoors where no external power source is available. If installed outdoors, the meter must be shielded from direct sunlight to prevent damage to the enclosure and overheating. Calibration of the meter is accomplished by selecting the pipe size and schedule then choosing the units.

## 3. Theory of Operation

When the flow meter is properly installed, the paddle spins at a rate linearly proportional to the velocity of the flow. A magnet, contained within the paddle, actuates a switch every time the paddle revolves. By measuring the time it takes the paddle to revolve, the velocity is determined, and, from this, the flow rate can be calculated. A stable reading is obtained by averaging many revolutions of the paddle.

# 4. Installation

This section explains the procedure for properly installing the flow meter to obtain accurate readings and to assure a trouble free operating life.

**Paddle wheel flow meters will only produce accurate results when the pipe is full, and the meter is properly installed.**

**To accommodate the many different mounting positions, the head of the meter can be rotated.**

**General:**

**This meter will not withstand direct sunlight exposure and sunlight damage (degradation of the display and plastic case) will not be covered under a warranty.**

The flow meter must be installed in a straight length of pipe with at least 10 pipe diameters upstream of the meter. The length of the pipe downstream must be at least 5 pipe diameters. (See Figure 1)

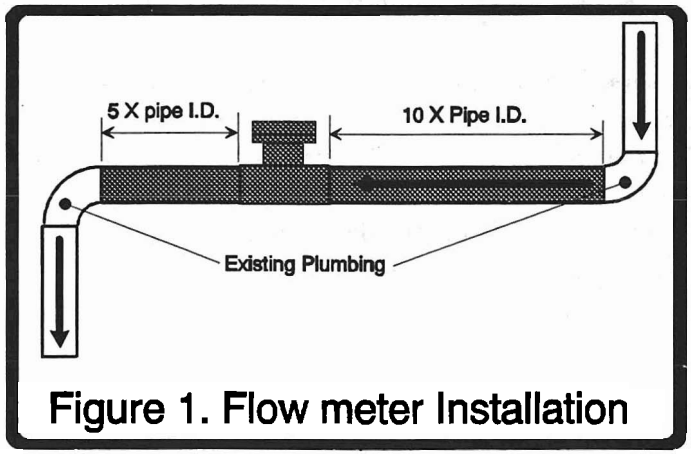



Figure 1. Flow meter Installation

In testing this and other paddle-wheel flow meters, it was found that accurate readings were only obtainable when the meter was installed in a section of pipe that was truly straight, i.e. no sagging or drooping. With the flow meter mounted in a sagging pipe, results were affected by as much as 5%. Secondly, on 3" and larger pipes, 20 pipe diameters were needed when the flow meter was down stream of a 90° elbow. Moreover, if a major flow obstruction such as a partially closed butterfly valve or a pump is upstream of the flow meter, 50 pipe diameters may be required to assure uniform flow.

**Vertical Installations:**

If possible, mount the flow meter in a pipe with an upward flow. Upward flows will assure that the pipe remains full of liquid; however, downward flows can be measured if the pipe is slightly pressurized to assure that the pipe remains full.

**Horizontal Installations:**

If horizontally mounting the meter, Figure 2 illustrates the preferred positions. If the flow meter is mounted on the top, air bubbles may become entrapped around the paddle and produce inaccurate results. Mounting the flow meter on the bottom of the pipe may entrap sediment that will eventually effect the operation of the paddle wheel. However if no suspended particles are present, a bottom-mounted position is acceptable.

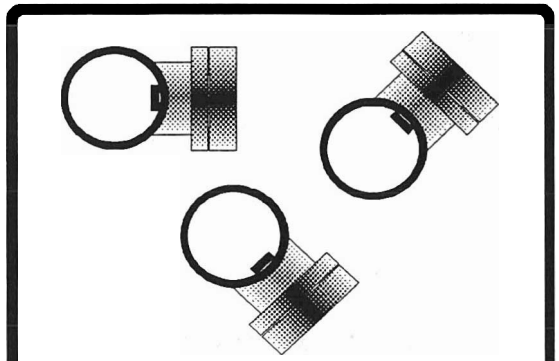


Figure 2. Side Mounting Postion

## Installation of the Pipe Mounted Flow Meter

After determining a suitable location, a section of pipe will need to be removed from the existing system equal to the length of the flow meter plus the length of the coupling fittings. Be sure the mounting location and position will allow the flow meter to be removed and cleaned, and also allow viewing of the display.

Install the meter using traditional PVC plumbing procedures.

Align the holes for the stainless steel pin, then using a rocking motion, press the meter into the adapter, and install the pin.

**Once installed, the face of the meter can be rotated, allowing the display to be easily viewed regardless of the mounting position.**

## Installation of the Insertion Flow Meter on PVC Pipe

Be sure the mounting location and position will allow the meter to be removed and cleaned, and also allow viewing of the display.

1. Referring to figure 4, install the hose clamps and slide them off to the side.

2. Clean the curved part of the adapter and the pipe using PVC primer.

3. Let the primer dry until it is tacky.

4. Apply PVC cement to the pipe and the adapter.

5. Mount the adapter to the pipe.

6. Slide the clamps into the adapter grooves and tighten them to pull the adapter tight to the pipe.

**Note: Over tightening the clamps will distort the pipe.**

7. Wipe off any excess cement, and let it dry for 2 hours.

8. Using a 1 ½" hole saw and the adapter as a guide, bore a hole through the pipe. Deburr and clean up the shavings.

9. Align the holes for the stainless steel pin, then using a rocking motion, press the meter into the adapter, and install the pin.

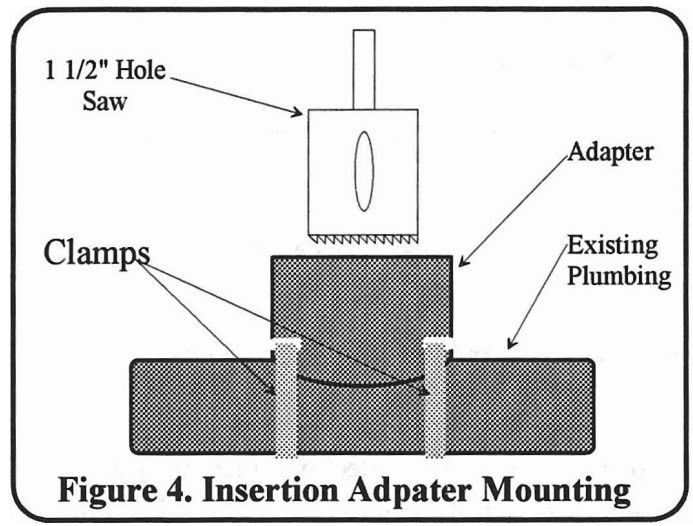


**Figure 4. Insertion Adpater Mounting**

10. Once installed, the face of the meter can be rotated, allowing the display to be easily viewed.

The meter is now mounted and ready for operation.

## Installation of the Insertion Flow Meter on Metal Pipes and other non-PVC pipes:

The meter should be mounted in a location and position that will allow it to be removed for cleaning and easy viewing.

1. Referring to figure 4, install the hose clamps and slide them off to the side.

2. Using medium grit sandpaper, clean the pipe.

3. Clean the curved part of the adapter and the pipe using an acetone soaked rag.

4. After the acetone has dried, apply a layer of RTV silicon sealer to the pipe and adapter.

5. Mount the adapter to the pipe

6. Slide the clamps into the adapter grooves and tighten them to pull the adapter to the pipe.

7. Wipe off the excess silicone, and let the assembly cure for 3 hours.

8. Using a 1 ½" hole saw and the adapter as a guide, bore a hole through the pipe. Deburr and clean up the shavings.

9. Align the holes for the stainless steel pin, then using a rocking motion, press the meter into the adapter, and install the pin.

10. Once installed, the head of the meter can be rotated, allowing easy viewing regardless of the mounting position.

The meter is now mounted and ready for operation.

## 5. Reading the Display

The upper left corner of the display contains an icon resembling a paddlewheel. This icon only appears when the paddle wheel is rotating. Encircling the paddle icon are three arrows. When the paddle is rotating the arrows will follow each other around at a rate proportional to the flow rate. If the flow rate is too low and/or the paddle is stuck, the paddle wheel icon and the arrows will disappear. In this case the flowrate will have to be increased, the pipe diameter reduced or the paddle wheel freed.

By pressing and releasing the **"metering mode"** ► button, the meter will toggle between displaying the flow rate, the totalized flow and the resettable totalized flow. The resettable totalizer can be reset using the **"reset"** button, whereas the totalizer is not resettable. The left side of the display will indicate the currently selected metering mode.

Pressing the "size ▼" button will display the currently programmed size and schedule of the pipe followed by the units and finally the "adjust" factor will be displayed.. Refer to the calibration section if any of the information is incorrect.

**To be able to store totalized data for a long periods, the larger sized meters will have the totalizer registers stored with a multiplier. The multiplier, either x 10 or x 100, will be displayed every 6 seconds when either of the totalizers are displayed. Example, a 4" meter will have the totalizer registering in gallons x 10. When the totalizer feature is selected, every 6 seceonds "by 10" will be displayed. To get get the correct reading the totalizer must be multiplied by 10.**

## 6. Care & Maintenance

The serviceable parts that may need replacing are the paddle wheel, pin, and O-ring. The life of these parts is dependent on the flow rate and the fluid. If the display becomes erratic or readings seem lower than normal, inspect the paddle wheel and pin.

## 7. Replacing the Battery

**The battery is sealed inside the enclosure, thereby reducing the likelihood of water leakage. Advancements in battery powered semiconductors have made a battery life of 7+ years possible. When the display becomes faint the meter will have to be sent in and a new battery installed.**

## 8. Checking & Replacing the Paddle and Pin

The paddle wheel should turn freely. If not, check for foreign material lodged between the paddle and housing. If the unit is operated in water with fine suspended sand, it is possible for a grain of sand to become lodged between the paddle and the pin. If this occurs, the pin will have to be removed, and the paddle cleaned. To remove the paddle pin, use a drill bit slightly smaller than 3/32". Hold the bit in a vise or pair of pliers, and push the paddle pin out. Do not grab the pin with the pliers, as this will mar the surface.

## 9. Specifications

Operating pressure/temperature corresponds to standard schedule 40 & 80 PVC pipe with **maximum operating pressure not to exceed 200 PSI.**

| | |
|---|---|
| Wetted Materials: | PVC<br>Stainless Steel or Teflon Paddle Pin<br>Buna N or Viton O-Ring |

| | |
|---|---|
| Ambient Operating Temperature: | 20° to 140° F |
| Maximum % Solids: | 1% of Fluid Volume |
| Linearity: | ±1.5% Full Scale |
| Repeatability: | ±1% Full Scale |
| Battery Life | **Greater than 7 Years** |

**Pipe Size vs. Flow Range**

| Pipe Size | | id.(inches) | Flow Range (GPM) |
|---|---|---|---|
| | 1/2" | | 0.6 - 15 |
| | 3/4" | | 1.5 - 30 |
| | 1" | | 5 - 55 |
| 1 1/2" | sch40 | 1.61" | 10-125 |
| | sch80 | 1.50 | |
| 2" | sch40 | 2.07 | 15 - 200 |
| | sch80 | 1.94 | |
| 3" | sch40 | 3.07 | 40 - 450 |
| | sch80 | 2.90 | |
| 4" | sch40 | 4.03 | 60 - 800 |
| | sch80 | 3.83 | |
| 6" | sch40 | 6.07 | 120 - 1800 |
| | sch80 | 5.76 | |
| 8" | sch40 | 7.98 | 250 – 3200 |
| | sch80 | 7.63 | |

# 10. Troubleshooting

Most problems with the flow meter can be traced to either an improper installation or solids becoming entrapped in the paddle. If the paddle clogs, the arrows encircling the paddle wheel icon in the upper lefthand corner of the display will not move around the paddle. Most times, cleaning can be accomplished by washing the paddle under running water. If not, refer to Section 8 for removal and cleaning.

**Common Problems**

- Inadequate lengths of pipe before or after meter
- Bubbles or silt trapped around the paddle
- Pipe not full of water
- Flow rate too low

| Symptom | Possible Cause | Corrective Action |
|---|---|---|
| No display or Totalizer Automatically Resets | Low or Dead Battery | Have Battery Replaced |
| Erratic, Low or No Reading | Paddle Clogged | Clean the Paddle |
| | Paddle/Pin Badly Worn | Replace Paddle and Pin |
| | Flow rate out of range | Increase flow or reduce pipe size |

# 11. Calibration

**Overview:**

The calibration procedure matches the meter with the pipe and also allows the user a selection of unit options (gallon/min., liters/min., etc.). The process is broken down into three parts: selecting a factory preset; choosing the units and possibly changing the calibration factor.

## Programming Procedure

**(Refer to the flow chart)**

### PreSetS:

Using the three buttons on the face of the meter and the flow chart as a guide, the meter is programmed as follows. The programming mode is accessed by depressing and holding the menu/enter ► button for ten seconds until "**PreSetS**" is displayed. Release the button and press the down ▼ key. A list of factory presets, stored in the meter, will be displayed. Using the up ▲ and down ▼ keys, select the size and schedule of the pipe. After selecting the size and schedule, press the enter ► key to confirm. If the pipe size or type of pipe is not listed, the meter will have to be calibrated using a pipe size that has a similar inside diameter and then adjusted using the "**adjust**" procedure outlined in the Appendix, example 2.

### UnitS:

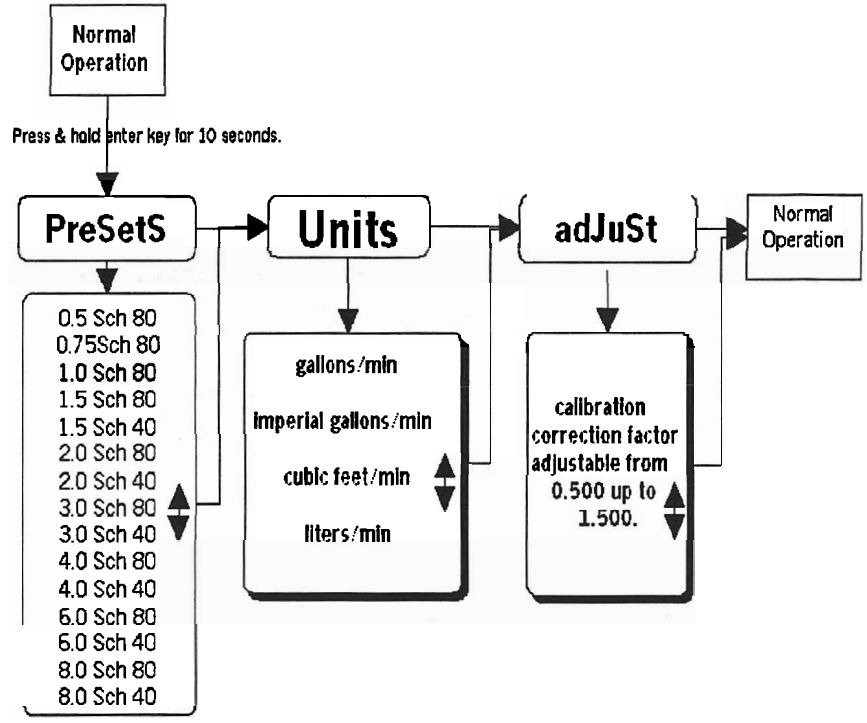
The word "**UnitS**" should now be displayed. Pressing the down ▼ key will display the units that were previously selected. Using the up ▲ and down ▼ keys, other units can be selected. The four options are gallons/min, imperial gallons/min, cubic feet/min and liters/min. After selected, press the enter ► key to confirm.

## adjuSt:

The meter should now be displaying **"adJuSt".** If this register needs to be changed, press the down ▼ key. The register can be modified using the up ▲ and down ▼ keys. Press and hold either button to advance the count quickly.

This register contains the value used to "fine tune" the accuracy of the meter or reprogram the meter to accommodate a pipe size or pipe schedule that is not on the **"PreSetS"** list. The adjustment is accomplished by multiplying the flowrate, resettable totalizer and totalizer with the value stored in the **"adjust"** register. The flowrate and both totalizers will be increased or decreased by up to 50%. The factory preset of 1.000 can be changed from 0.500 up to 1.500. The examples in the appendix outline the calculation and adjustment of this register.

Once the register has been adjusted, press the enter ► button to accept the changes and return to the normal monitoring mode.




**Flow chart for calibration**

# Appendix

## Calibration Examples

## Example 1

**This example demonstrates the procedure for improving the accuracy of the meter.**

Variations in fluid viscosity and the numerous mounting configurations cause slight inaccuracies. By modifying the **"adjust"** register, these inaccuracies can be eliminated..

The procedure is as follows.

- Place a tank of known volume at the outlet.
- Using a stopwatch, determine the time it takes to fill the tank.
- Divide the volume of water (in gallons) by the time (in minutes), this will result in the actual flow rate.
- Divide the actual flow rate by the current reading, this will result in a multiplier.
- Next, using the procedure outlined in Section 11 and the flow chart, access the "**adjust**" register.

- Using the up ▲ and down ▼ buttons, change the **"adjust"** register to reflect the new value. To increment or decrement the register rapidly, depress and hold either button. Press the enter ► key to confirm the change and return to normal metering mode.

Example, a 1" meter is mounted in a location that does not allow the recommended straight run of pipe. This common problem usually affects the accuracy of the meter and not the linearity. By recalibrating the meter it is usually possible to reduce this error.

The meter is indicating 33.4 gpm. The flow is diverted into a 100-gallon tank that takes 175 seconds to fill.

$$actual\ flow\ rate = \frac{(volume\ of\ Tank)}{} \ gpm$$

$$actual\ flow\ rate = \frac{100}{\left(175/60\right)}$$

$$actual\ flow\ rate = 34.3\ gpm$$

Next, calculate the multiplier

$$"adjust" = \frac{actual\ flow\ rate}{present\ meter\ reading}$$

$$"adjust" = \frac{34.3}{33.4}$$

$$"adjust" = 1.027$$

Modify the **"adjust"** register to 1.027 and press the enter ► key place the meter back in service.

## Example 2

**This procedure is used to calibrate the meter for a pipe that is not listed as a factory preset.**

- Measure or look up the inside diameter (id) of the pipe.
- Referring to Section 9, Specifications, find a pipe size with a similar id.
- **Program the meter using the closest factory preset value.**

Next, calculate the **"adjust"** factor by dividing the two squared numbers as shown.

$$"adjust" = \frac{(new\ pipe\ id)^2}{(closest\ pipe\ id)^2}$$

**Note: The cross sectional area of a pipe increases as the square of the diameter.**

- Using the procedure outlined in Section 11 and the flow chart. access the "adjust" register
- Using the up ▲ and down ▼ buttons, adjust the value to match the value calculated above. To increment the register rapidly, depress and hold either button.
- Once adjusted, press the enter ► key to confirm.

Example, a fish processing plant wants to monitor water usage. The supply line feeding the facility is 2" type L copper pipe. Using a data sheet, the id of the type L pipe is found to be 1.96", referring to Section 9, Specifications, the nearest pipe id is 2" schedule 80 with an id of 1.94".

Calculate the **"adjust"** multiplier

$$"adjust" = \frac{(new\ pipe\ id)^2}{(closest\ pipe\ id)^2}$$

$$"adjust" = \frac{(1.96)^2}{(1.94)^2}$$

$$"adjust" = 1.02$$

Modify the **"adjust"** register to 1.020 using the ▲ and down ▼ buttons. Press the enter ► key to confirm the changes, this also places the meter back in service.

## Example 3

This procedure is used to calibrate the meter to display the flow rate and totalizers in units other than *gallons/minute.*

Example: A Canadian farmer wants to use the meter to adjust a valve that will restrict the flow in a 2" schedule 40 pipe to 300 *liters/minute*.

Using the flowchart and the Calibration section of this manual, proceed to the "**UnitS**" section as follows.

- Press and hold the enter ► key for 10 seconds. **"PreSetS"** should display.
- Press the down ▼ button and select *2.0 sh40* from the list
- Press the enter ► key, **"UnitS"** should now be displayed.
- Press the down ▼ key and select *liters* from the options, press the enter ► key to confirm the changes and place the meter back into service.

Note: Unit options are "gallons/min", "imperial gallons/min", "liters/min" and "cubic feet/min".