

Thermo-Flo™

**With Compact Flow Controller
AT12, AT14, AG12 & AG14 Series Manual**



**Flowline Inc.
10500 Humbolt Street
Los Alamitos, CA 90720
Tel: (562) 598-3015
Fax: (562) 431-8507
www.flowline.com**

Offered in liquid and gas sensor types, the general purpose flow switch package provides reliable no or low-flow detection of relatively clean non-coating media with a 16A SPDT compact flow controller for pump or process protection. Liquid examples include water and sulfuric acid. The optional flash alarm brings attention to low-flow alarm conditions. Available in Polypropylene-Ryton® or Polyvinylidene Fluoride (PVDF), the short flow sensor is used in pipe from ½” to 1-1/2”, and the long configuration is used in 2” and up. The flow switch set point may be adjusted from 0.04 fps to 3 fps in liquids, or 1 to 90 fps in gases for low-flow control. The flow sensor is best applied in applications with relatively constant temperature.

Features

- Rugged Polypropylene-Ryton® or Polyvinylidene Fluoride sensor for corrosive liquids and gases.
- Fail-Safe relay control of pumps, valves or alarms with a 0.15 to 60 second delay
- Optional flashing alarm brings immediate attention to level alarm conditions.
- Polypropylene enclosure rated NEMA 4X with swivel base for conduit alignment.
- Invert switch changes relay state from NO to NC without rewiring.

Table of Contents

Specifications: 3

Dimensions:..... 4

Components:..... 5

Standard Configuration:..... 6

Safety Precautions: 7

Make a Fail-Safe System: 8

Technology:..... 9

Getting Started:..... 10

Guide to Controls:..... 10

Electrical:..... 11

Connecting Switches to Input Terminals: 11

VAC Power Input Wiring: 11

Relay Input Wiring: 11

Strobe Alert Output: 12

Changing from 120 to 240 VAC:..... 12

Installation: 13

Mounting on a Sensor:..... 13

Calibration:..... 14

Set Points: 14

Accessing the Adjustment Potentiometer:..... 14

Application Examples:..... 15

Low Flow Alarm:..... 15

Appendix: 16

Controller Logic:..... 16

Troubleshooting:..... 16

LED Indication: 17

Maintenance: 18

Cleaning Procedure:..... 18

Testing Flow Switch Alone: 18-19

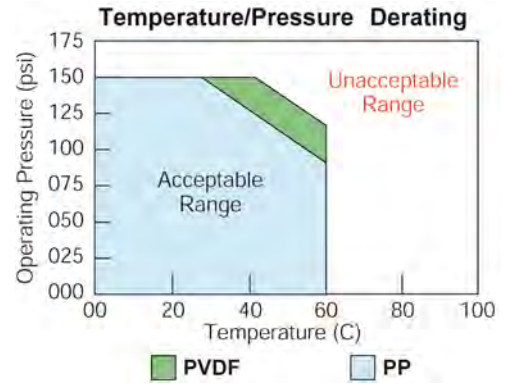
Warranty, Returns and Limitations:..... 20

Set point range: AT1_: .04 to 3 fps (.012 to .91 mps)
 AG1_: 1 to 90 fps (.3 to 27 mps)
 Factory set point: AT1_: .2 fps (.06 mps)
 AG1_: 10 fps (3 mps)
 Viscosity range: AT1_: 1 to 200 centipoise
 AG1_: N/A
 Repeatability: ±.5% of set point @ fixed temp.
 Response time: 1 to 10 seconds
 Set point adjust.: Potentiometer
 LED indication: Power, relay and sensor status
 Supply voltage: 120/240 VAC @ 50-60 Hz.
 Consumption: 0.25A maximum
 Contact type: (1) SPDT Relay
 Contact rating: 250 VAC @ 16A, ½ Hp
 Contact output: Selectable NO or NC
 Contact delay: 0.15 - 60 seconds
 Process temp.: F: 32°to 140° / C: 0°to 60°
 Ambient temp.: F: -40°to 140° / C: -40°to 60°
 Pressure: 150 psi (10bar) @ 25 °C, derated @
 1.667 psi (0.113 bar) per °C above
 25 °C.

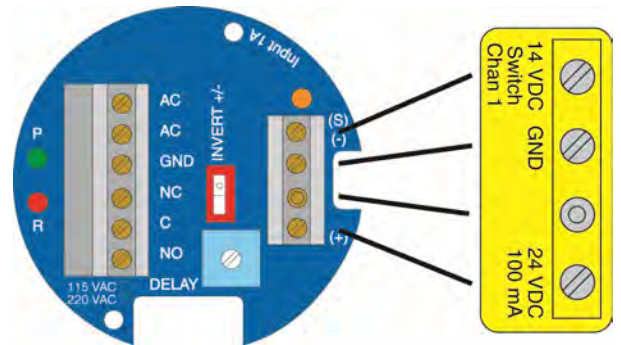
Enclosure rating: NEMA 4X (IP65)
 Enclosure material: -_61_: PP (U.L. 94 VO & PC)
 -_62_: PP (U.L. 94 VO)
 Conduit entrance: Single, 1/2" NPT
 Wetted material: -16__: PP-Ryton®
 -36__: PVDF
 Enclosure mount.: 3/4" NPT (Rp or G)
 Enclosure rotation: 300°swivel base
 Mount. Gasket: Viton® (Rp or G version only)
 Classification: General purpose
 Certificate number: LR 79326-3

Strobe Alert

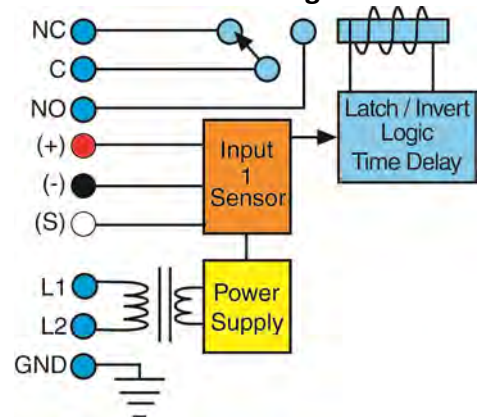
Flash type: Xenon tube
 Flash frequency: 1 per second
 Strobe life: 10M cycles
 Supply voltage: 120 VAC, 50-60 Hz.
 Consumption: 3 Watts max.
 Material: Polycarbonate
 Enclosure rating: NEMA 4X (IP65)
 Color: Amber



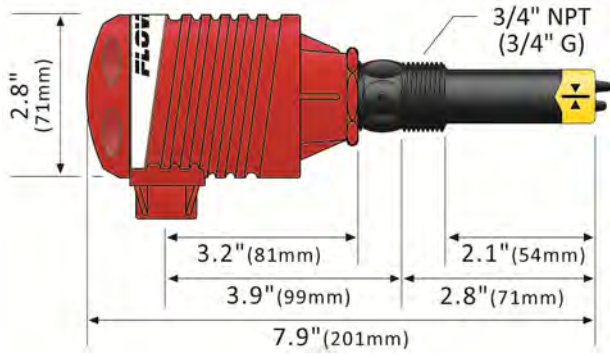
Controller Labels



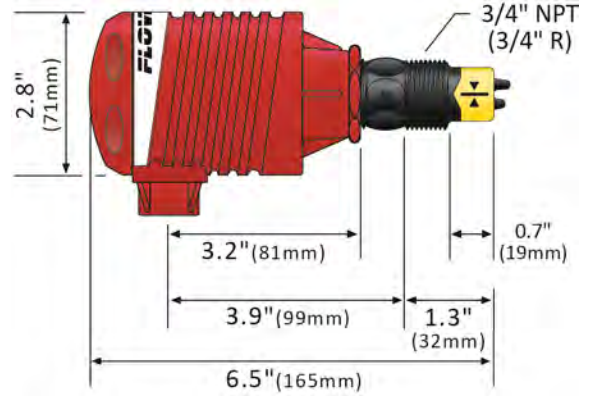
Functional Diagram



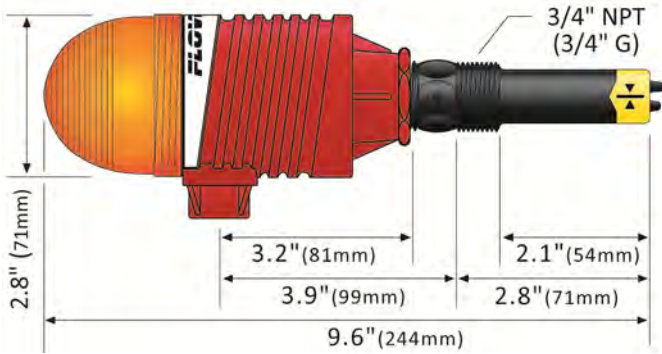
**Dimensions
Long Sensor**



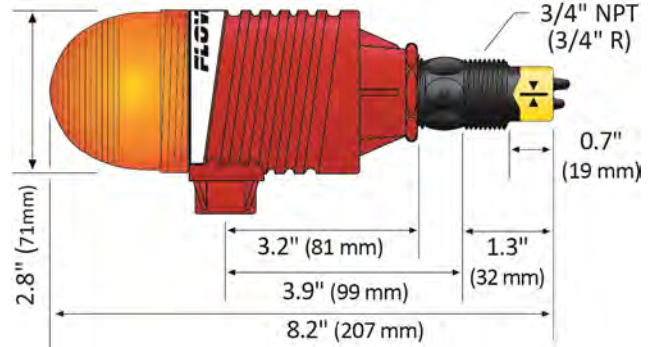
Short Sensor



Long Sensor with Strobe Alert™



Short Sensor with Strobe Alert™



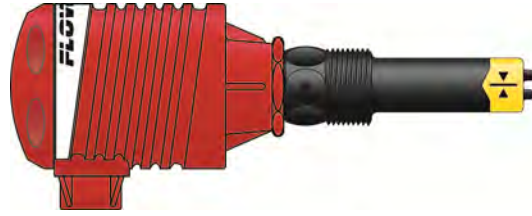
About Thermo-Flo™: Flowline’s Thermo-Flo™ with Compact Relay Controller is a single-point mounting system for installing one flow sensor within a pipe or fume. The compact relay controller features a 120/240 VAC controller with a 250 VAC, 16A, 1/2Hp SPDT relay contract.

Part Number	240 VAC Option	Thread	Strobe Alert	Sensor Material	Sensor Length	Application Media
AG12-1610	Add (-E)	NPT	Yes	PP & Ryton®	Short	Gas
AG12-1614		R				
AG12-1620		NPT	No			
AG12-1624		R				
AG12-3610		NPT	Yes	PVDF		
AG12-3614		R				
AG12-3620		NPT	No			
AG12-3624		R				
AG14-1610		NPT	Yes	PP & Ryton®	Long	
AG14-1614		G				
AG14-1620		NPT	No			
AG14-1624		G				
AG14-3610		NPT	Yes	PVDF		
AG14-3614		G				
AG14-3620		NPT	No			
AG14-3624		G				
AT12-1610		NPT	Yes	PP & Ryton®	Short	
AT12-1614		R				
AT12-1620		NPT	No			
AT12-1624		R				
AT12-3610		NPT	Yes	PVDF		
AT12-3614		R				
AT12-3620		NPT	No			
AT12-3624		R				
AT14-1610		NPT	Yes	PP & Ryton®	Long	
AT14-1614		G				
AT14-1620		NPT	No			
AT14-1624		G				
AT14-3610	NPT	Yes	PVDF			
AT14-3614	G					
AT14-3620	NPT	No				
AT14-3624	G					

- Owner’s Manual

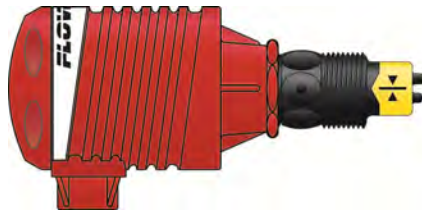
Relay Controller: The flow switch is pre-wired before shipment to the 3-pole terminal strip [Input 1 (+), (-) & (S)]. The technologies used to indicate flow is Thermal Dispersion. Both the liquid and gas configurations feature similar wiring/power configuration. The Compact Relay Controller provides a 1/2” Conduit connection and 6 poles for wire termination of power and relay contact. Use the AC, AC and GND terminals for providing power. Use the NC, NC and COM terminals for interfacing to the relay contact.

Standard Configuration:
AT14- 6 _ _ or AG14- 6 _ _



		Liquid		Gas	
		Strobe Alert	No Strobe	Strobe Alert	No Strobe
PP-Ryton®	¾" NPT	<u>AT14-1610</u> 1 x FT10-1405 1 x LC10-1002	<u>AT14-1620</u> 1 x FT10-1405 1 x LC10-1001	<u>AG14-1610</u> 1 x GT10-1405 1 x LC10-1002	<u>AG14-1620</u> 1 x GT10-1405 1 x LC10-1001
	¾" G	<u>AT14-1614</u> 1 x FT10-1425 1 x LC10-1052	<u>AT14-1624</u> 1 x FT10-1425 1 x LC10-1051	<u>AG14-1614</u> 1 x GT10-1425 1 x LC10-1052	<u>AG14-1624</u> 1 x GT10-1425 1 x LC10-1051
PVDF	¾" NPT	<u>AT14-3610</u> 1 x FT10-5405 1 x LC10-1002	<u>AT14-3620</u> 1 x FT10-5405 1 x LC10-1001	<u>AG14-3610</u> 1 x GT10-5405 1 x LC10-1002	<u>AG14-3620</u> 1 x GT10-5405 1 x LC10-1001
	¾" G	<u>AT14-3614</u> 1 x FT10-5425 1 x LC10-1052	<u>AT14-3624</u> 1 x FT10-5425 1 x LC10-1051	<u>AG14-3614</u> 1 x GT10-5425 1 x LC10-1052	<u>AG14-3624</u> 1 x GT10-5425 1 x LC10-1051

AT12- 6 _ _ or AG12- 6 _ _



		Liquid		Gas	
		Strobe Alert	No Strobe	Strobe Alert	No Strobe
PP-Ryton®	¾" NPT	<u>AT12-1610</u> 1 x FT10-1305 1 x LC10-1002	<u>AT12-1620</u> 1 x FT10-1305 1 x LC10-1001	<u>AG12-1610</u> 1 x GT10-1305 1 x LC10-1002	<u>AG12-1620</u> 1 x GT10-1305 1 x LC10-1001
	¾" R	<u>AT12-1614</u> 1 x FT10-1325 1 x LC10-1052	<u>AT12-1624</u> 1 x FT10-1325 1 x LC10-1051	<u>AG12-1614</u> 1 x GT10-1325 1 x LC10-1052	<u>AG12-1624</u> 1 x GT10-1325 1 x LC10-1051
PVDF	¾" NPT	<u>AT12-3610</u> 1 x FT10-5305 1 x LC10-1002	<u>AT12-3620</u> 1 x FT10-5305 1 x LC10-1001	<u>AG12-3610</u> 1 x GT10-5305 1 x LC10-1002	<u>AG12-3620</u> 1 x GT10-5305 1 x LC10-1001
	¾" R	<u>AT12-3614</u> 1 x FT10-5325 1 x LC10-1052	<u>AT12-3624</u> 1 x FT10-5325 1 x LC10-1051	<u>AG12-3614</u> 1 x GT10-5325 1 x LC10-1052	<u>AG12-3624</u> 1 x GT10-5325 1 x LC10-1051

- ⚠ About This Manual:** PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on the Thermo-Flo™ with Compact Relay Controller (Flow) from Flowline: AG12-_6__, AG14-_6__, AT12-_6__ & AT14-_6__. The units are identical except for the material of construction and size of the sensor.
- ⚠ User's Responsibility for Safety:** Flowline manufactures a wide range of liquid sensors, controllers, and mounting systems. It is the user's responsibility to select components that are appropriate for the application, install them properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.
- ⚠ Proper Installation and Handling:** Use a proper sealant with all installations. Never over-tighten the components. Always check for leaks prior to system start-up.
- ⚠ Material Compatibility:**
- **Polypropylene** (PP, a polyolefin): Sensor, Junction Box.
 - **Ryton:** Sensor (AT1_-16__ and AG1_-16__ only).
 - **Polyvinylidene Fluoride** (PVDF): Sensor (AT1_-36__ and AG1_-36__ only).
 - Make sure that the application liquids are compatible with the materials that will be wetted. To determine the chemical compatibility between the components and its application liquids, refer to the Compass Corrosion Guide, available from Compass Publications (phone 858-589-9636).
- ⚠ Electrical Shock Hazard:** It is possible to contact components on the controller that carry high voltage, causing serious injury or death. All power to the controller and the relay circuit(s) it controls should be turned OFF prior to working on the controller. If it is necessary to make adjustments during powered operation, use extreme caution and use only insulated tools. Making adjustments to powered controllers is not recommended. Wiring should be performed by qualified personnel in accordance with all applicable national, state and local electrical codes.
- ⚠ Flammable or Explosive Applications:** DO NOT USE THE AG12-_6__ , AG14-_6__ , AT12-_6__ OR AT14-_6__ Thermo-Flo™ GENERAL PURPOSE SENSOR WITHIN CLASSIFIED HAZARDOUS ENVIRONMENTS.

⚠ Warning ⚠

- ⚠** *The rating for the relay is 250 VAC, 16A, ½ Hp.*
- ⚠** *Flowline's Thermo-Flo™ flow switches are not recommendable for use with electrically charged application liquids. For most reliable operation, the liquid being measured may need to be electrically grounded.*
- ⚠** *The sensing tip of the sensor must always be submersed in the liquid and never exposed to air.*
- ⚠** *The liquid temperature must remain constant and not change throughout the process*

Make a Fail-Safe System: Design a fail-safe system that accommodates the possibility of relay or power failure. If power is cut off to the controller, it will de-energize the relay. Make sure that the de-energized state of the relay is the safe state in your process. For example, if controller power is lost, a chemical feed pump will turn off if it is connected to the Normally Open side of the relay.

While the internal relay is reliable, over the course of time relay failure is possible in two modes: under a heavy load the contacts may be “welded” or stuck into the energized position, or corrosion may buildup on a contact so that it will not complete the circuit when it should. In critical applications, redundant backup systems and alarms must be used in addition to the primary system. Such backup systems should use different sensor technologies where possible.

While this manual offers some examples and suggestions to help explain the operation of FLOWLINE products, such examples are for information only and are not intended as a complete guide to installing any specific system.

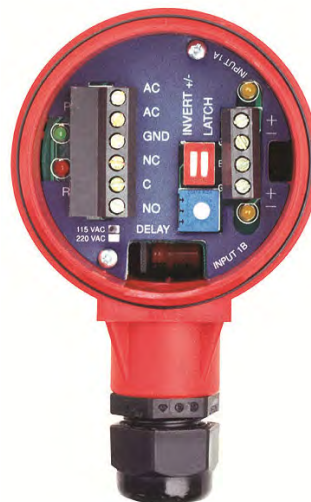
Relay Contact Rating: The relay is rated for a 16 amp resistive load. Many loads (such as a motor during start-up or incandescent lights) are reactive and may have an inrush current characteristic that may be 10 to 20 times their steady-state load rating. The use of a contact protection circuit may be necessary for your installation if the 16 amp rating does not provide an ample margin for such inrush currents.

Safety Cover: Based upon the part number selected, a safety cover has been placed within the enclosure. Always replace the safety cover after any service.

Standard Version



Open View of Controller (without safety cover)



Technology: The thermal dispersion flow switches measure liquid or gas temperature to determine changes in flow velocity. As fluid flows across the sensing tips, the temperature is reduced proportionately as a function of the flow rate. When a temperature or velocity shift reaches the user defined set point, the switch changes state indicating the appropriate flow condition (flow or no-flow).

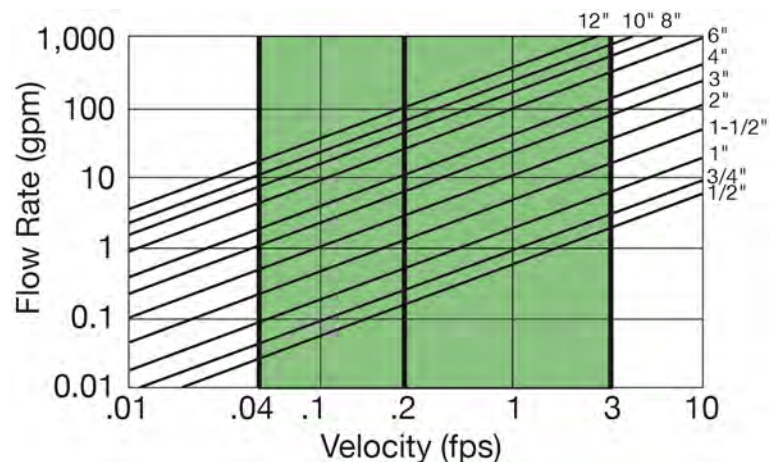
FLOWLINE's sophisticated electronics convert the temperature shift into a signal which indicates whether a flow or no-flow condition occurs. Depending on how the sensor is wired, this signal may be wired for normally open or normally closed circuits.

FLOWLINE's Thermo-Flo™ flow switches have no moving parts to clog or foul, making them suitable for a variety of applications, including non-coating and non-scaling liquids. The AT12 & AT14 series directly measure mass flow and can operate over board range of liquids from 0.4 to 1.2 specific gravity and 1 to 300 cp.

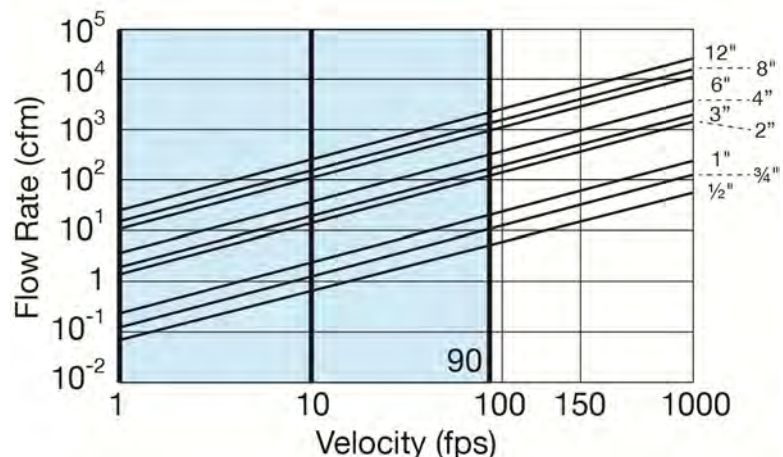
Initializing Sequence for liquid flow switch series (AT12 & AT14): When the flow switch is powered up while submersed, the liquid flow switch will immediately indicate flow before switching to its correct state. A time delay may be used to eliminate the initialization sequence. Flowline's thermal dispersion relay controllers feature a 0.15 to 60 second time delay for your convenience.

Set Points: The liquid flow switch (AT12 & AT14 series) set point is factory calibrated to 0.2 fps and the gas flow switch (AG12 & AG14 series) are set to 10 fps. To convert feet/sec to GPM, please refer to the chart below.

**Liquid Flow Switch
(AT12 & AT14 series)
Flow Rate vs. Velocity
(gpm vs. fps)**



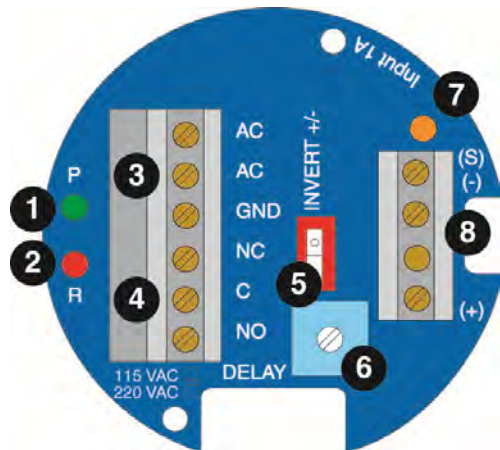
**Gas Flow Switch
(AG12 & AG14 series)
Flow Rate vs. Velocity
(cfm vs. fps)**



The relay inside the controller is a single pole, double throw type; the controlled device can be connected to either the normally open or normally closed side of the relay. A time delay from 0.15 to 60 seconds can be set before the relay responds to the sensor input.

Guide to Controls: Below is a listing and the location of the different components for the controller:

Standard Version



- 1. Power indicator:** This green LED lights when AC power is ON.
- 2. Relay indicator:** This red LED will light whenever the controller energizes the relay, in response to the proper condition at the sensor input and after the time delay.
- 3. AC Power terminals:** Connection of 120 VAC power to the controller. The setting may be changed to 240 VAC if desired. This requires changing internal jumpers; this is covered in the Installation section of the manual. Polarity (neutral and hot) does not matter.
- 4. Relay terminals (NC, C, NO):** Connect the device you wish to control (pump, alarm etc.) to these terminals: supply to the COM terminal, and the device to the NO or NC terminal as required. The switched device should be a non inductive load of not more than 16 amps; for reactive loads the current must be derated or protection circuits used. When the red LED is ON and the relay is in the energized state, the NO terminal will be closed and the NC terminal will be open.
- 5. Invert switch:** This DIP switch reverses the logic of the relay control in response to the sensor(s): conditions that used to energize the relay will make it turn off and vice versa.
- 6. Time Delay:** After the input(s) change(s) state, this control sets a delay from 0.15 to 60 seconds before the relay will respond.
- 7. Input 1A indicator:** These amber LED will light immediately whenever the appropriate sensor attached to the terminals detects no-flow, and will turn off when it detects flow. This polarity can be reversed by change of the switches polarity.
- 8. Input terminals:** Connect the wiring from the sensors to these terminals: Note the polarity: (+) is a 24 VDC, 100 mA power supply (to be connected to the red wire of a Flowline sensor), and (-) is the return path from the sensor (to be connected to the black wire of a Flowline sensor). (S) is the relay signal input to be connected to the white wire? The remaining green wire will return to the (-) terminal. If polarity is reversed, the sensors will not work.

Follow these steps for the electrical portion of this manual:

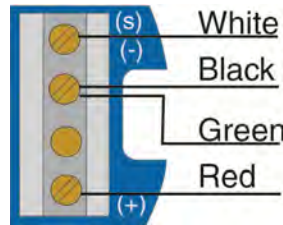
1. Confirm flow switch is attached to the input terminals.
2. Provide 120/240 VAC power to the sensor.
3. Connect switched device to the relay terminals.
4. Attach strobe (if included) to the relay terminals.

1. Confirm flow switch is attached (Connecting switches to input terminals):

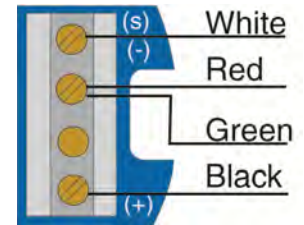
The sensor provided is prewired. The flow switch will be wired with the White wire to the (S) terminal (Switch Chan 1) and the Green wire to the (-) terminal (GND). Typically, the Red wire is wired to the (+) terminal (24 VDC) and the Black wire to the (-) terminal. This is a Normally Closed (NC) state. Reversing the Red and Black wires will switch the polarity from Normally Closed to Normally Open (NO).



Normally Closed - Amber LED is ON for a no-flow state and OFF for a flow state.

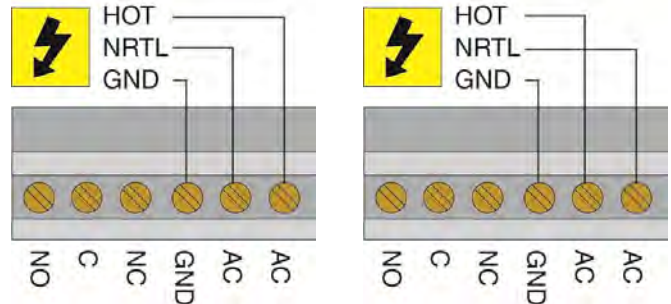


Normally Open - Amber LED is ON for a flow state and OFF for a no-flow state.



2. Provide 120/240 VAC power (VAC Power Input Wiring):

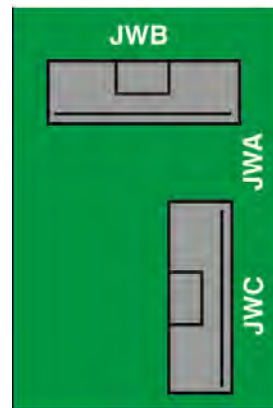
Observe the labeling on the controller on whether it is configured as 120 or 240 VAC. **Note:** Polarity does not matter with the AC input terminal.



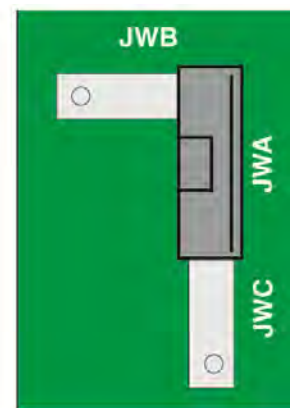
Standard Version

Changing from 120 to 240 VAC:

1. Remove the two screws from the top of the printed circuit board (PCB) and gently slide the PCB from the housing. Use caution when removing the PCB.
2. Located jumpers JWA, JWB and JWC on the PCB.
3. To change to 240 VAC, remove jumpers from JWB and JWC and place a single jumper across JWA. To change to 120 VAC, remove jumper JWA and place jumpers across JWB and JWC.
4. Gently return PCB into housing and replace the two screws.



120 VAC Configuration

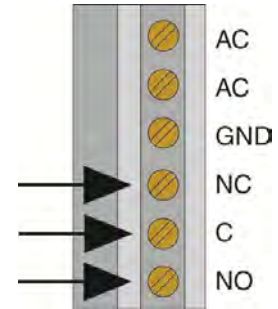


240 VAC Configuration

3. Connect switched device to the relay (Relay Input Wiring):

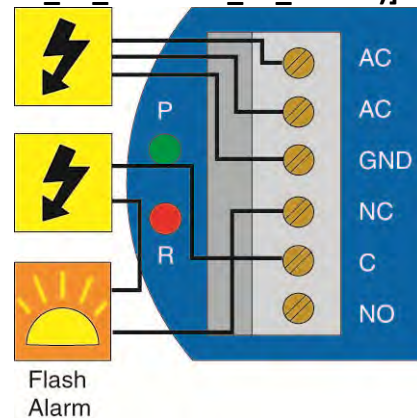
The relay is a dry contact single pole, double throw type rated at 250 VAC, 16A, ½ Hp. The two terminals NO and NC (normally open and normally closed) will be used in different applications with C (common) used regardless of choice between NO or NC.

Note: the "normal" state is when the relay coil is de-energized (the Red relay LED will be OFF). Regardless of the invert status (ON or OFF), the normal state will always be when the Red LED is OFF.



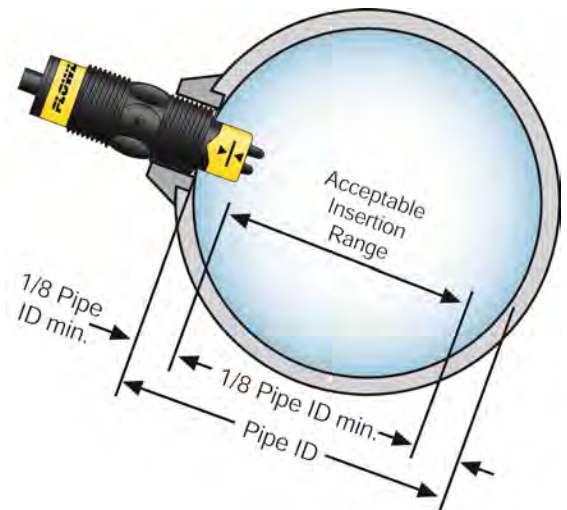
4. Attach strobe [Strobe Alert Output (AT12-_61_, AT14-_61_, AG12-_61_ & AG14-_61_ Series)]:

With the Strobe Alert wired NC; it can be used as a high or low level alarm, depending on the setting for the invert switch. The Strobe Alert can also be wired NO. **Note:** the Strobe Alert™ shares the relay within the sensor. The flashing alarm can be set to either indicate when the switched device (pump, valve or alarm) is active or not active.



The Thermo-Flo™ AT1_ series liquid flow switch must always be in contact with the liquid being measured. The Thermo-Flo™ AG1_ series gas flow switch must never be submersed in liquid. Both flow switches feature a 3/4" NPT threads which will allow it to be used with various types of fittings. Be sure to check the insertion depth of the flow switch in the fitting after it is installed. See the diagram to the right for the recommended insertion depth.

- The two tips of the sensor are to be perpendicular to the flow (as seen to the right). Never mount the tips with one in front of the other.



When using any type of fitting, the orientation as well as the insertion depth of the flow switch in the pipe is critical. See the diagram to the right for the recommended orientation.



Warning

- ⚠ The flow switch tips have a thin plastic wall which may be damaged if dropped or installed improperly.
- ⚠ The **AT1_** series flow switch is designed for use in **liquid**. For best results, avoid installing the sensor where bubbles are present or where the tips of the switch may be out of the liquid.
- ⚠ The **AG1_** series flow switch is designed for use in **gas** applications. For best results, avoid installing the sensor where it may be submersed in liquid.
- ⚠ Always install the Viton gasket with all versions of the AT1_ _6_4 or AG1_ _6_4. The G threaded version will not seal unless the gasket is properly installed.
- ⚠ The two temperature probes (tips) must always be perpendicular to the flow (see the flow at the same time).
- ⚠ **Install In a Dry Location:** The controller housing is liquid-resistant and made of Polypropylene (PP). When installed properly, the controller is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid. Refer to an industry reference to ensure that compounds that may splash onto the controller housing will not damage it. Such damage is not covered by the warranty.

Set Points: If the preset factory calibration is not adequate for your application, follow the calibration steps listed below. **Note:** the switch's internal LED will be on when the switch detects no-flow and will off when the switch detects flow.

1. Install the fitting and flow switch as described in the Installation section of this manual. Turn the flow switch and controller power on and adjust the flow rate to the application setting. If the medium to be sensed is likely to be subject to high temperature variations, the flow switch should be set at the highest normal temperature likely to be encountered.
2. Locate the potentiometer knob at the top of the flow switch. The red LED is visible through the potentiometer. (If the LED is on, slowly adjust the potentiometer counterclockwise, with a small flat head screwdriver until the LED turns off.) The adjustment is a single turn 270° potentiometer. The initial response time of the flow switch after adjustment is 1 to 10 seconds. Adjust the potentiometer in slow increments and wait for the response. If the LED is off, slowly adjust the potentiometer clockwise until the light turns on. Then turn the potentiometer counterclockwise to bring the LED off at a reliable setting. Remember, adjust the potentiometer in slow increments and wait for the response.
3. Verify that the new calibration is correct by lowering the system flow rate below the set point and check to see that the red LED turns on. Then increase the flow rate above the set point and verify that the red LED turns off accordingly.



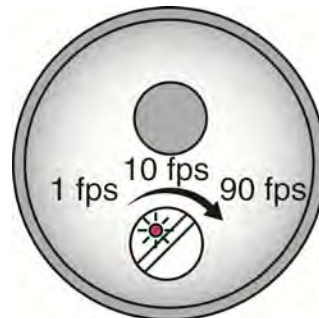
Liquid Switch

FT10 - ___ 5 or FT10 - ___ 2 Series

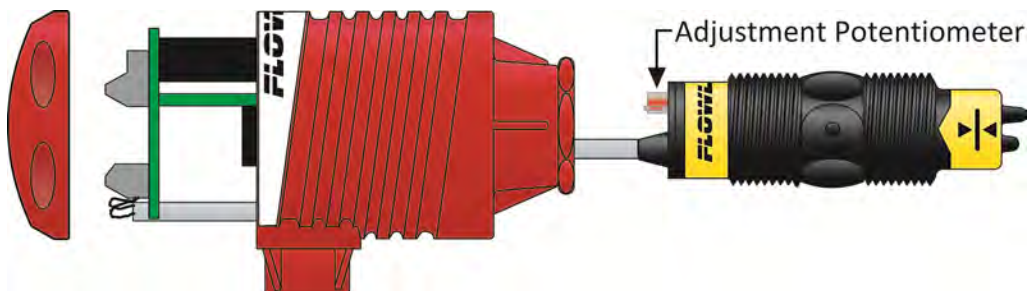


Gas Switch

GT10 - ___ 5 or GT10 - ___ 2 Series

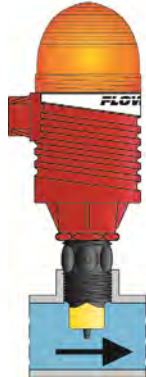


Accessing the Adjustment Potentiometer: Remove the two screws from the top of the printed circuit board (PCB). Then gently slide the PCB from the housing. Use caution when removing the PCB. You will now be able to see the potentiometer through the housing. Make any necessary adjustment. **Note:** Electrical wiring of any liquid level control system should be performed in accordance with all applicable national, state, and local codes. When completed, gently return PCB into housing and replace the two screws.



Low Flow Alarm: The goal is to indicate when the flow rate falls below a certain point. If it does, an alarm is supposed to sound, alerting the operator of a low flow condition.

Flow



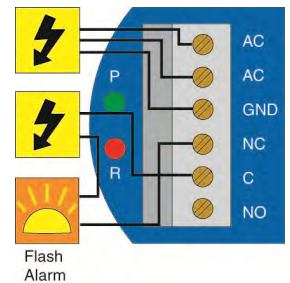
No Flow



If power is accidentally cut to the controller, the sensor's ability to notify the operator of a low flow condition could be lost. The system must alert the operator not only to low flow, but to controller power loss.

To do this, connect the hot lead of the alarm to the NC side of the relay terminal of the controller. If power is lost, the relay will be de-energized, and the alarm will sound (if there is still power to the alarm circuit itself). The alarm circuit should have a noninterruptible power supply or some other indicator or backup alarm to warn of a power failure in the alarm circuit.

In this application, the normal status is when the sensor is in the flow condition, and the relay will be energized holding the alarm circuit open. Please note that the flow switch can be wired either normally closed or normally open (Step 6). When the switch is wired NC, the input LED will be off and the relay LED will be on. So for this application, Invert should be set to the On position. When the switch is wired NO, the input LED and the relay LED will be on simultaneously. So for this application, Invert should be set to the Off position.



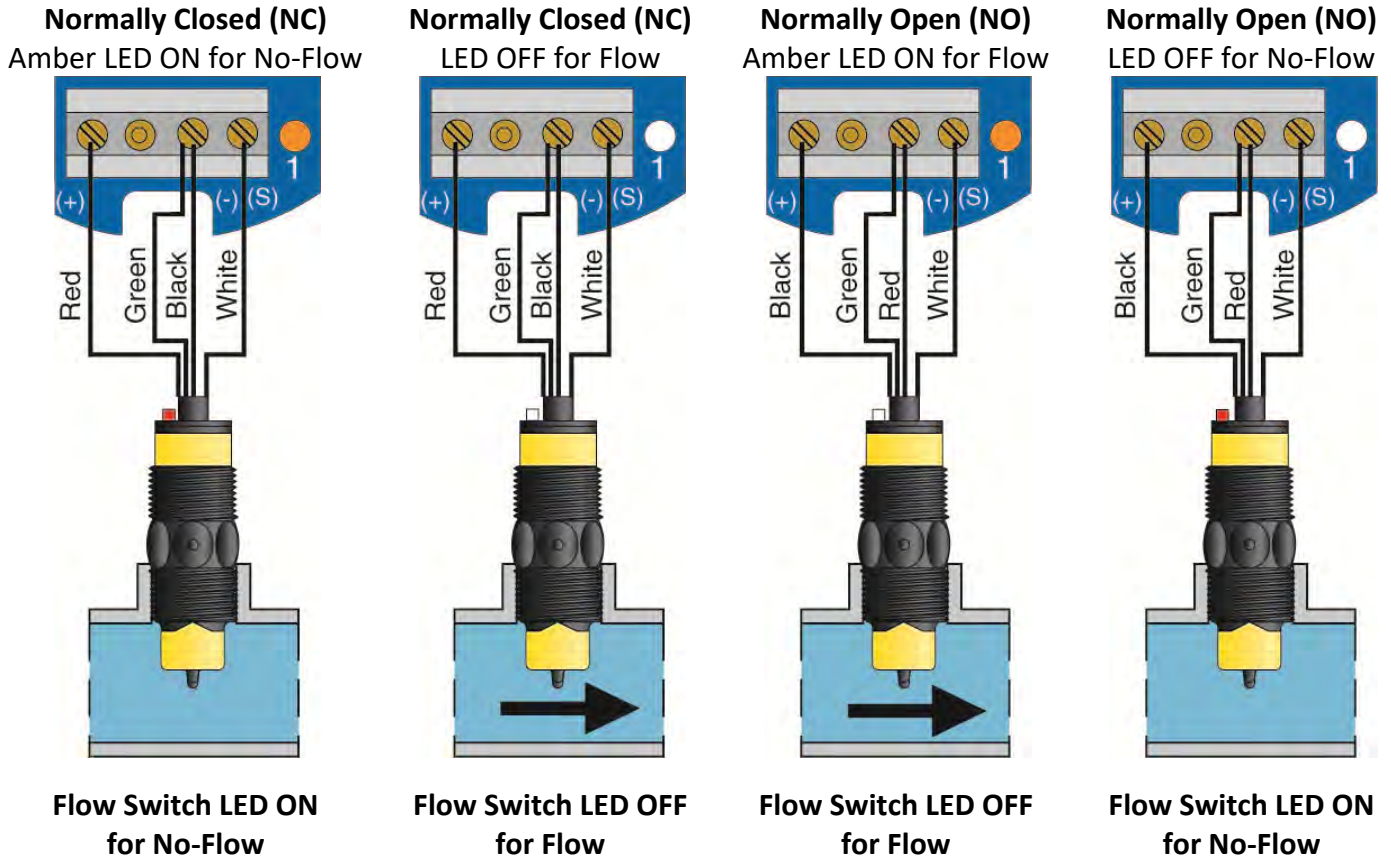
Controller Logic: Please use the following guide to understand the operation of the controllers.

1. **Power LED:** Make sure the Green power LED is ON when power is supplied to the controller.
2. **Input LED:** For NC switch wiring, the input LED on the controller will be Amber when the switch reads no-flow and OFF when the switch reads flow.
3. **Invert Operation:** When the input LED turn Off and On, the relay LED will also switch. With invert Off, the relay LED will be On when the input LED is On and Off when the input LED is Off. With invert On, the relay LED will be Off when the input LED is On and On when the input LED is Off.
4. **Relay Operation:** The relay may be wired either NO or NC. The normal state of the relay is when its LED is Off. With the LED On, the relay is in the energized mode and all terminal connections are reversed.

Troubleshooting:

PROBLEM	SOLUTION
Controller is powered, but nothing happens.	First check the Power LED to make sure it is Green. If not, check the wiring, power and make sure the terminal is seated correctly over the 6-pins.
A Flow or No-Flow condition is met but the relay did not switch.	Check the relay by switching the invert switch. Confirm that relay click on and off as well as the relay LED.
The Flow or No-Flow is not switching at the correct flow rate.	The flow switch may need to be adjusted. Review the Flow Switch Calibration section on the previous page for instructions on setting the actual flow switch. Note: access to the flow switch adjustment is difficult and requires the removal of the PCB assembly. Use caution when performing this step.
Trying to start the flow but the controller keeps turning the flow off.	To restart a flow condition, the sensor needs to sense an actual flow condition before changing the relay in the controller. A flow switch over-ride may need to be added across the relay contacts that allows for a true flow to occur before switching back to the controller. The use of a moment switch is recommended for the over-ride switch.
Relay LED does not match my flow condition.	The relay LED can be switched by either the reversing the wiring of the sensor to the controller or by flipping the invert switch. This means that the relay LED can either be set to turn on during a flow condition or to turn off during a no-flow condition. This is all dependent on the wiring and the invert position.
Relay LED does not match the sensor's LED indicator.	The sensor's LED will always be ON during a No-Flow state and OFF during a Flow state, regardless of the switches wiring. As per above the input LED can be inverted to any condition. In some applications, they will match and in others they will be opposite. This is all dependent on the application parameter/setup.

LED Indication: Use the LED for the switch input to identify the state of the flow switch (flow or no-flow). The LED is located next to the input terminal. When the switch is wired NC, an Amber LED indicates no-flow and an Off LED indicates flow. Reversing the polarity (Normally Open), an Amber LED indicates flow and an Off LED indicates no-flow.



Note: The LED inside the flow switch will always be ON for No-Flow and OFF for Flow, regardless of the polarity of the flow switch. In NC wiring, the switch's LED will match the controller's LED. In NO wiring, the switch's LED will be opposite of the controller's LED.

General: The Thermo-Flo™ flow switch requires no periodic maintenance except to clean off any deposits or scaling from the sensor tip as necessary. It is the responsibility of the user to determine the appropriate maintenance schedule, based on the specific characteristics of the application liquids.

Cleaning Procedure:

- 1. Power:** Make sure that all power to the sensor, controller and/or power supply is completely disconnected.
- 2. Sensor Removal:** *Make sure that the flow is off and the pressure is down prior to removing the Thermo-Flo™.* Carefully, remove the sensor from the installation. Replace the sensor with a 3/4" NPT plug to insure that liquid does not leak out during this procedure. **Do not re-install the Thermo-Flo™ if the threads are damaged.**
- 3. Cleaning the Sensor:** Use a soft bristle brush and mild detergent, carefully wash the Thermo-Flo™ flow switch. Do not use harsh abrasives such as steel wool or sandpaper, which might damage the surface sensor. Do not use incompatible solvents which may damage the sensor's PP/Ryton or PVDF plastic body.
- 4. Sensor Installation:** Follow the appropriate steps of installation as outlined in the installation section of this manual.

Testing the Flow Switch Alone [Liquid Series (AT12 & AT14) Only]:

- 1. Immersing the switch:** Place the switch in a cup of water. Make sure the tips are submersed in the water.
- 2. Power:** Turn on power (14 to 36 VDC) to the switch with Red to (+) and Black to (-), see drawing on next page. You can reverse the polarity if desired.
- 3. No-Flow/Flow Test:** With the switch setting still in the cup, wait until the Red LED turns ON (no-flow condition).
 - a. Swirl the switch in the cup and wait until the Red LED turn OFF (flow condition).
 - b. Stop swirling the sensor and let it rest in the cup waiting for the Red LED to turn ON again (no-flow condition).
 - c. Repeat the above two steps.
- 4. Relay Test:** Connect a multimeter (set to read Ohms) to the White and Green Wires. Perform the above No-Flow/Flow test with the multimeter connect to observe the actuation of the relay.
 - a. With Red to (+) and Black to (-), the multimeter will read a small resistance during no-flow (closed relay) and OL during a flow condition (open relay).
 - b. Reverse Polarity [Red to (-) and Black to (+)] to see the multimeter read OL during a no-flow state (open relay) and a small resistance during a flow condition (closed relay).

The No-Flow/Flow test determines if the switch is capable of sensing the changes between no-flow and flow. The Relay test determines the ability of the relay to switch between a no-flow and flow condition. This is the basic test to determine functionality of the sensor.

Testing the Switch Alone [Gas Series (AG12 & AG14) Only]:

1. **Creating a No-Flow Test Point:** The purpose of this step is to create a no-flow state for the sensor to be tested against. Since this is a low flow switch, even a buildings HVAC system can create a flow that the sensor can read.
 - a. Place the switch on a table and place an empty cup over the sensing tips.
 - b. The cup will act like a shield to protect the sensor from air flow.
2. **Power:** Turn on power (14 to 36 VDC) to the switch with Red to (+) and Black to (-), see drawing below. You can reverse the polarity if desired.
3. **No-Flow/Flow Test:** With the switch setting still under the cup, wait until the Red LED turns ON (no-flow condition).
 - a. Remove the cup and move the sensor in air and observe when the Red LED turn OFF (flow condition).
 - b. Place the sensor on the table and place the cup over the sensor and let it rest waiting for the Red LED to turn ON again (no-flow condition).
 - c. Repeat the above two steps.
4. **Relay Test:** Connect a multimeter (set to read Ohms) to the White and Green Wires. Perform the above No-Flow/Flow test with the multimeter connect to observe the actuation of the relay.
 - a. With Red to (+) and Black to (-), the multimeter will read a small resistance during no-flow (closed relay) and OL during a flow condition (open relay).
 - b. Reverse Polarity [Red to (-) and Black to (+)] to see the multimeter read OL during a no-flow state (open relay) and a small resistance during a flow condition (closed relay).

The No-Flow/Flow test determines if the switch is capable of sensing the changes between no-flow and flow. The Relay test determines the ability of the relay to switch between a no-flow and flow condition. This is the basic test to determine functionality of the sensor.



Warranty

Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service in accordance with instructions furnished by Flowline for a period of two years from the date of manufacture of such products. Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products or components, which Flowline's examination determines to its satisfaction to be defective in material or workmanship within the warranty period. Flowline must be notified pursuant to the instructions below of any claim under this warranty within thirty (30) days of any claimed lack of conformity of the product. Any product repaired under this warranty will be warranted only for the remainder of the original warranty period. Any product provided as a replacement under this warranty will be warranted for the full two years from the date of manufacture.

Returns

Products cannot be returned to Flowline without Flowline's prior authorization. To return a product that is thought to be defective, go to www.flowline.com, and submit a customer return (MRA) request form and follow the instructions therein. All warranty and non-warranty product returns to Flowline must be shipped prepaid and insured. Flowline will not be responsible for any products lost or damaged in shipment.

Limitations

This warranty does not apply to products which: 1) are beyond the warranty period or are products for which the original purchaser does not follow the warranty procedures outlined above; 2) have been subjected to electrical, mechanical or chemical damage due to improper, accidental or negligent use; 3) have been modified or altered; 4) anyone other than service personnel authorized by Flowline have attempted to repair; 5) have been involved in accidents or natural disasters; or 6) are damaged during return shipment to Flowline. Flowline reserves the right to unilaterally waive this warranty and dispose of any product returned to Flowline where: 1) there is evidence of a potentially hazardous material present with the product; or 2) the product has remained unclaimed at Flowline for more than 30 days after Flowline has dutifully requested disposition. This warranty contains the sole express warranty made by Flowline in connection with its products. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. The remedies of repair or replacement as stated above are the exclusive remedies for the breach of this warranty. IN NO EVENT SHALL FLOWLINE BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND INCLUDING PERSONAL OR REAL PROPERTY OR FOR INJURY TO ANY PERSON. THIS WARRANTY CONSTITUTES THE FINAL, COMPLETE AND EXCLUSIVE STATEMENT OF WARRANTY TERMS AND NO PERSON IS AUTHORIZED TO MAKE ANY OTHER WARRANTIES OR REPRESENTATIONS ON BEHALF OF FLOWLINE. This warranty will be interpreted pursuant to the laws of the State of California. If any portion of this warranty is held to be invalid or unenforceable for any reason, such finding will not invalidate any other provision of this warranty.

For complete product documentation, video training, and technical support, go to www.flowline.com.

For phone support, call 562-598-3015 from 8am to 5pm PST, Mon - Fri.

(Please make sure you have the Part and Serial number available.)