Oval Gear
Industrial Oval Gear Flow Meters

Industrial Oval Gear

Meters and Registers

RusAutomation

Badger Meter

IOG-UM-00046-EN-09 (February 2015)

User Manual

CONTENTS

SCOPE OF THIS MANUAL

This manual contains installation and operation instructions for the Badger Meter Industrial Line of Oval Gear Meters and Registers.

Proper performance and reliability of these meters and registers depends upon installation in accordance with these instructions.

Be sure to read all safety information beginning on page 6 and throughout this manual.

PRODUCT UNPACKING AND INSPECTION

Upon receipt of the product, perform the following unpacking and inspection procedures:

NOTE: If there is damage to the shipping container, request the carrier to be present when unpacking the product.

Carefully open the shipping package and follow any instructions marked on the exterior. Remove all packing material and carefully lift the product from the package.

Retain the package and all packing material for possible use in reshipment or storage.

Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts or any other sign of damage that may have occurred during shipment.

NOTE: If you find damage, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier.

A claim for equipment damage in transit is the sole responsibility of the purchaser.

PRODUCT IDENTIFICATION

Record the product identification numbers from the nameplate.

Model #_____

Serial Number # _____

Tag # _____(if applicable)

DISCLAIMER

The user/purchaser is expected to read and understand the information provided in this manual, follow any listed safety precautions and instructions and keep this manual for future reference.

Misuse, mishandling and/or inadequate maintenance may impair performance and/or compromise safety.

QUESTIONS OR SERVICE ASSISTANCE

If you have questions regarding the product or this document contact:

Badger Meter, Inc.
P.O. Box 245036
Milwaukee, WI 53224-9536
Telephone: 414-355-0400, 800-876-3837
Fax: 888-371-5982
Web site: www.badgermeter.com
or call your local Badger Meter representative.

SAFETY

⚠WARNING

Explosion and Fire Hazards

- Improper grounding, poor ventilation, open flames or sparks can cause a hazardous condition and result in an explosion or fire and cause serious injury.
- Be sure the fluid system is properly grounded. See your pump instruction manual for details.
- If there is static sparking or if you feel an electric shock while using the meter, stop dispensing immediately. Identify and correct the problem before continuing.
- Provide fresh air ventilation. This will avoid the buildup of fumes from the fluid being dispensed.
- Do not smoke while dispensing flammable fluids.
- Keep the dispensing area free of debris including solvents, rags and spilled gasoline.

⚠WARNING

Meter Hazards

- Equipment misuse can cause the meter to rupture or malfunction and cause serious injury.
- This equipment is for professional use only.
- Read all instructions, tags and labels before operating the equipment.
- Use the equipment only for its intended purpose.
- Do NOT modify or alter the equipment.
- Do NOT leave equipment unattended while dispensing.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- Do NOT exceed the maximum working pressure level of the lowest rated system component.
- Use only extensions and nozzles that are designed for use with this equipment.
- Use only fluids and solvents that are compatible with the equipment. Read all fluid and solvent manufacturer's warnings.
- Tighten all fluid connections before operating this equipment.
- Do NOT stop or deflect leaks with hands, body, gloves or rags.
- Do NOT dispense towards any person or any part of the body.
- Do NOT place hands or fingers over the end of or into the dispense valve.
- Comply with all local, state and federal fire, electrical and safety regulations.
- Use of this product in a manner other than specified in this manual may result in impaired operation or damage to equipment.

These meters are designed to dispense a wide range of chemicals. Consult the factory for chemical compatibility.

METER INSTALLATION

⚠ CAUTION

READ THE FOLLOWING INFORMATION AND HAVE A THOROUGH UNDERSTANDING BEFORE PROCEEDING WITH METER INSTALLATION. ONLY QUALIFIED PERSONNEL SHOULD PERFORM METER INSTALLATION.

- Install a type 60 mesh strainer or Y or basket as close to the inlet side of the meter as possible. Strainers prevent dirt and other fluid contaminants from impeding meter performance. Strainers require periodic cleaning, as clogged strainers also impede meter performance. Contact your local representative for specific information, per your specific application.

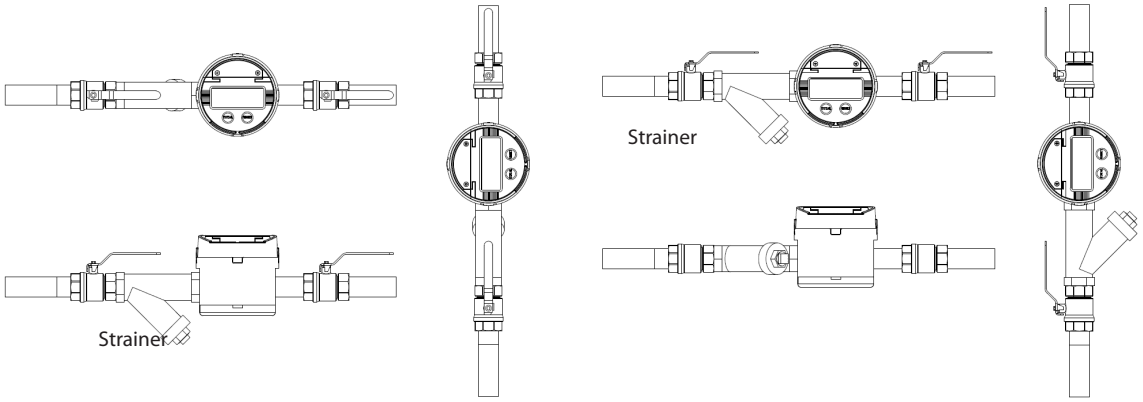


Figure 1: Meter installation

- Turn off any associated pumps to reduce line pressure and slowly fill the line and meter with fluid before restarting pumps. Doing so reduces the possibility of meter damage caused by errant air pressures in the line and meter.
- Make sure all pipe conforms to the same pressure output rating as the pump.
- Make sure to apply thread sealant to all pipe threads.
- Check for and repair leaks upon initialization of fluid flow.

METER OPERATION

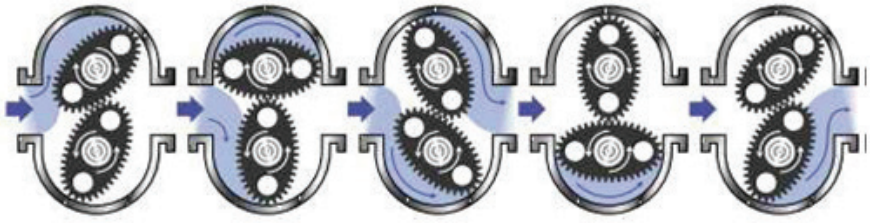
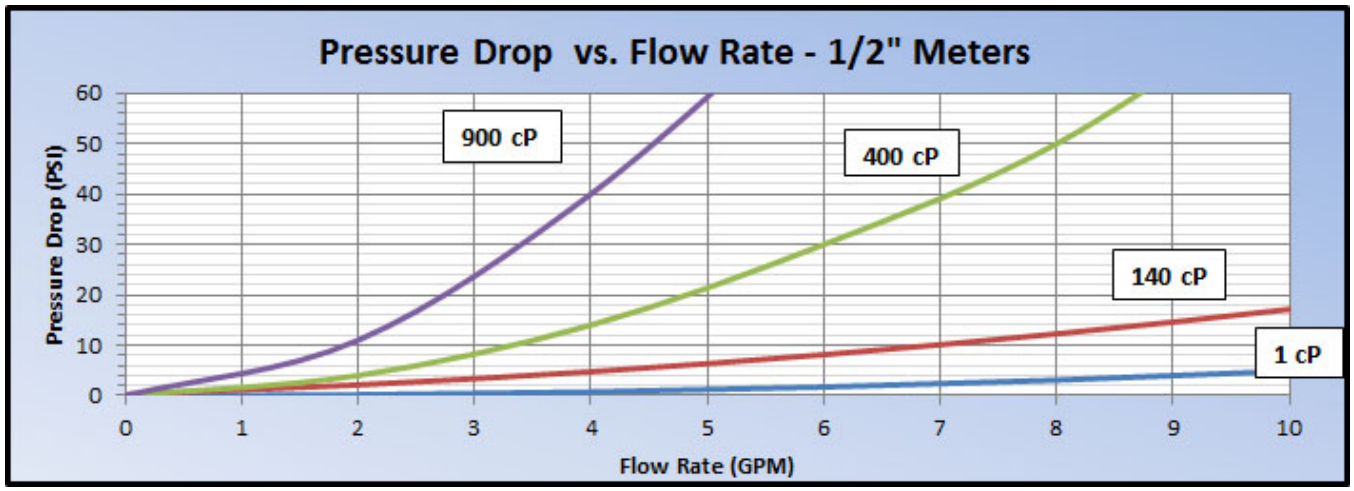


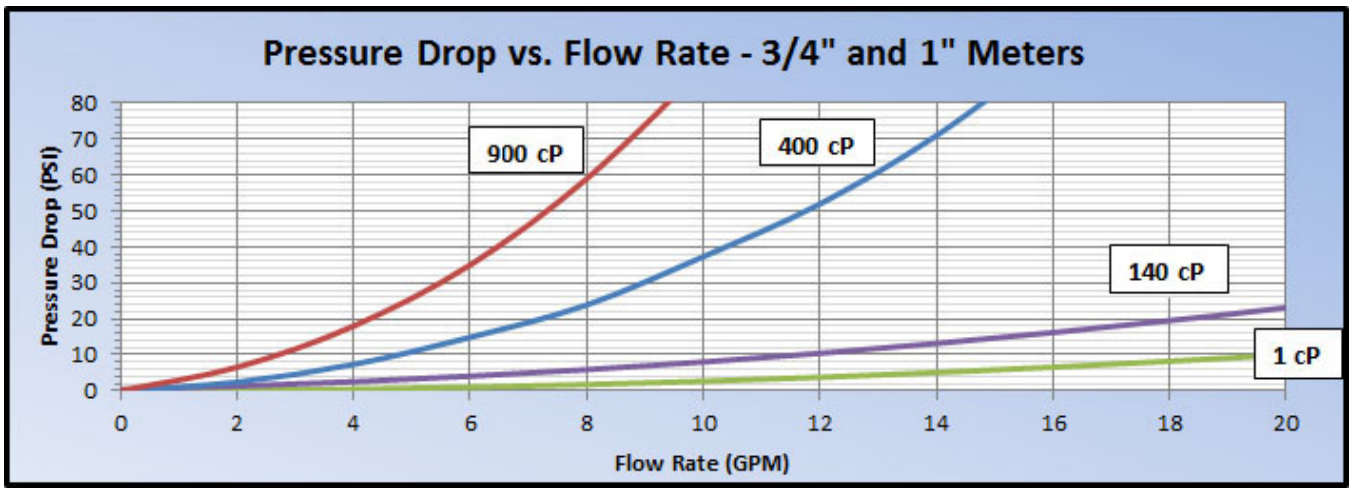
Figure 2: Operation depiction

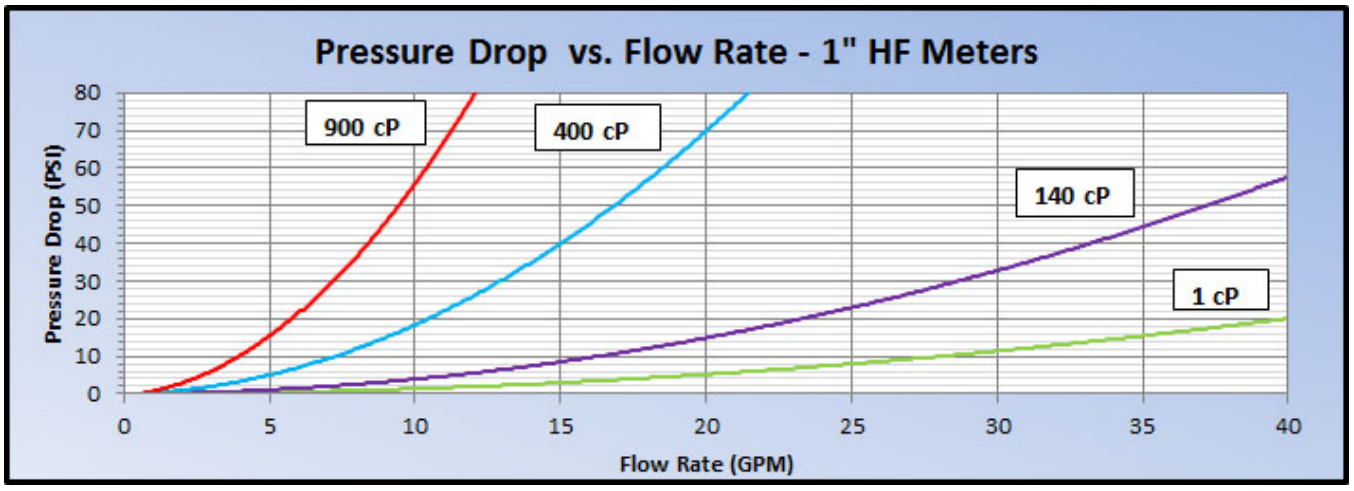
Fluid enters the inlet port and then passes through the metering chamber. Inside the chamber, fluid forces the internal gears to rotate before exiting through the outlet port. Each rotation of the gears displaces a specific volume of fluid. As the gears rotate, a magnet on each end of the gear pass a reed switch in the top-mounted register's circuit board. The reed switches send pulses to the microprocessor in the register to change the LED display segments.

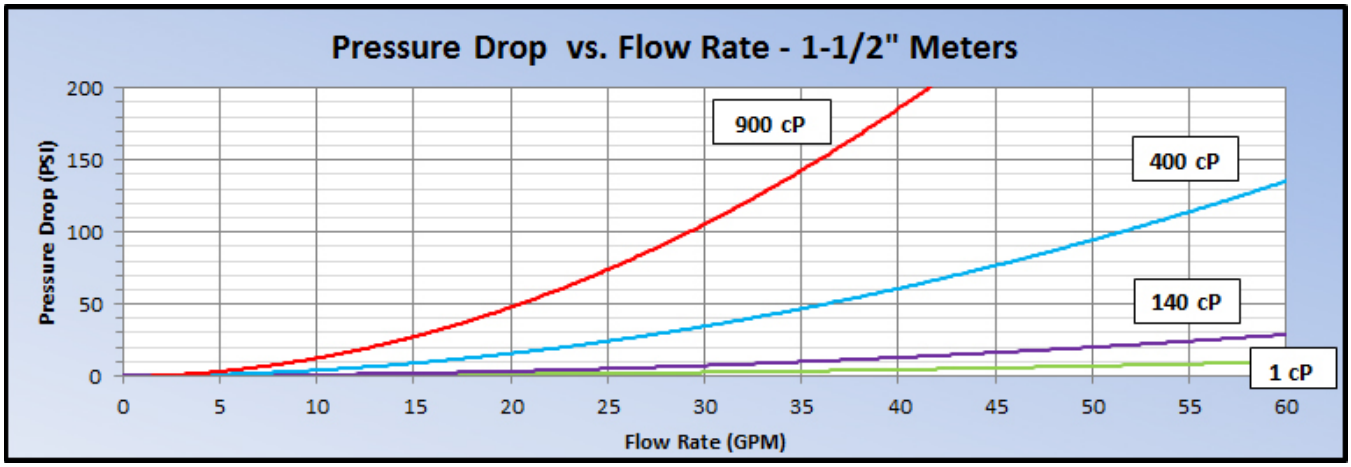
Upon initialization and continuation of fluids through the line and meter, the expected pressures are:

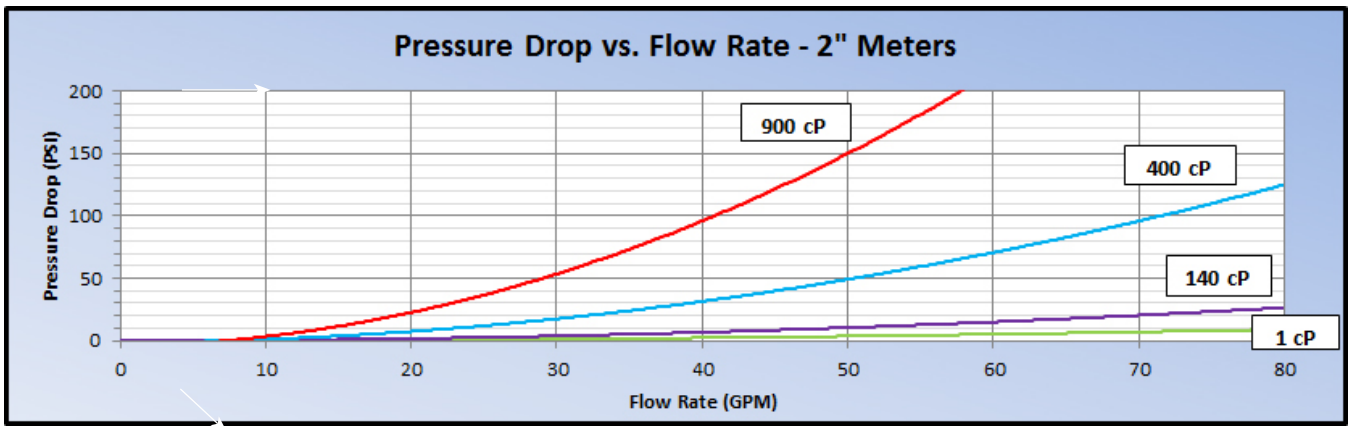
Pressure Drop vs Flow Rate

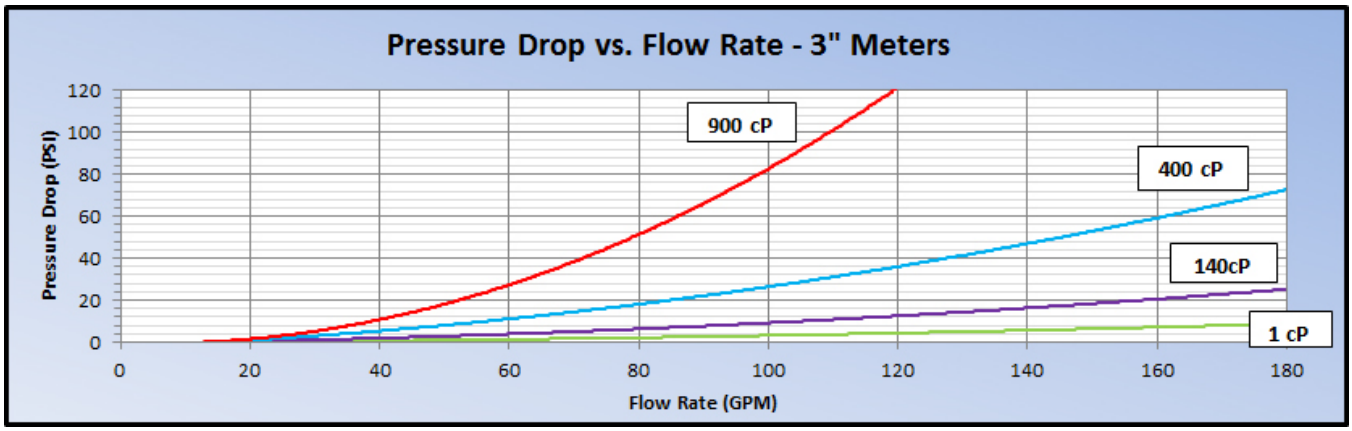







Pressure Drop vs. Flow Rate - 1-1/2" Meters
Pressure Drop (PSI)
200
150
100
50
0
0
5
10
15
20
25
30
35
40
45
50
55
60
Flow Rate (GPM)
900 cP
400 cP
140 cP
1 cP


Pressure Drop vs. Flow Rate - 2" Meters
Pressure Drop (PSI)
200
150
100
50
0
0
10
20
30
40
50
60
70
80
Flow Rate (GPM)
900 cP
400 cP
140 cP
1 cP


Pressure Drop vs. Flow Rate - 3" Meters
Pressure Drop (PSI)
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
180
Flow Rate (GPM)
900 cP
400 cP
140cP
1 cP

REGISTER OPERATION

The following describes register operation and program settings for all four Industrial Oval Gear (IOG) Series registers: Industrial Standard (ILR 700), Industrial Pulse (ILR 710), Industrial Quadrature/Dual Pulse (ILR 720) and Industrial Analog (ILR 730). See *"Additional Programming: Industrial Analog and Industrial Pulse (ILR 710 & ILR 730)" on page 15*. The Pulse Transmitter (ILR 740) wiring is shown on *page 21*. The Pulse Transmitter (ILR 741) wiring is shown on *page 22*.

The register display consists of two rows of seven-segment digits, status, unit of measures, flow rate and battery indicators. Operating function settings and programming are provided by the **TOTAL** and **RESET** buttons.

Figure 3: Register display and buttons

Normal Operation

(For models ILR 700, 710, 720 and 730)

To enter normal operation mode: When the screen is blank after exiting programming mode or upon initial use, press either **TOTAL** or **RESET** once.

Status

The status indicators are RESET and TOTAL.

Totalizers

The top row of indicators is the *Batch Totalizer*, which displays the cumulative volume of flow through the meter with six digits. The *Batch Totalizer* totalizes in selected units of measure.

To reset the *Batch Totalizer*, after 2 seconds of no flow, press and release **RESET**.

NOTE: For the ILR 720 model only, the *Batch Totalizer* can be reset by a low pulse on the external reset input.

The bottom row of indicators display the *Resettable Totalizer* with five digits or the five least significant digits of the *Non-Resettable Totalizer*. RESET and TOTAL are indicated when the *Resettable* total is displayed in the 5-digit lower row. Only TOTAL is indicated when the *Non-Resettable* total is displayed.

To toggle between the *Non-Resettable Totalizer* and the *Resettable Totalizer*, press and release **TOTAL**.

To display 11-digit *Non-Resettable Totalizer*:

1. While the *Non-Resettable* total is displayed, press and hold **TOTAL** for 2 seconds.
2. The top row displays the six most significant digits and the bottom row displays the five least significant digits.

NOTE: The *Non-Resettable Totalizer* normally displays 5 least significant digits.

Flow Rate

PER MIN is displayed in conjunction with the unit of measure. All flow rates are calculated in volume unit per minute.

Battery

The "LBat" indicator displays when the battery is approaching end of life. When the indicator is illuminated, the 2/3AA, 3.0 VDC lithium battery is drained to 10% of its total capacity and should be changed. Normal battery life is four years. "Normal" assumes operating conditions of an ambient temperature of 25° C (77° F) and a throughput of 60,000 liters (15,850 gallons, 63,400 quarts, 126,800 pints (US)).

NOTE: A 2/3AA, 3.6 VDC battery may also be used as a replacement.

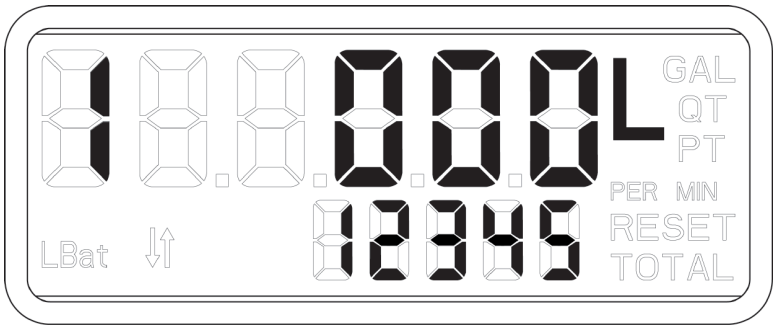


Figure 4: Low battery indicator

Checksum

To display the firmware checksum:

1. Press and hold **RESET** for three seconds.
2. To return to normal display, release **RESET**.

Display Scale Factor

To display the Scale Factor:

1. At the same time, press and hold **TOTAL** and **RESET** for two seconds to display the programmed scale factor.
2. To return to the normal display, release both buttons.

REGISTER PROGRAMMING

In programming mode only, pressing and releasing **TOTAL** advances to the next parameter on the current screen. Pressing and releasing **RESET** changes the current flashing selection to another selection (such as "L" to "GAL").

To enter the programming mode: Press **TOTAL** three times and then press **RESET** three times (the time lag between pressing both buttons six times must be within two seconds).

Changing the Unit of Measure

(For models ILR 700, 710, 720 and 730)

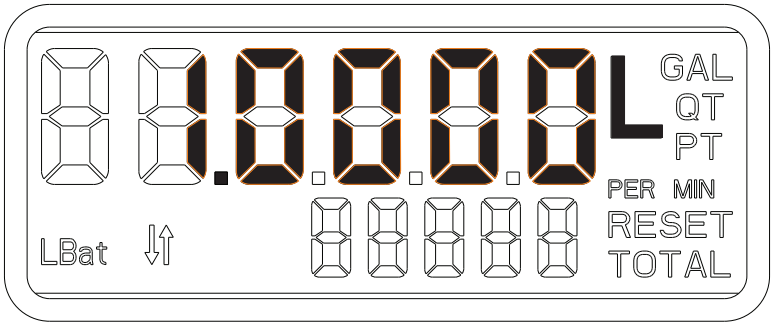


Figure 5: Unit of measure & scale factor programming

1. Press and release **RESET** to change the unit of measure (L, GAL, QT, PT).
2. Press and release **TOTAL** to select desired the unit of measure (the selected unit of measure will flash).
3. When the appropriate unit of measure is selected, press **TOTAL** to advance to the scale factor programming.

Changing the Scale Factor

(For models ILR 700, 710, 720 and 730)

The register collects input pulses from the oval gear meter and then determines the appropriate display output using the scale factor. This scale factor varies depending upon the viscosity of the liquid being measured, therefore calibrating the meter and register in the appropriate liquid will affect the scale factor. The scale factor is displayed as 5 digits (on the top row) next to the unit of measure. The scale factor consists of 1 integer digit and 4 decimal digits (see *Figure 6*).

1. Press **TOTAL** to select a digit (selected digits flash). After cycling through all 5 digits of the scale factor, the register will return to the unit of measure selection.
2. Press **RESET** to change the selected digit. The scale factor must fall between the values of 0.5000 and 2.0000. The Badger Meter factory preset is set between those values at 1.0000.
3. When you are finished adjusting the unit of measure and scale factor, press and hold **TOTAL** for one second to advance to the Pulse Rate section.

NOTE: Error checking will not allow the user to advance to the next screen.

Changing the Meter Pulse Rate

(For models ILR 700, 710, 720 and 730)

The *Meter Pulse Rate* (indicated by the "I" on the top row, on the left side) is the number of pulses per unit of measure as detected by the register. The pulse rate varies according to the type of meter attached. The bottom row shows the 5-digit integer value of the meter pulse rate. The top row shows the 2-digit decimal value of the meter pulse rate.

The meter pulse rate is entered in pulses-per-liter if the selected unit of measure is liters or pulses-per-gallon if the selected unit of measure is US gallons, quarts or pints.

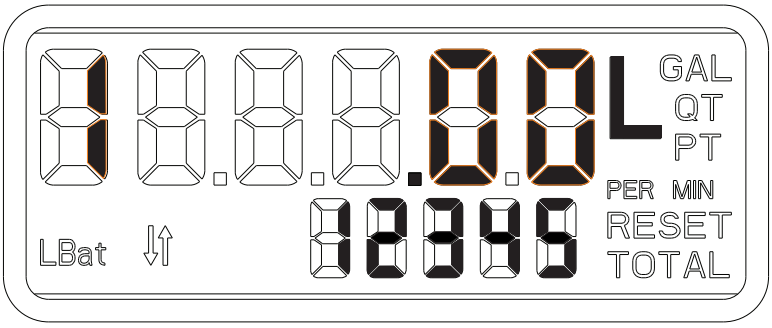


Figure 6: Meter pulse rate

NOTE: The general pulses-per-unit of measure data is available in *"Pulse Chart of Approximate Values" on page 24*.

1. Press **TOTAL** to select a digit (selected digits flash). Press **RESET** to change the selected digit. The pulse rate can be any value between 00000.01 and 99999.99 on the top row; integer values are displayed on the bottom row. Example: 10.45 would display .45 on the top row and 10 would be displayed on the bottom row.
2. When finished adjusting the pulse rate, press and hold **TOTAL** for one second to advance to the *Register Orientation* section.

NOTE: Error checking will not allow the user to advance to the next screen.

Changing the Register Orientation

(For models ILR 700, 710, 720 and 730)

Depending on the orientation (perpendicular or inline on the meter), this setting may need to be changed.

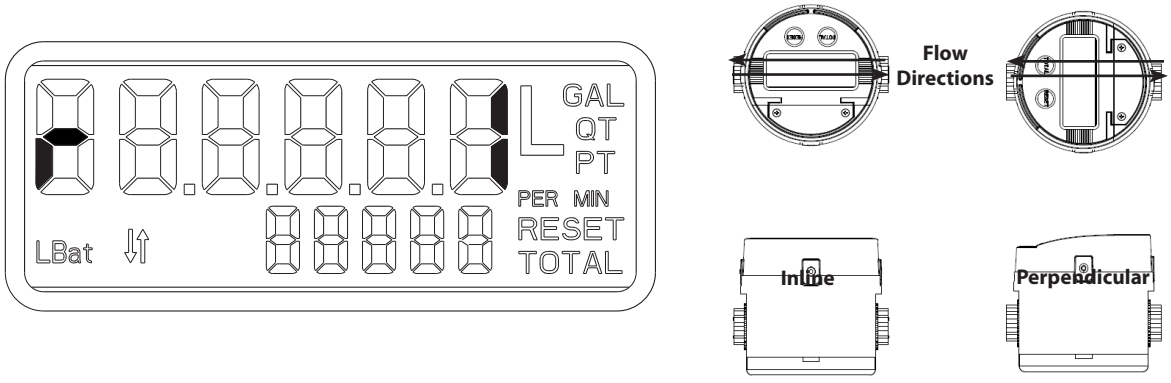


Figure 7: Register orientation

1. Press **RESET** to toggle between available options ("I", for an inline-to-flow orientation and "P" for a perpendicular-to-flow orientation).
2. When finished adjusting the register orientation, press and hold **TOTAL** for one second to advance to the Default Display section.

Changing the Display Mode

(For models ILR 700, 710, 720 and 730)

The *Display Mode* screen (indicated by a "d" on the top row, on the left side) determines the information displayed on the top line of the register during normal operation. The display mode may be either the *Totalizer* screen or the *Flow Rate* screen.

"C," indicates the *Totalizer* screen and "F" indicates the *Flow Rate* screen. The *Totalizer* screen is depicted below:

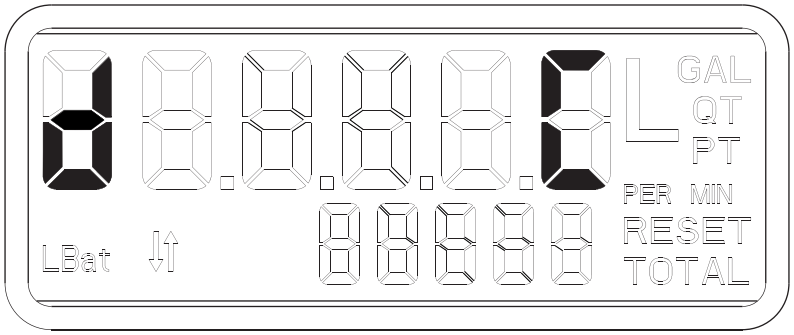


Figure 8: Default display

1. While a letter is flashing on the display, press **RESET** to select either *Totalizer* or *Flow Rate*.
2. Upon completion of this setting, the programming of the Industrial Standard Register and the Industrial Dual Pulse Output is complete. For ILR 710 and ILR 730 models, see *"Additional Programming: Industrial Analog and Industrial Pulse (ILR 710 & ILR 730)" on page 15*.

NOTE: For ILR 710 and ILR 730 models, see *"Additional Programming: Industrial Analog and Industrial Pulse (ILR 710 & ILR 730)" on page 15*.

Exiting Programming Mode

(For models ILR 700, 710, 720 and 730)

To exit the programing mode: On any screen, press and hold both **TOTAL** and **RESET**. The screen will revert back to the programmed scale factor and then flash. Following the three flashes, the register display will be blank.

NOTE: Press **TOTAL** or **RESET** to turn on the display.

Additional Programming: Industrial Analog and Industrial Pulse (ILR 710 & ILR 730)

Output Pulse Length

(For model ILR 710 only)

Indicated by a "P" on the leftside of the display, use this screen to select the low duration of the output pulse.

- "0" for zero milliseconds (Pulse Output is disabled)
- "2" for 2 milliseconds
- "10" for 10 milliseconds
- "20" for 20 milliseconds
- "40" for 40 milliseconds
- "100" for 100 milliseconds

To advance to the next programming screen, press and hold **TOTAL**.

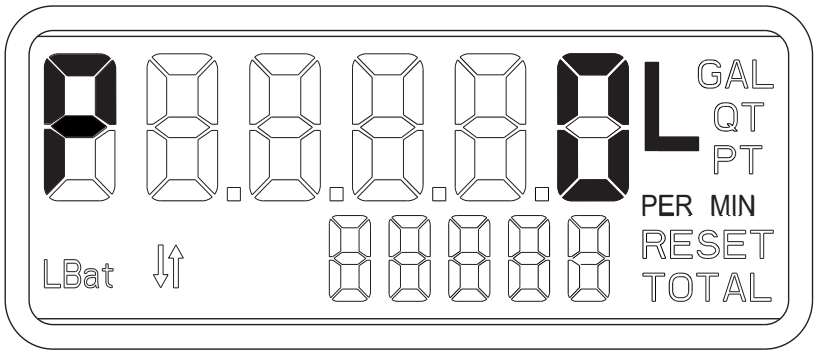


Figure 9: Output pulse length screen

About Output Pulse Length: The pulse rate duration should take into account the "Pulse Rate Out" and maximum meter flow rate, to prevent an output pulse duration greater than the required time between pulses. The *Output Pulse Length* should be set to less than the value of "t" per the equation:

$$t = \frac{\text{Maximum Meter Flow Rate (in gpm or lpm)}}{\text{60X Output Pulse Rate}} \times 1000$$

where t = the required pulse rate in milliseconds.

The Output Pulse Rate = the programmed parameter (default = 1.00 ppl/ppg)

The Maximum Meter Flow Rate = the maximum flow rate of the meter for the application.

Pulse Rate Out

(For model ILR 710 only)

Indicated by an "O" on the left side of the display, this screen allows selection of the of pulses output per liter or per US gallon depending on unit of measure (0.01 ppl/ppg to 100 ppl/ppg).

The meter pulse rate is entered in pulses-per-liter if the selected unit of measure is liters or pulses-per-gallon if the selected unit of measure is US gallons, quarts or pints.

To advance to the next programming screen, hold **TOTAL**.

NOTE: Error checking will not allow the user to advance to the next screen.

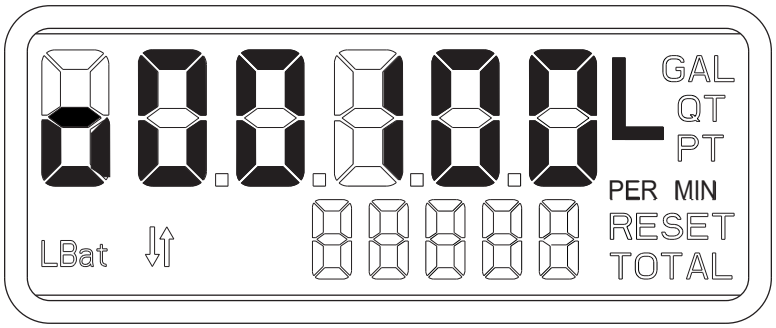


Figure 10: Pulse rate out screen

Analog Minimum Flow Rate

(For model ILR 730 only)

Indicated by a "L" on the left side of the display, use this screen to set the flow rate that corresponds to the 4 mA output:

NOTE: The minimum flow rate value must be less that the maximum flow rate value.

- Minimum 0.0 lpm/gpm
- Maximum 100.0 lpm/gpm
- Default 0.0 lpm/gpm

NOTE: Error checking will not allow you to advance to the next screen.

To advance to the next programming screen, hold **TOTAL** for one second.

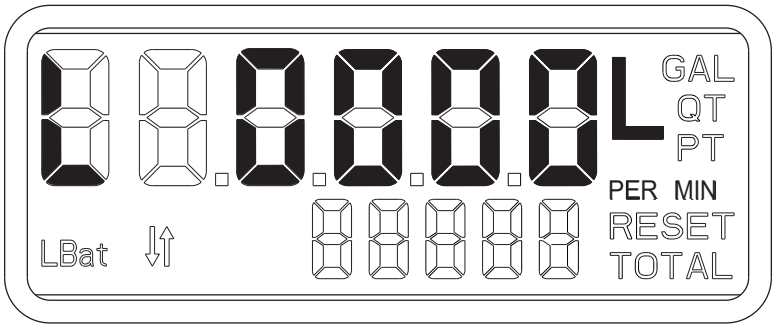


Figure 11: Analog minimum flow rate screen

Analog Maximum Flow Rate

(For model ILR 730 only)

Analog Maximum Flow Rate is indicated by an "H" on the left side of the display. Use this screen to set the flow rate that corresponds to the 20 mA output:

NOTE: The maximum flow rate value must be greater than the minimum flow rate value.

- Minimum 0.0 lpm/gpm
- Maximum 100.0 lpm/gpm
- Default 30 lpm/8 gpm

To advance to the next programming screen, press and hold **TOTAL**.

NOTE: Error checking will not allow you to advance to the next screen.

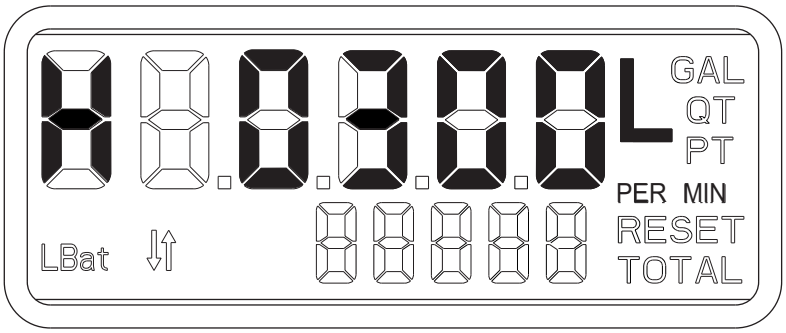


Figure 12: Analog maximum flow rate screen

Register Output Specifications & Wiring

Pulse (Model ILR 710)

Register Wiring

External DC+: Yellow

External Ground: Brown

Pulse Output: White

DC Input: 6…24V DC; 10…20 mA

Outputs: Pulse Output with internal pull-up resistor; optional open collector output with output jumper removal; pulse output is scalable in pulses per liter or pulses per gallon.

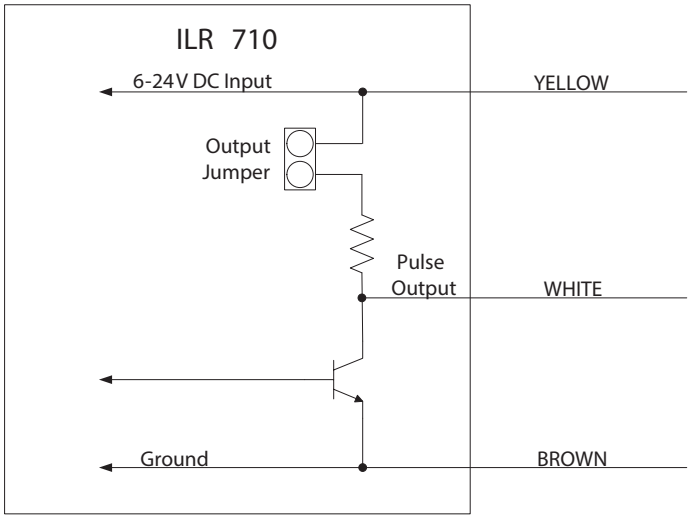


Figure 13: ILR 710 wiring

Dual Pulse (Model ILR 720)

Register Wiring

External DC+: Yellow

External Ground: Brown

Pulse Output 1: White

Pulse Output 2: Green

External Reset: Grey

DC Input: 6…24V DC; 10…20 mA

Outputs: Dual-pulse output with internal pull-up resistor; optional open collector output with output jumper removed; dual pulse output forms a quadrature signal for direction of flow.

Inputs: External reset pulled low to reset the batch totalizer.

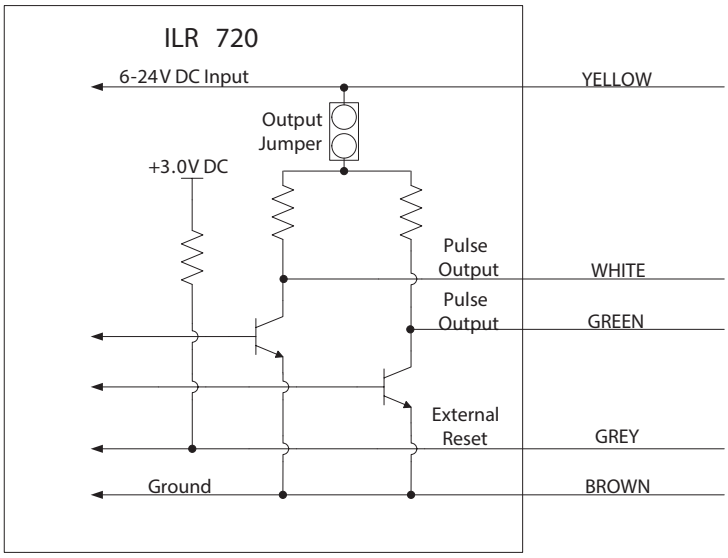


Figure 14: ILR 720 wiring

Analog (Model ILR 730)

Register Wiring

External DC+: Yellow

External Ground: Brown

Analog Output: White

DC Input: 6…24V DC; 10…20 mA

Outputs: Analog 4…20 mA output in loop powered configuration; 6…12V DC external load of 50…250 ohms, 12…24V DC external load of 50…500 ohms; flow rate is linear scaled between 4 mA minimum and 20 mA maximum setpoints; flow rates below programmed minimum read 4 mA.

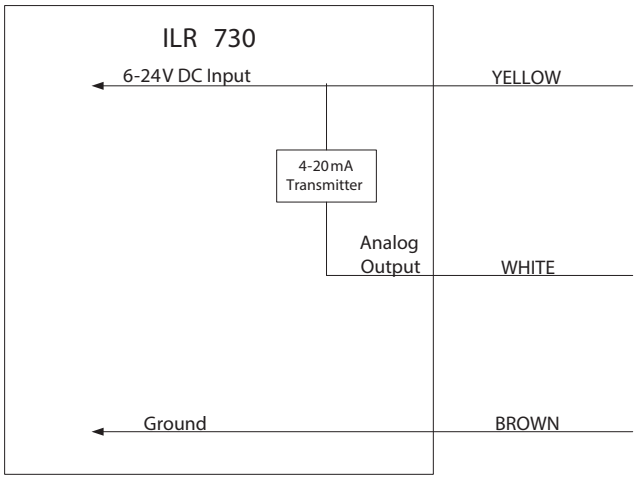


Figure 15: ILR 730 wiring

Pulse Transmitter (Model ILR 740)

Figure 16: ILR 740 pulse transmitter

Orientation: The transmitter register must be mounted as shown above, perpendicular to the flow. The transmitter will not function properly if mounted inline to the flow.

Transmitter Wiring

Reed switch outputs: Green and white.

Ratings:

Maximum Power	10 watts (not to exceed 10 W)
Maximum Voltage	200V DC / peak AC
Maximum Current	0.5A DC / peak AC

Outputs: Raw reed switch output with no signal conditioning.

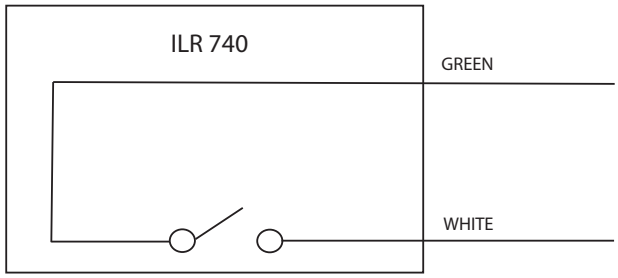


Figure 17: ILR 740 wiring

Pulse Transmitter (Model ILR 741)

The meter size selector switch must be set to correspond to the size of the meter to properly detect fluid flow:

- Position 1 (top): 1/2", 3/4", 1"
- Position 2 (center): 1-1/2"
- Position 3 (bottom): 2", 3"

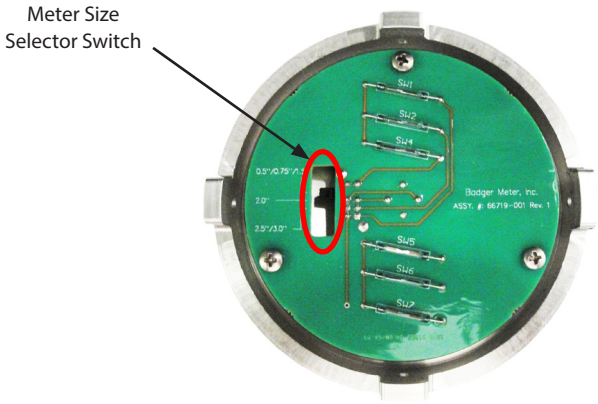


Figure 18: ILR 741 transmitter switch positions

Transmitter Wiring

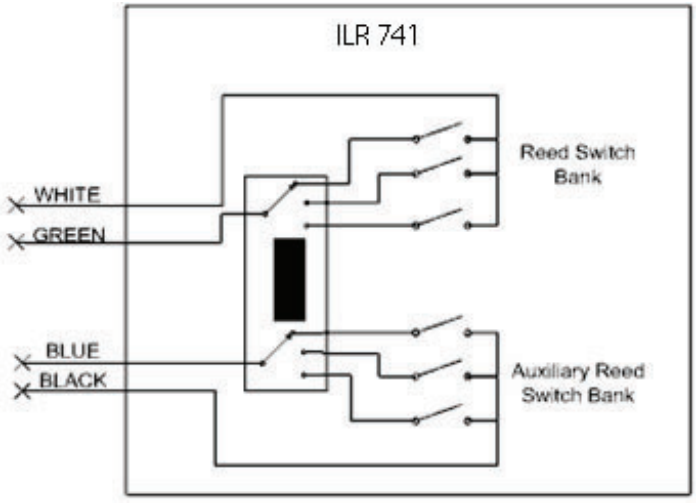


Figure 19: ILR 741 wiring

Pulse Transmitter (for 1/4")

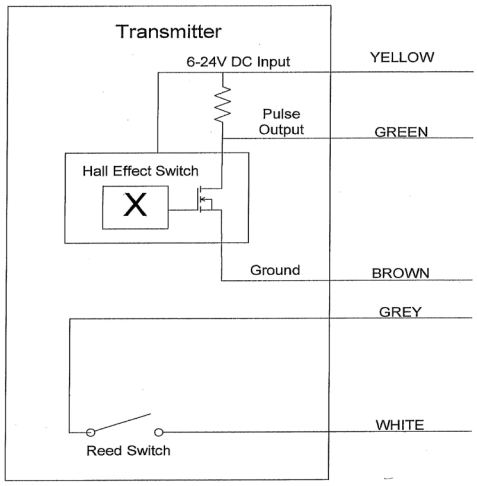


Figure 20: 1/4" wiring

Hall Effect Switch

Rating:

Power Supply:

Supply Input Range: 5…24V DC
Supply Current: 3.5 mA

Pulse Output

Output Current: 30 mA, max.

Wiring:

Yellow: Hall Effect DC+
Brown: Hall Effect Ground
Green: Hall Effect Pulse Output

Reed Switch

Rating:

Power Rating: 10W:
Switching Voltage: 100V (DC or Peak AC)
Switching Current: 500 mA (DC or Peak AC)

Wiring:

Grey: Reed Switch
White: Reed Switch
Green: Hall Effect Pulse Output

Pulses Per Liter

Meter Size	Pulses Per Liter
1/4"	390 PPL

PULSE CHART OF APPROXIMATE VALUES

Meter		PPG	PPL
1/2"	Industrial OG	378.5 ppg	100 ppl
3/4"	Industrial OG	249.8 ppg	66 ppl
1"	Industrial OG	249.8 ppg	66 ppl
1" HF	Industrial OG	162.8 ppg	43 ppl
1-1/2"	Industrial OG	64.4 ppg	17 ppl
2"	Industrial OG	34.1 ppg	9 ppl
3"	Industrial OG	11.4 ppg	3 ppl