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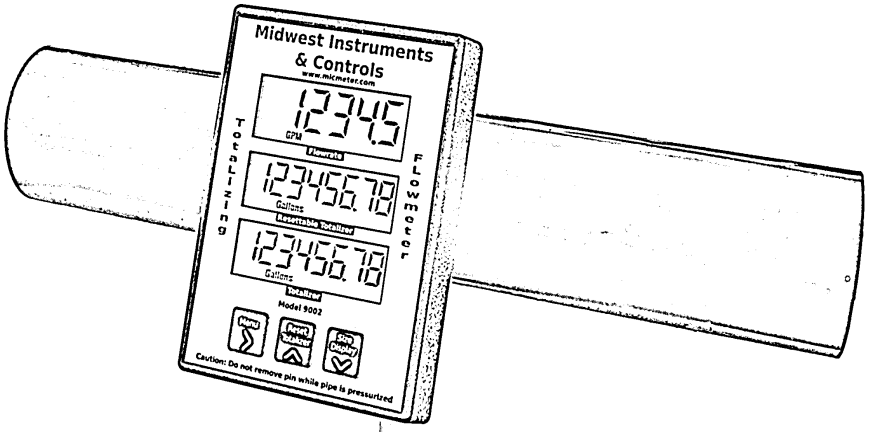

Paddle Wheel Flow Meter with Totalizers Pipe Mounted

Instruction and Installation Manual

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Appendix: Calibration Examples

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

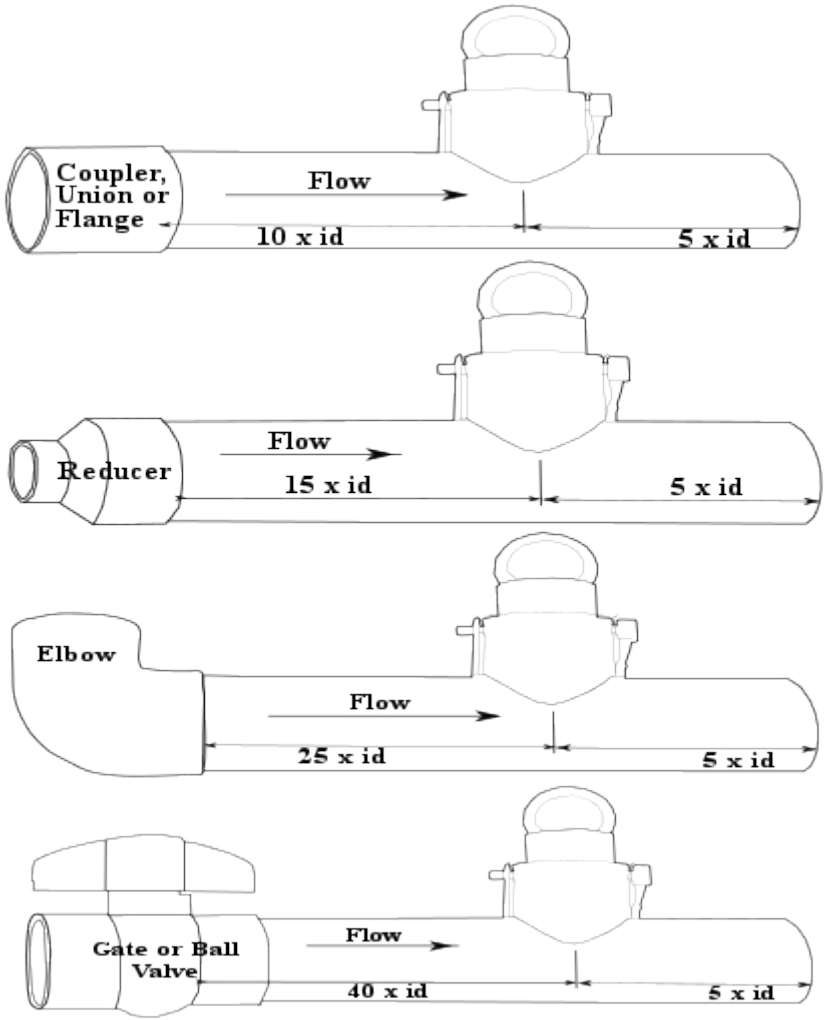
This digital meter is a paddle wheel type, microprocessor-based instrument. The compact, efficient design operates with negligible head loss. The meter is waterproof and battery powered. This allows it to be installed outdoors where no external power is available. If installed outdoors, the display must be shielded from direct sunlight to prevent ultraviolet 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.



<u>Flow meters will only produce accurate results when the pipe is full, flow rate within recommended range and the meter is properly installed</u>.

General:

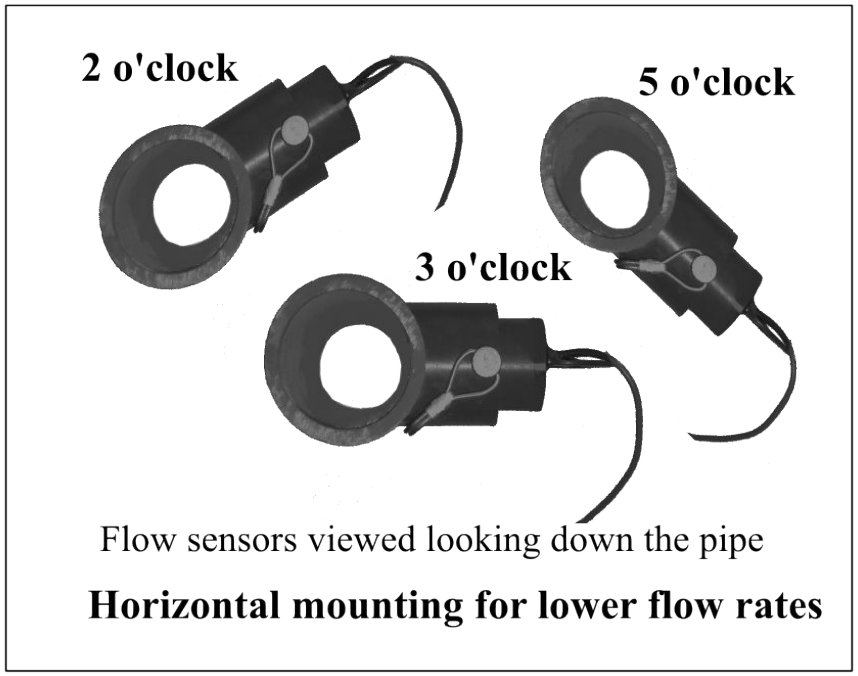
The flow meter must be installed in a straight length of pipe with at least 10 pipe diameters upstream of the meter. The length of the pipe downstream must be at least 5 pipe diameters. In testing this and other paddle-wheel flow meters, it was found that accurate readings were only obtainable when the meter was installed in a section of pipe that was truly straight; no sagging or drooping. With the flow meter mounted in a sagging pipe, results were affected by as much as 5%. Use the diagram as a guideline for required straight run before the meter. If the required dimensions cannot be met, the meter will still work, however accuracy will be compromised. Luckily, the inaccuracy is linear throughout the flow range and the calibration factor in the data acquisition system can be modified.

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 the flow to be measured is typically in the upper half of the recommended flow rate range(see chart in Section 9), the meter



should be mounted on either the top(12 o'clock) or bottom(6 o'clock) of the pipe. If the flow meter will be operated in the lower half of the flow rate range, the meter should be mounted on the pipe as shown in the diagram below. If the flow rate is low and the meter is mounted on the top of the pipe, air bubbles may become entrapped around the paddle and produce inaccurate results. Likewise, 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 with low flows. The life of the paddle wheel will be extended if the meter is mounted on either the top or bottom of the pipe.

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 supplied section of pipe plus the length of the coupling fittings. Be sure the mounting location and position will allow the flow meter to be removed for cleaning/servicing. Install 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.

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.

1. Referring to figure, install the hose clamps on the pipe.

2. Prime the mating surfaces of the adapter and pipe with PVC primer.

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

4. Mount the adapter to the pipe.

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

6. Wipe off any excess cement, and let it dry for 1/4 hour.

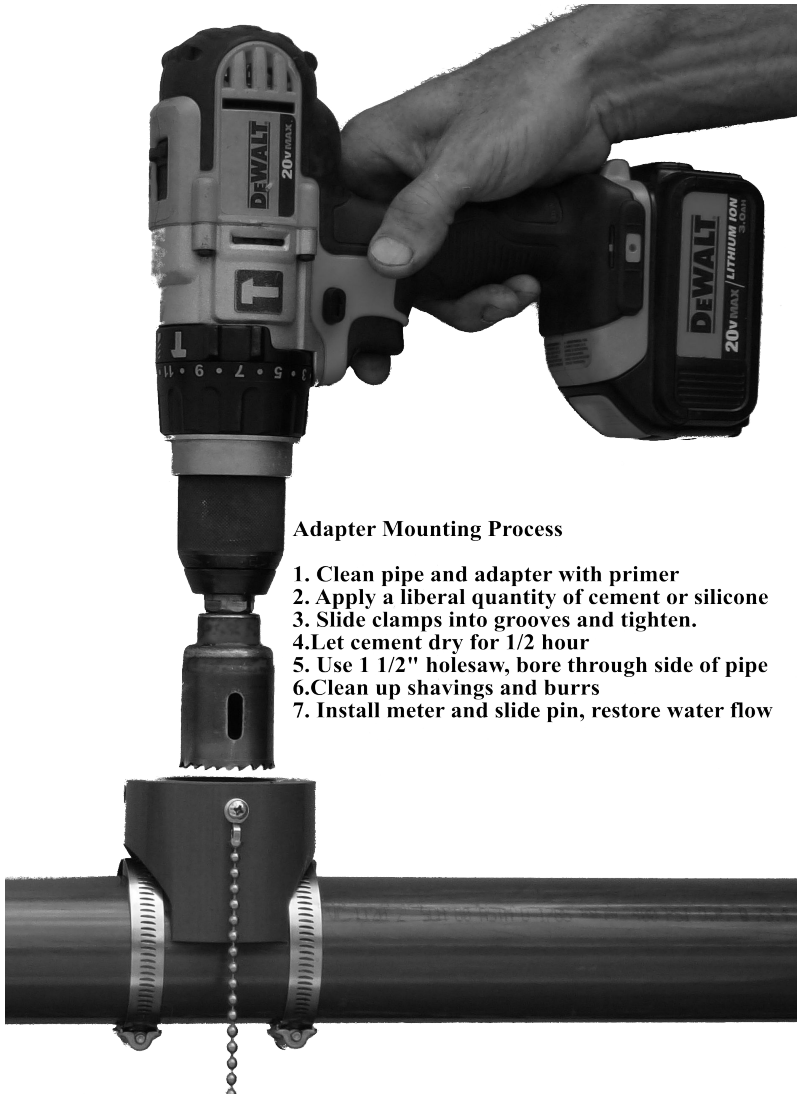
7. Using a 1 ½" hole saw and the adapter as a guide, bore a hole through the pipe. De burr and clean up the shavings.

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

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.

1. Referring to figure in above section, 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. 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, this pulls the adapter tight to the pipe.

7. Let the assembly cure for 2 hours.

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

9. Align the holes for the stainless steel pin and install the pin.

5. Reading the Display

The left corner of the flow rate display(upper most display window) contains two icons resembling paddle wheels. These icons will appear and alternately flash when the paddle wheel is rotating. If the flow rate is too low and/or the paddle is stuck, the paddle icons will disappear. In this case the flow rate will have to be increased, the pipe diameter reduced or the paddle wheel freed. The resettable totalizer can be reset using the middle "**Reset"** button, whereas the totalizer is not resettable. Pressing the **"Size"** button will display the currently programmed size and schedule of the pipe followed by the **units** and finally the **percent adjus**t factor will be displayed. Refer to the calibration section if any of the information is incorrect.

To be able to store totalized data for longer 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. Example, a 4" meter will have the totalizer registering in gallons x 10. Every 6 seconds "by 10" will be displayed. To get get the correct readings both totalizers must be multiplied by 10. The 4", 6" and 8" meters use a x100 multiplier for the liter units.

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 meter output becomes erratic or readings seem lower than normal, inspect the paddle wheel and pin.

7. Replacing the Batteries

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 5+ 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 drill in a vise or pliers and push the pin out.

9. Specifications

Operating pressure/temperature corresponds to standard schedule 40 & 80 PVC pipe with **maximum pressure not to exceed 150 PSI.**

Wetted Materials: PVC, Stainless Steel Paddle Pin
Buna N or Viton O-Ring

Ambient Operating Temperature: 20° to 130° F
Maximum % Solids: 1% of Fluid Volume
Linearity: ±1.5% Full Scale
Repeatability: ±1% Full Scale

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 ½"	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 entrapped in the paddle. Most times, cleaning can be accomplished by washing the paddle under running water. If not, refer to Section 6 for removal and cleaning.

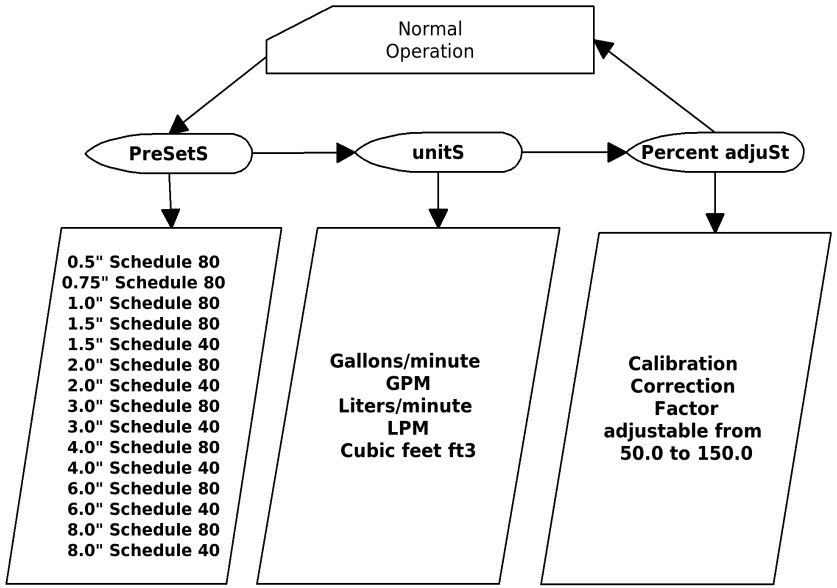
Common Problems

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

11. Calibration

The calibration procedure matches the meter with the pipe. The process is broken down into three parts: selecting a factory preset; choosing the units and possibly changing the calibration factor.

Programming Procedure



Calibration Flowchart

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 ► button for ten seconds until "**PreSetS**" is displayed. Release the button and press the ▼ key. A list of factory presets stored in the meter will be displayed. Using the ▲ and ▼ keys, select the size and schedule of the pipe. After selecting the size and schedule, press the menu ► 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 "**percent adjust**" procedure outlined in the Appendix, example 2.

UnitS:

The word "**UnitS"** should now be displayed. Using the ▲ and ▼ keys, other units can be selected if needed. The three options are gallons/min, cubic feet/min and liters/min. After selecting, press the menu ► key to confirm.

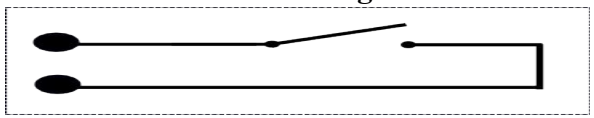
PerCent AdJUSt:

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 in the **"PreSetS"** list. The adjustment is accomplished by multiplying the flow rate, resettable totalizer and totalizer with the value stored in the **"percent adjust**" register. The flow rate and both totalizers will be increased or decreased by up to 50%. The factory preset of 100.0 can be changed from 50.0 up to 150.0. The examples in the appendix outline the calculation and adjustment of this register. The meter should now be displaying **"PerCent AdJUSt**:". If this register needs to be changed, press the ▼ key. The register can be modified using the ▲ and ▼ keys. Press and hold either button to advance the count quickly. Once the register has been adjusted, press the menu ► button to accept the changes and return to the normal monitoring mode.

9. Meter Calibration Factors
(for models equipped with a pulse output)

If your meter is equipped with a pulse output, a 5' long, twin conductor wire will be present. A magnet contained in the paddle passes by a reed switch once per revolution. When interfacing the meter, a switch de-bounce routine may needed as this is a mechanical switch.

Schematic diagram



Size & Pipe Schedule	*Gallons/pulse*
1/2”	0.0072
3/4”	0.0142
1”	0.024
1 1/2” schedule 40	0.071
1 1/2” schedule 80	0.061
2” schedule 40	0.119
2” schedule 80	0.109
3” schedule 40	0.308
3” schedule 80	0.268
4” schedule 40	0.567
4” schedule 80	0.507
6” schedule 40	1.28
6” schedule 80	1.16
8” schedule 40	2.20
8” schedule 80	2.03

Sizes and schedules of pipe and their corresponding volume per revolution of the paddle.

. 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 **“percent adjust**” register, these inaccuracies can be greatly reduced.

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 “**percent adjust**” register.

- Using the ▲ and ▼ buttons, change the **“percent adjust”** register to reflect the new value. To increment or decrement the register rapidly, depress and hold either button. Press the menu ► 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 but not the linearity. By recalibrating the meter it is 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.

$$actual\ flow\ rate = \frac{(volume\ of\ Tank)}{\left(seconds / 60\right)}$$

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

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

Next, calculate the multiplier (multiply by 100 to convert to percentage).

$$percent\ adjust = \frac{actual\ flow\ rate}{present\ meter\ reading}\ x100$$

$$percent\ adjust = \frac{34.3}{33.4} x100$$

$$percent\ adjust = 102.7$$

Modify the **"percent adjust"** register to 102.7 and press the menu ► key, this places 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 **"percent adjust"** factor by dividing the two squared numbers and multiplying by 100 to convert to a percentage.

$$percent\ adjust = \frac{(new\ pipe\ id)^2}{(closest\ pipe\ id)^2} x\,100$$

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 "**percent adjust**" register
- Using the ▲ and ▼ buttons, adjust the value to match the value calculated above. To increment the register rapidly, depress and hold either button.
- Once adjusted, press the menu ► key to confirm the changes.

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". Program the meter for the 2" schedule 80 pipe, this will load the parameters that will next be modified to match the 2" type L pipe.

Calculate the **"percent adjust"** multiplier

$$percent\ adjust = \frac{(new\ \ pipe\ id)^2}{(closest\ \ pipe\ id)^2} x\ 100$$

$$percent\ adjust = \frac{(1.96)^2}{(1.94)^2} x\ 100$$

$$percent\ adjust = 102.1$$

Modify the **"percent adjust"** register to 102.1 using the ▲ and ▼ buttons. Press the menu ► 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 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 menu ► key for 10 seconds. **"PreSetS**" should display.
- Press the ▼ button and select *2.0 schedule 40* from the list
- Press the menu ► key, **"UnitS"** should now be displayed.
- Press the ▼ key and select *liters* from the options, press the menu ► key.
- **"Percent AdJust"** will now be displayed, press the menu ► key to confirm the changes and place the meter back into service.

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