WARRANTY

Intek, Inc. warrants each Rheotherm product to be free from defects in material and workmanship under normal use and service, Intek's obligation under this warranty being limited to making good any part or parts thereof which shall, within one (1) year after delivery of such product to the original purchaser, be returned to Intek with transportation charges prepaid and which Intek's examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties, express or implied and all other obligation or liabilities on Intek's part. The purchaser will assume all responsibility and expense for removal, decontamination and reinstallation of equipment.

Rheotherm flow meters are manufactured under United States patent numbers 4,255,968; 4,942,763; 4,949,578; 5,485;754 and 5,752,411
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Manual no. A100AFS9505 REV B
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SECTION 1 – GENERAL INFORMATION

1.1 INTRODUCTION

Rheotherm flow switches offer reliable flow switch protection in liquids, gases and slurries. They can be used for flow/no flow detection, or specific low and/or high level alarms over a given 10 to 1 flow range. They are manufactured exclusively by Intek, Inc. and employ a patented thermal technique used by industry since 1978. The unique transducer designs have protected sensors, are easy to install and require little or no maintenance.

Each Rheotherm 100FS flow switch consists of two elements a transducer and an electronics unit. The transducers come in two basic designs, intrusive and nonintrusive (SECTION 2.1). Design selection is based on application constraints or customer preference. The electronics, for signal processing, are housed in one of two basic enclosure styles (SECTION 2.2). Again, selection is based on application requirement.

Key features of Rheotherm flow switches and flow meters are:

Nonintrusive flow monitoring For pipe sizes from .030 to 1 inch, flow sensing is done from outside the flow tube.

No moving parts There are no rotating, translating, undulating or oscillating parts to wear, stick, break or fatigue.

Chemical compatibility The wetted surface(s) can be any of a number of corrosion resistant metals or alloys. There are no internal seals in a TU type transducer. Most sensors are 316 SS or 316 SS and nickel braze.

Flexibility Rheotherm meters can be ordered calibrated for mass or volumetric units or in average velocity. Flow rate, totalization and fluid temperature displays or output signals are available as well as rangeability up to 100:1 or more.

Fluid pressure options to 10,000 psi.

Withstands over ranging No damage or change in operation will occur due to excessive flow rates many times higher than originally specified.

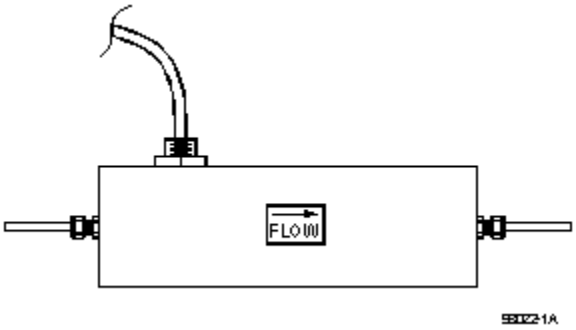
Immunity to shock and vibration.

Optional nuclear radiation hardening.

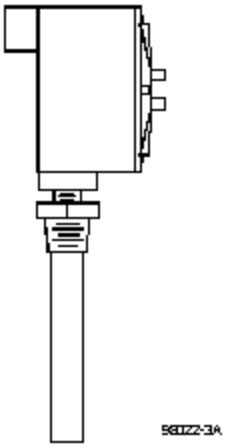
Range of application includes measurements in capillary tubes to large diameter pipes or ducts.

1.2 DESCRIPTION OF OPERATION

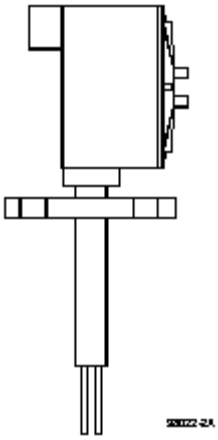
Rheotherm flow meters are available with various nonintrusive and intrusive transducer designs, but they all use the same thermal sensing technique. Two temperature sensors are used one is in thermal equilibrium with the fluid and provides a fluid temperature reference, while the second temperature sensor is located near a heater so that its temperature is slightly above that of the fluid. In a TU transducer, the temperature sensors and heater are attached to the outside of the flow tube, whereas the probe transducers have the sensors and heater located in the probe(s) that are inserted into the stream. The amount of heat removed from the heated sensor by the stream is related to fluid velocity. Hence, the measured temperature differential between the reference sensor and heated sensor is a function of flow rate. Intek, Inc. is licensed to use this patented and trademarked flow measurement technique.



Nonintrusive transducer (TU)



Example of single probe with NPT fitting



Example of dual probe with flange fitting

1.3 PRECAUTIONS

1. Use proper input power Check the label on the electronics for the input power requirements.

2. Use reasonable care in handling the transducer. Do not try to disassemble the transducers; there are no removable parts.

   TU excessive twisting or bending can damage the sensor. The flow tubes are thin-walled tubing.
   Probes (NPT/2I, NPT/I, BF/2I, BF/I, etc.) take care not to bend the probes or damage the tips. Do not try to remove or turn the conduit junction box.

3. Check the transducer maximum temperature rating do not operate a transducer at or subject it to a temperature above its specified limit.

4. Keep moisture out of the electronic enclosure and sensor junction box. Once cable connections are made in the junction box, make sure the lid is tightly closed. Seal conduit lines if they can become wet inside.

5. Keep transducer wetted surfaces clean and free of permanent layer build-up.

6. Do not exceed pressure limits of the tube or fittings.

7. Maintain a thermally stable environment (short-term) for the transducer and adjacent line. (See SECTION 2 INSTALLATION.)

These instructions cover installation, operation and maintenance of Rheotherm flow switches in standard configurations. Any special information pertaining to your unit is covered under CUSTOM INFORMATION (SECTION 6). Time should be taken to carefully read these instructions prior to installation of the equipment. Should any questions arise or problems occur, call Intek for immediate assistance.

SECTION 2 – INSTALLATION

2.1 TRANSDUCER

> !! **IMPORTANT:** All transducers have a directional arrow on the tag and/or etched into a metal part. Before installing a sensor, please note proper flow direction. This is critical to sensor operation.
>
> !! **IMPORTANT:** If you have more than one Rheotherm unit, make sure the complete serial number of the transducer matches the complete serial number of the electronics. The transducer and electronics are a matched set. Components with different serial numbers should not be interchanged. The transducers have no user serviceable parts, so do not try to disassemble, as permanent damage may result.

The transducer style supplied with your meter is listed in the model code number in SECTION 6. Proper installation of the sensor is necessary for achieving accuracy and repeatability. Installation suggestions for each type of standard transducer are given here. For custom transducer installations, refer to CUSTOM INFORMATION SECTION 6.

Be sure wetted surfaces are clean before installing. If cleaning is needed, use non-residue solvent and wipe dry. If the sensor has a connector box, keep moisture out. Make sure the lid is tightly sealed and, if supplied, the gasket is in place. Seal conduit lines at the connector box if conduit lines can become wet.

1. TU (nonintrusive) TU $^{1}/_{16}$ and TU⅛ transducers, unless they have optional ¼" O.D. ends, require special care in handling and installing to avoid damage to sensor tube stubs.

   > !! **CAUTION:** TU transducers are made with thin-walled tubing use care when installing.

   Straight run for a flow switch is not a requirement, but for best repeatability some straight run is useful, such as 10 to 20 pipe diameters on the inlet and 6 to 10 diameters on the outlet. If installed vertically, the flow should be going up through the sensor. Connection in the line is via compression fittings, hose with clamp, threaded fittings or flanges, whichever is appropriate. Care must be taken not to transmit a twisting force through the transducer's midsection. The TU transducer, whether flanged or not, must not be used to pull other piping together or to make up angular mismatch of fittings. The transducer junction box (if supplied) should never be rotated for any reason.

   Typically, TU$^{1}/_{16}$ transducers are sleeved with a ⅛" tube for added support. Connection should always be made to the $^{1}/_{16}$" tube, as there is no assured seal between the $^{1}/_{16}$ tube and the sleeve.

Some TU transducers have an integrally mounted cable; do not pull on this cable, or attempt to remove the fitting where the cable enters the shell.

Fluid temperatures other than ambient require special attention. Thermal gradients from one end of the transducer to the other, as well as along the radius of the connection pipe, are undesirable. Therefore, effective insulation should be installed around the inlet and outlet straight line runs. Gradients which may exist in the line further up stream can be removed if an insulated elbow is installed in the line prior to entering the straight line portion of the plumbing. Metallic support braces for the sensor or adjoining plumbing can act as a heat sink and cause operational problems in high temperature applications. The support braces should be thermally isolated from the line to avoid large heat conduction effects.

If the transducer is for use above 300°F, it will have a side arm and connector box, where the internal high temperature wiring is connected to the lower temperature transducer cable. Free air should be allowed to flow around the side arm and connector box to keep the box cool. The side arm can be insulated up to one third of its length from the transducer body.

The ideal installation will provide the sensor with well established smooth flow, uniform system temperature and consistent fluid media.

2. Intrusive Probes

Straight run is not critical, but if trying to hold a precise set point, some straight run is useful, such as 10 to 20 pipe diameters on the inlet and at least 6 diameters on the outlet.

The various probe transducers are mounted through a threaded collar (NPT/2I and NPT/I) or flanged tee (BF/2I or BF/I). Other fittings and sensor designs are also available and are discussed on the Custom Information page. Generally the probes are sized so the tips extend ½ to 1 inch beyond the pipe center line when properly installed. However, for larger pipes, the probes may extend in ⅛ of a diameter from the wall.

Proper alignment of the sensor with flow is important; the flow direction is indicated on the transducer tag and/or etched into the transducer. All dual probe transducers (NPT/2I, BF/2I) are installed so that the two probes are side-by-side across the fluid stream. Never rotate the junction box that houses the terminal cable connection. If this occurs the transducer could be damaged and/or installed misaligned with the flow direction.

For high temperature applications, the sensor and surrounding line should be well insulated. Leave a portion of the transducer neck un-insulated to allow heat dissipation before reaching the junction box.

2.2 ELECTRONICS

Two types of electronics housings are typically available for flow switches. These are NEMA 4 (or 4X) and explosion-proof. These come in different sizes to accommodate options and special features.

1. NEMA 4 The standard industrial housing, this enclosure is watertight (non-submersible) when the door is properly clamped shut. The housing should be mounted such that wire/cable ports are located at the bottom of the housing, to reduce problems associated with water spray, condensation and settling of dust and dirt. An all stainless steel version (4X) for corrosive environments is also available.

2. NEMA 7 For use in hazardous (class I) environments. The lid should b e closed and all bolts tightened before the unit is powered up. If a NEMA 7/NEMA 4 enclosure was ordered, the unit will have a rubber gasket in a groove in the top of the enclosure base. Conduit seals are frequently required, so applicable code requirements should be met when installing the conduit into the box.

The electronics housing should be installed keeping in mind the length and routing of the transducer cable. Standard cable length is six feet but it can be specified up to 200 feet. If the cable length is changed (a portion cut off or additional cable spliced on), there may be a shift in the set point due to the change in cable resistance. The size of this effect depends on the amount of change. Follow instructions for adjusting the trip level in SECTION 3.

Unless otherwise specified, normal ambient environment for the electronics is 40-120°F. Recommended maximum temperature is 135°F.

2.3 ELECTRICAL CONNECTIONS

1. Transducer Cable The standard transducer cable is 22 or 24 gauge, multi-conductor (6), shielded cable with a PVC jacket. Connect the transducer cable to the electronics (and transducer junction box if supplied) following the wire color codes shown on the wiring diagram (Figure 1). Make sure all connections are tight. If the unit does not operate properly after installation is completed, check these connections again.

2. Power The input power requirement is listed on the tag on the electronics e nclosure and is shown on the input power connector; make sure the input power source is compatible. The standard power requirement is 120 Vac, 60 Hz, ½ A, single phase. (For units going to Europe, the standard is 220 Vac, 50 Hz, ½ A, single phase.) Power connections are as shown in Figure 1.

   !! **CAUTION:** Never make or break transducer cable connections with the electronics powered up (unless instructed by factory to do so).

   As a general rule, if the flow is to be shut off or the flow line empty for long periods of time, power to the unit should also be turned off. An on/off switch, provided by the customer, is recommended for all industrial installations.

3. Output The relay connection s are made to the small switch board terminals. If the instrument was ordered with two (2) relays, be sure to note which one will be used for low flow and which one will be used for high flow detection.

SECTION 3 – OPERATION

3.1 START UP

Typically, Rheotherm flow switches come from the factory set up for a 10 to 1 flow rate range, and with the trip level set approximately as requested by the customer. SECTION 6 shows whether the unit is factory set as a low flow switch or as a high flow switch (see 1 or 2 below as appropriate). The trip level can be adjusted using the instructions in SECTION 3.3.

When power is first turned on, the flow switch may indicate a high flow rate, even if there is no flow occurring. Correct indication of flow level will result after an initial period, which can extend to about forty (40) seconds and depends on where the level adjust is set.

For standard flow switches, the relay operates as stated below. See SECTION 6 for the type of flow switch you have. For nonstandard units, the relay operation is also described in SECTION 6.

1. Low Flow Switch The relay is energized (N.O. contact is made) when the flow rate is above the trip level. Therefore, an alarm condition (relay de-energizes) occurs when the flow rate drops below the trip level or there is a loss of power to the sensor (N.C. contact is made).

2. High Flow Switch The relay is energized (N.O. contact is made) when the flow rate is below the trip level. Therefore, an alarm condition (relay de-energizes) occurs when the flow rate is higher than the trip level, or there is a loss of power to the sensor (N.C. contact is made).

For operation as a level switch, see SPECIAL INSTRUCTIONS (SECTION 6.3).

3.2 GENERAL INFORMATION

The Rheotherm instrument is compensated for a wide range of both ambient and flowing media temperatures. However, abrupt changes in the temperature of the flowing material can cause the instrument to read the flow rate improperly, which could lead to an inappropriate tripping of the relay or a delay in reading loss of flow. A proper reading is obtained only when the transducer is in thermal equilibrium with the material. Typically, a 20°F abrupt change in temperature may require 40 seconds to stabilize.

In general the heater used in the transducer does not develop enough power to cause damage to the system in the absence of flow. This includes those used in liquids even if the line becomes empty and filled with air. During long shutdowns, it is recommended that the power to the unit be turned off. (This does not apply to units for which "no flow" is the standard condition.)

3.3 ADJUSTING THE TRIP POINT

Adjust the flow switch trip level as follows:

1. Establish a flow rate at the desired trip level. (This should be done with flow in the line, not at zero flow. Select a flow rate below your normal usage. One example would be to use 50% of your lowest normal flow rate as the set point.)

2. On the small switch board, if LED is green, adjust "Trip" potentiometer clockwise* until the relay de-energizes (LED turns red). This is the alarm condition.

3. If LED is red, adjust "Trip" potentiometer slowly counterclockwise* just until the relay energizes (LED turns green).

   * Reverse direction of turns if the switch is used as a high flow alarm.

4. If the relay cannot be made to drop out over the full range of the "Trip" potentiometer, see SECTION 3.4.

3.4 CHANGING THE TRIP POINT RANGE

Generally, the instructions in SECTION 3.3 should be followed for setting the trip point of the flow switch. In some cases, the "Trip" potentiometer may not have enough adjustment on a particular fluid; or you may wish to set the trip level beyond the range for which the flow switch was originally set up. If this is the case, the settable range can be changed by the following procedure:

1. Attach a current meter to the + and – output terminals (see Figure 1. Rheotherm 100 Signal Conditioner PCB Layout).

2. Establish a flow rate close to the desired trip level.

3. Adjust "FLOW ZERO" potentiometer (P2) until the current meter reads 12 mA.

4. Follow instructions in SECTION 3.3 for setting the trip level.

3.5 TRANSDUCER FUNCTIONAL TESTS

A test of the Rheotherm instrument transducer can be performed as outlined below:

1. Transducer continuity check, Figure A.
2. Transducer isolation check, Figure B.

1. The transducer continuity check is performed as follows (see Figure A):

   A. Disconnect the transducer cable from the electronics.
   B. Make resistance measurements between the cable pairs as shown in Figure A. The readings should be as indicated; if not, consult factory for repair.

2. The transducer isolation check is performed as follows (see Figure B):

   A. Disconnect the transducer cable from the electronics.
   B. Make the circuit connections illustrated in Figure B.
   C. Probe all the conductors and note the voltage with respect to the shield. All readings should be less than 0.5 Vdc. The yellow (Y) wire should also be isolated from the green (G) wire. Connect the "low" test lead to Y and probe the Blu and G wires with the "high" lead. Again, the meter should read less than 0.5 Vdc; if not, consult factory for service. Similarly, check the isolation between the Blu and G wires.

Figure A. Transducer Continuity Check

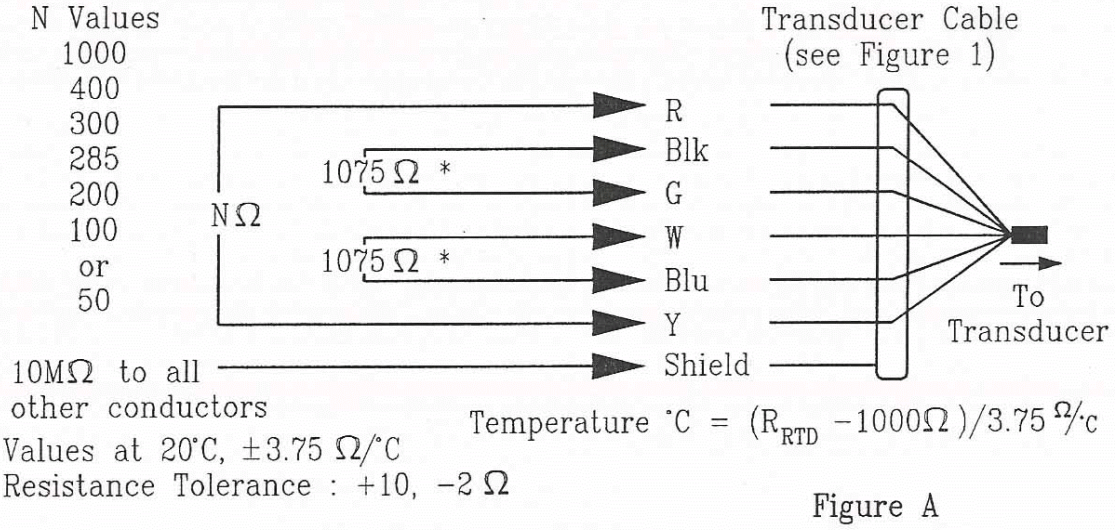


Figure A

Figure B. Transducer Isolation Check

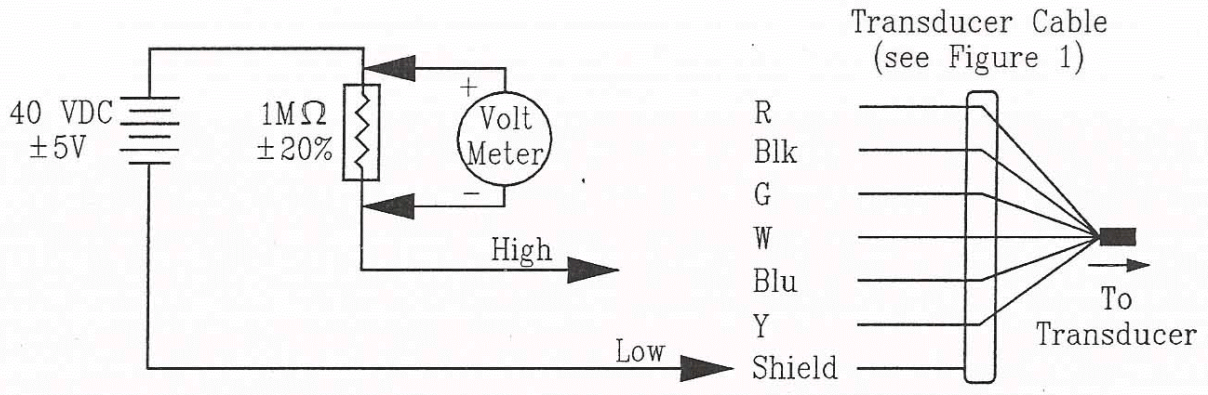


Figure B

SECTION 4 – MAINTENANCE

4.1 GENERAL MAINTENANCE

Certain precautions should be taken to insure proper performance of all models of flow instruments. Since the measurement technique involves a signal resulting from heat transfer to the flowing medium, care should be exercised to prevent build-up of varying layers on the walls of the transducer. Layers such as bacterial growth, dried paints, gas bubbles and non-solubles can result in measurement below actual flow rates. Periodic checks and cleaning should be performed to insure a clean pipe or probe surface.

It should be part of normal maintenance procedure to check the system for proper functioning. Experience and other observable conditions should be utilized to determine the frequency of inspection. To test the flow switch action. the flow rate should be reduced below (for low flow switch) or raised above (for high flow switch) the switching level. Then check and insure relay action and continuity of the shut down or warning circuits which it operates.

4.2 SPARE PARTS

There are no normally recommended spare parts to stock. The transducer and electronics are a matched set and therefore are not interchangeable with others. Should a spare be needed, a complete unit should be ordered and stocked.

If fuse replacement is ever needed, for AC powered units , use a Wickman part no. 3730500041 (½A, fast acting fuse) or equivalent. For units powered by 24 Vdc, the fuse is a 1A, slow blow fuse and may be replaced with Wickman part no. 3741100041 or equivalent.

4.3 TROUBLE SHOOTING

TABLE I. TROUBLE SHOOTING GUIDE

OBSERVATION	PROBABLE CAUSE	REMEDY
Flow trip level continually drifting downward with constant flow.	Coating forming on wetted surface of transducer.	1. Clean transducer periodically.
After switch has been operating properly: a. Relay trips with flow above trip level and cannot be adjusted using SECTION 3.3 instructions. b. Relay does not trip when flow falls below trip level and cannot be adjusted using SECTION 3.3 instructions.	1. Loose transducer cable connections. 2. Transducer cable damaged. 3. Bad electronic component. 4. Blown fuse.	1. Securely connect transducer cable. Replace if damaged. 2. Replace fuse as needed. 3. Perform transducer functional tests (SECTION 3.5).
Relay cannot be made to trip by adjusting "Trip" potentiometer.	1. Initial flow rate estimate was too low or too high. 2. Flow media change.	1. Follow instructions under SECTION 3.4 to adjust trip level range. 2. Consult factory.
Switch level varies with flow, but not stable.	1. Fluid temperature not stable. 2. Fluid mixture not properly blended. 3. Air mixed with liquid. 4. Flow not fully developed.	1. Correct conditions to remove obvious cause. 2. Check inlet an outlet for proper straight line length & freedom from obstructions. 3. Consult factory.

SECTION 5 – CUSTOMER SERVICE

Intek's corporate philosophy is to solve our customer's difficult flow measurement problems. This means that each instrument is custom configured and calibrated for the application. When you purchase a Rheotherm instrument you also receive Intek's outstanding customer service. For sales or product service, call your local representative or Intek directly at (614) 895-0301, 8AM to 5PM EST/EDT weekdays or fax us anytime at (614) 895-0319. E-mail inquiries should be sent to *sales@Intekflow.com* or *techsupport@Intekflow.com*. Our customer service staff will provide assistance promptly.

5.1 QUESTION ON EXISTING HARDWARE

To allow us to help you more quickly, please have the serial number of the equipment available before you call.

5.2 TROUBLE SHOOTING

If you have reviewed SECTION 4.4 TROUBLE SHOOTING and have questions, please call our experienced engineers for assistance. In many cases we can solve a problem over the phone. Please provide as complete a description as possible of the problems encountered.

5.3 FACTORY AND FIELD SERVICE

If you request field service, Intek has experienced engineers available to meet your needs. Many of the repairs or recalibrations will require returning the instrument to the factory. If a problem cannot be solved over the phone, with your help, we will determine if factory service or field service will be the best solution.

To request factory service, a Return Material Authorization (RMA) and purchase order is required. Our customer service staff will assist you with the required information to return instruments for service.

5.4 DECONTAMINATION OF EQUIPMENT

For the safety of your personnel and ours, any hardware that has been in contact with potentially hazardous liquids or gases must be properly decontaminated before shipment to Intek.

5.5 QUESTIONS ON NEW EQUIPMENT

For a new Rheotherm application or any liquid or gas flow measurement need, contact your local Rheotherm representative or the Intek technical sales department at the above phone/fax numbers. Our staff will be pleased to answer all questions and provide quotations.

SECTION 6 – CUSTOM INFORMATION

6.1 UNIT IDENTIFICATION

Model no.: _____

Serial no.: _____

Customer identification: _____

6.2 CONFIGURATION

The configuration of this unit, as originally shipped from the factory:

Flow switch setting:

☐ Low flow switch ☐ High flow switch ☐ Other _____

Input Power:

☐ 115 Vac, 50/60 Hz ☐ 230 Vac, 50/60 Hz ☐ Other _____

Line Connection:

6.3 SPECIAL INSTRUCTIONS

		Reference			Reference
____	None	_____	____	Installation	_____
____	Other	_____			
____	Trip level adjustment required for start up				_____

Figure 1. Rheotherm® 100 Rev. A Signal Conditioner PCB Layout

Figure 2. Rheotherm® Flow Switch Add-on Option