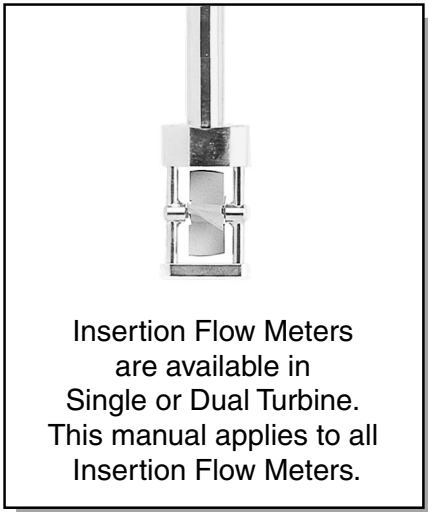


# Owner's Manual for ONICON Insertion Turbine Flow Meters



Insertion Flow Meters  
are available in  
Single or Dual Turbine.  
This manual applies to all  
Insertion Flow Meters.

For use with serial numbers  
115692 and later

## SAFETY INFORMATION



Throughout this manual some text appears in bold type. These statements contain information related to safety issues. Many installations of our meters will be in high pressure or high temperature systems and accidents with these systems can cause serious injury or death to those working on them or standing nearby. There is also the possibility of property damage.

**Please pay extra attention to these areas of bold text.**

The information in this manual has been carefully checked for accuracy. There is, however, the possibility of omission or error. In such an event, ONICON Incorporated does not assume liability for any damages resulting from the use of this manual.

## SERVICE

If ONICON equipment requires servicing, we prefer to have it returned to the factory. In some cases you may want to service it yourself. Our technical staff will be happy to work with you in these cases; however, we request that you contact us before beginning to work on the equipment because we can provide helpful information which is beyond the scope of this manual.

## TABLE OF CONTENTS

1.0	INTRODUCTION .....	3
1.1	Purpose of This Guide.....	3
1.2	A Typical Insertion Turbine Flow Meter .....	3
1.3	Standard Features and Specifications.....	4
1.4	Installation Hardware.....	5
1.5	Model Numbering System .....	5
1.6	Warranty and Serial Number.....	6
2.0	UNPACKING.....	7
2.1	Checking That You Have Received Everything .....	7
3.0	INSTALLATION, REMOVAL & ADJUSTMENT .....	8
3.1	Site Selection.....	8
3.2	Mechanical Installation.....	10
3.3	Insertion of the Meter.....	11
3.4	Removal of the Meter .....	12
3.5	Adjustment of the Meter .....	13
3.6	Wiring Connections.....	14
4.0	START-UP & COMMISSIONING FOR ONICON INSERTION TURBINE FLOW METERS .....	15
4.1	Helpful Hints for Start-up and Commissioning.....	15
4.2	Start-up and Commissioning .....	16
4.3	Start-up and Commissioning Worksheet .....	17
4.4	Troubleshooting Guide .....	18
5.0	ANALOG ADJUSTMENT PROCEDURE.....	19
5.1	General Discussion.....	19
5.2	Analog Adjustment Procedure .....	20
APPENDICES		
A	User Connections and Internal Wiring Diagrams	
B	Turbine Assembly Detail Drawings	
C	Conditions of Sale	

## SECTION 1.0: INTRODUCTION

We, at ONICON INCORPORATED, would like to thank you for purchasing our quality U.S. made Insertion Turbine Flow Meter. As our valued customer, our commitment to you is to provide fast reliable service and assistance, while continuing to offer you new products to meet your growing flow measurement needs.

### 1.1 PURPOSE OF THIS GUIDE

We have written this guide to provide the persons responsible for the installation, operation and maintenance of your insertion flow meter with the most specific equipment information they will need. This is NOT an electrical or plumbing trade manual.

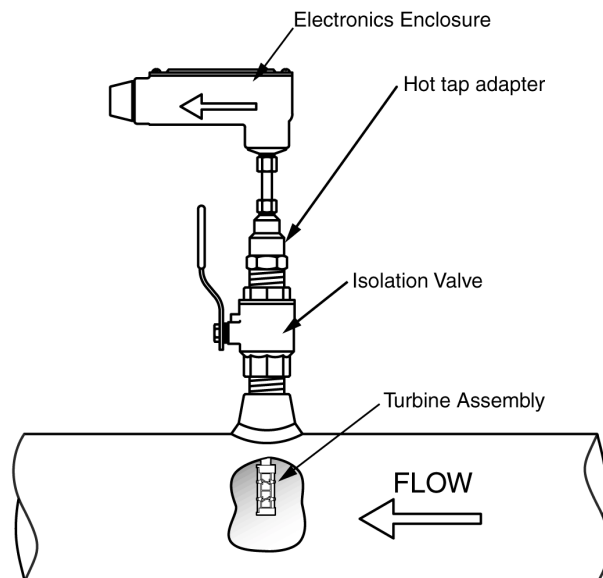


**PLEASE DO NOT PERMIT ANY PERSONS TO INSTALL, OPERATE OR MAINTAIN THIS EQUIPMENT UNLESS THEY HAVE A COMPLETE KNOWLEDGE OF THEIR TRADE SKILLS AND ARE COMPETENT TO WORK ON HIGH VOLTAGE POWER WIRING OR HIGH PRESSURE HOT AND COLD WATER AND STEAM SYSTEMS, ACCORDING TO THEIR INDIVIDUAL TRADES. DEATH OR PERMANENT INJURY MAY RESULT FROM ACCIDENTS WITH THESE SYSTEMS.**

This guide is the basic reference tool for all ONICON Insertion Turbine Flow Meters. If you have not purchased all of the options, there will be references in this manual which are not applicable to you meter(s).

### 1.2 A TYPICAL INSERTION TURBINE FLOW METER

ONICON's Insertion Turbine Flow Meters measure the velocity of flowing liquids by counting the frequency at which the blades of a rotating turbine pass a fixed electrode. Circuitry within the flow meter electronics enclosure then converts the rotational rate to digital and/or analog signals which are transmitted via a connecting cable to any of ONICON's display devices, BTU meters and/or a data acquisition system.



## 1.3 STANDARD FEATURES AND SPECIFICATIONS

(Refer to specification sheet for particular model for additional details)

- **F-1100 Series**

- Accuracy**

- ± 0.5% OF READING at calibrated velocity
    - ± 1% OF READING from 3 to 30 ft/s (10:1 range)
    - ± 2% OF READING from 0.4 to 20 ft/s (50:1 range)

- Sensing Method**

- Electronic impedance sensing (non magnetic and non-photoelectric)

- Pipe Size Range**

- 1¼" through 72" nominal

- Supply Voltage**

- 24±4 V AC/DC at 50 mA

- Liquid Temperature Range**

- Standard: 180° F continuous, 200° F peak
  - High Temp: 280° F continuous, 300° F peak
  - Meters operating above 250° F require 316 stainless steel construction option

- Ambient Temperature Range**

- 5 to 160° F (-20 to 70° C)

- Operating Pressure**

- 400 PSI maximum

- Pressure Drop**

- Less than 1 PSI at 20 ft/s in 1½" pipe, decreasing in larger pipes and lower velocities

- Material**

- Wetted metal components
  - Standard: Electroless nickel plated brass
  - Optional: 316 stainless steel
  - Electronics Enclosure
  - Standard: Weathertight aluminum enclosure
  - Optional: Submersible enclosure

- Electrical Connections**

- Standard: 10' of cable with ½" NPT conduit connection
  - Optional: Indoor DIN connector with 10' of plenum rated cable

- Output Signal(s)**

- Standard: Calibrated frequency output (0-15v pulse)
  - Optional: Analog and Digital outputs also available, based on model

- **F-1200 Series**

- This series has all of the features of the F-1100 series plus:

- Dual Turbines and frequency output averaging circuitry to provide improved Accuracy in short pipe runs.
    - Pipe size range is 2½" through 72" nominal

- **FB-1200 Series**

- This series has all the features of the F-1200 series plus:

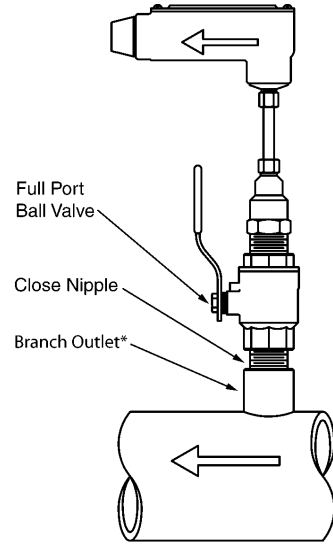
- Capability of detecting and reporting flow direction

## 1.4 INSTALLATION HARDWARE

All ONICON insertion type meters can be installed and removed via a 1" or larger full port ball valve without system shutdown. The terms "Standard" and "Hot Tap" refer to the installation method of the isolation valve kit only.

**Standard Installation Hardware:** For new construction or scheduled shutdown. Once kit is installed, the flow meter can be installed or removed without system shutdown.

**Hot Tap Installation Hardware:** For applications which require the access hole in the pipe to be drilled through the valve using a wet tap drilling machine, while the hydronic system is pressurized and operating.



\*Weld-on fitting, copper tee or saddle

## 1.5 MODEL NUMBERING SYSTEM

		F(B)-XX YY			
		↑	↑		
SERIES				OUTPUT SIGNAL	
F-11	Single Turbine, Insertion Type			00	<b>Frequency Output</b> (15 V pulse) For connection to Onicon display or BTU meter only. Signal is too fast for most building control systems (0-300 hz).
F-12	Dual Turbine, Insertion Type			10	<b>Analog Output</b> (non-isolated) Provides both 4-20 mA and 0-10 V outputs. Most commonly used output type. (3-wire connection)
FB-12	Bi-Directional, Insertion Type			11	<b>Isolated Analog Output</b> Provides both 4-20 mA and 0-10 V outputs. Signal ground is isolated from power supply and pipe ground. (4-wire connection)
F-13	Inline Turbine Meter			20	<b>Divided Output</b> (Solid state dry contact) Provides an isolated binary/digital output. Signal is divided to limit the maximum frequency. For rate/totalization.
				30	<b>Scaled Output</b> (Solid state dry contact) Provides an isolated binary/digital output scaled to provide one pulse per desired unit volume (i.e.: 1 pulse = 10 gal.). Ideal for totalization applications.

**Example:** "F-1210" = Dual turbine, analog output

## 1.6 WARRANTY AND SERIAL NUMBER

- Warranty

ONICON's complete warranty is included in Appendix C of this manual as a part of the "Conditions of Sale." Meters purchased after November 1, 2000 include a two-year "No fault" warranty which may cover accidental damage caused during installation or start up.

- Serial Number

The serial number of your Insertion Flow Meter is located on a label on the side of the electronics enclosure. The model number is also listed on this label. The serial number is a unique identifier that you should refer to, along with the model number, whenever you require assistance regarding your meter.

## **SECTION 2.0: UNPACKING**

Insertion Flow Meters are generally shipped in one package unless optional hardware or equipment is ordered. This package may contain up to two complete meters along with the optional installation kits. If any display equipment was ordered with the meters, the other equipment will be packed separately. Please open all packages with caution to prevent damage to their contents. In the event that they are damaged when you receive them, notify the shipping company immediately and the ONICON Customer Service Department. All products are shipped insured unless customer specifically requests otherwise.

### **2.1 CHECKING THAT YOU HAVE RECEIVED EVERYTHING**

- **The Documentation**

Enclosed with each Insertion Flow Meter is a comprehensive documentation package which includes the following items:

- OWNER'S MANUAL
- FLOW METER CALIBRATION DATA SHEETS

Please notify the ONICON customer service department if any of these documents are missing.

- **The Flow Meter**

The flow meter is a rugged instrument and should arrive without any damage; however, prior to installation, inspect it for physical damage such as broken turbine blades or a damaged stem.

- Test the turbine(s) to see that they rotate freely when you blow on them parallel to their shafts.
- Make sure that the threads on the hot tap adapter have not been damaged.
- Inspect the long stem for bends or other damage. The stem forms the seal against liquid leakage as it slides through an 'O' ring outside the hot tap adapter. Deep scratches may cause leakage.
- The serial and model numbers on the wire connection/calibration data tag should match the numbers on the tag mounted directly on the flow meter. Be sure that the unit was calibrated to the correct pipe size and flow range.



## SECTION 3.0: INSTALLATION, REMOVAL & ADJUSTMENT

\*\*\*CAUTION\*\*\*



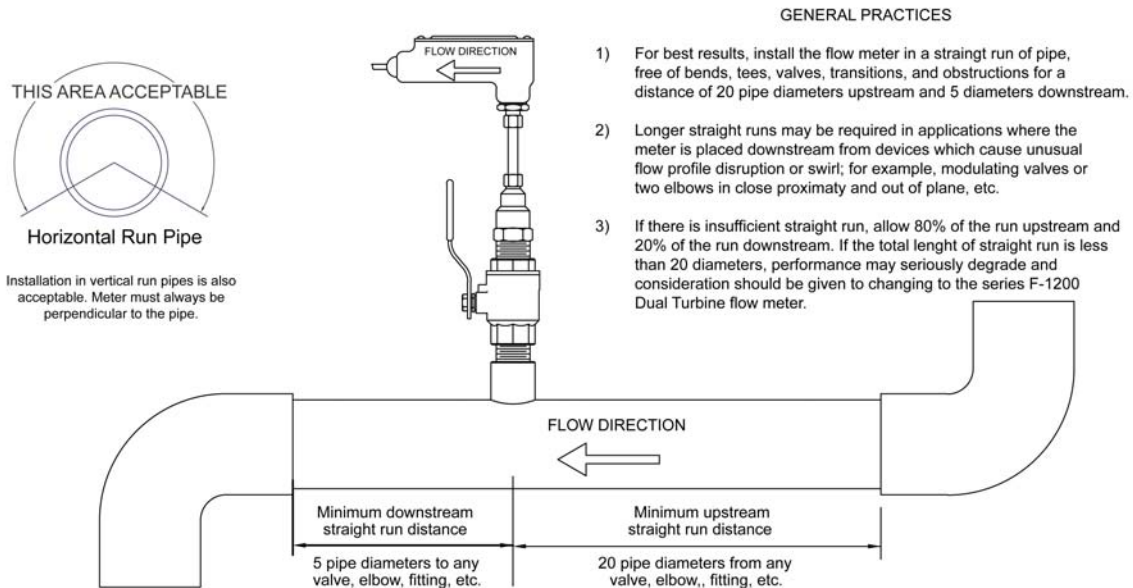
**Insertion Flow Meters may often be installed in pipes which are under high pressure. Accidents with these systems can cause serious injury or death. Only persons experienced with high pressure systems and related knowledge in the heating, cooling and fluid metering fields should attempt to install adjust or remove the flow meter. Refer to the installation drawings before performing any work on these meters.**

ONICON will be happy to assist with technical recommendations and to provide guidance by telephone and/or mail. On-site field engineering, installation and service is also available at additional cost.

### 3.1 SITE SELECTION

Install the flow meter where it will be accessible for personnel to perform necessary periodic maintenance. The clearance required for installation is typically 30-36" from the pipe wall to the nearest obstruction above the valve assembly. This clearance dimension will increase with large diameter pipes. The environment should be free of corrosive liquids/fumes, temperature extremes and heavy vibration. The following diagrams should be used as a guide to the proper location for installing the meter.

### Series F-1100 Single Turbine Flow Meters



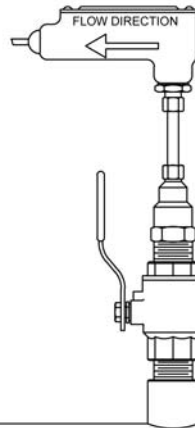
If yours is a single turbine meter and there is no suitable location, contact ONICON's Sales Office to discuss upgrading to a dual turbine meter. This meter is more tolerant of the conditions that cause swirl, turbulence and flow profile distortions. Please make this decision before installing the single turbine meter so that we may be able to give you credit if you elect to upgrade to a dual turbine meter. Returns may be subject to a restocking charge.

# Series F-1200 Dual Turbine Flow Meters

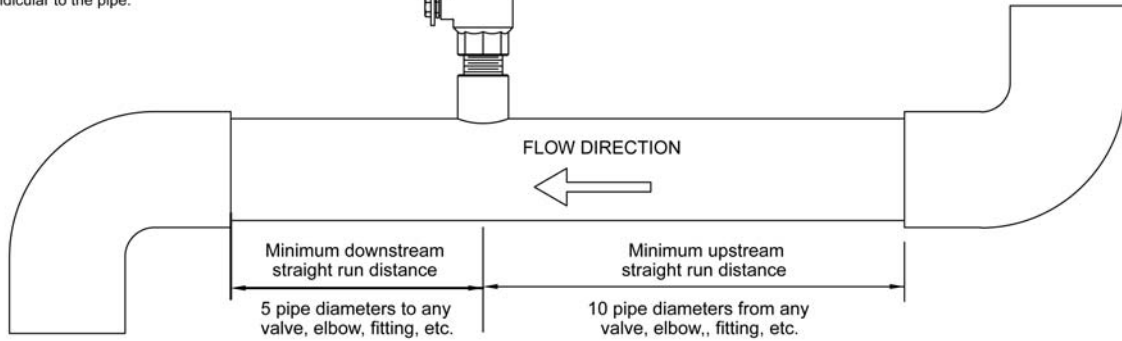
## GENERAL PRACTICES



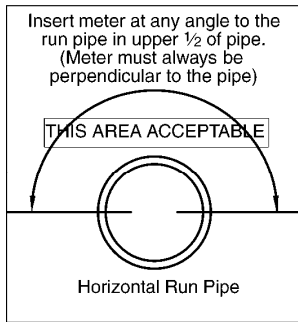
Installation in vertical run pipes is also acceptable. Meter must always be perpendicular to the pipe.



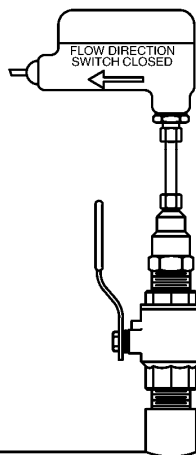
- 1) For best results, install the flow meter in a straight run of pipe, free of bends, tees, valves, transitions, and obstructions for a distance of 10 pipe diameters upstream and 5 diameters downstream.
- 2) Longer straight runs may be required in applications where the meter is placed downstream from devices which cause unusual flow profile disruption or swirl; for example, modulating valves or two elbows in close proximity and out of plane, etc.
- 3) If there is insufficient straight run, allow 80% of the run upstream and 20% of the run downstream. If the total length of straight run is less than 12 diameters, performance may seriously degrade.



## MECHANICAL INSTALLATION LAYOUT Series FB-1200 Dual Turbine Flow Meters Bi-Directional Flow Applications

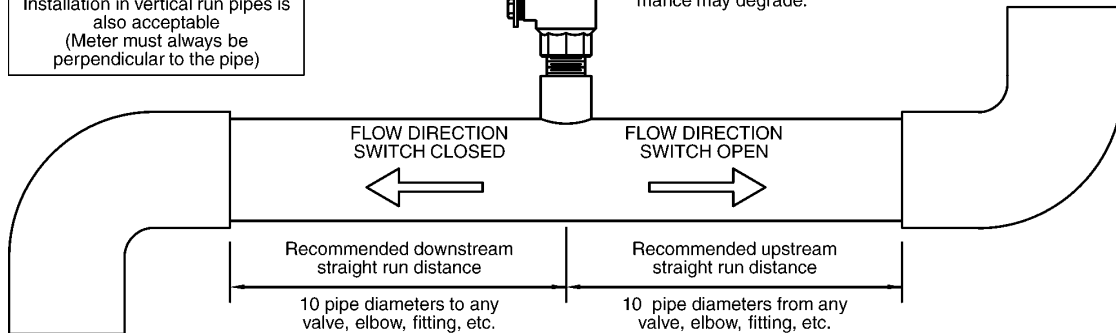


Installation in vertical run pipes is also acceptable (Meter must always be perpendicular to the pipe)



## GENERAL PRACTICES

- 1) For best results, install the flow meter in a straight run of pipe, free of bends, tees, valves, transitions, and obstructions, for a distance of 10 pipe diameters on each side of the flow meter.
- 2) Longer straight runs may be required in applications where the meter is placed downstream from devices which cause unusual flow profile disruption or swirl, for example, modulating valves or two elbows in close proximity and out of plane, etc.
- 3) If there is insufficient straight run, allow 50% of the run upstream and 50% of the run downstream. If the total length of straight run is less than 20 diameters, performance may degrade.



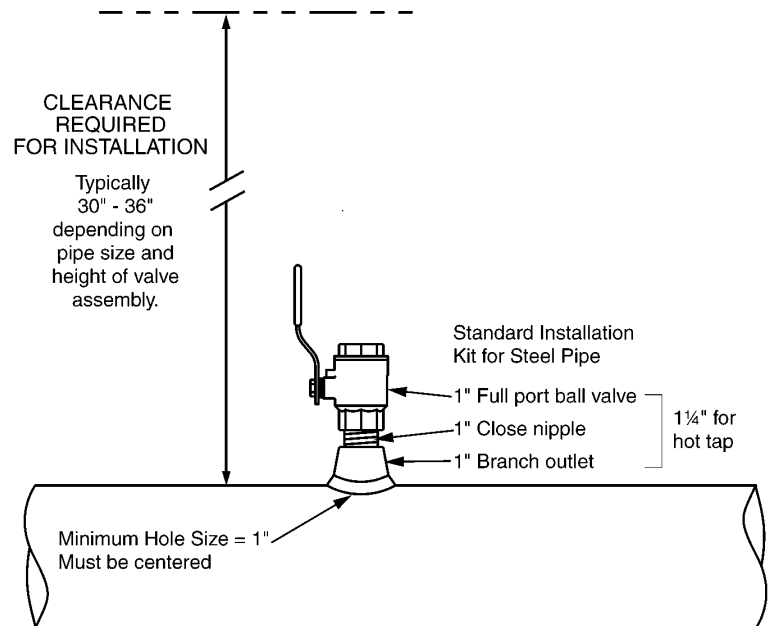
### 3.2 MECHANICAL INSTALLATION

Turbine meters may require periodic maintenance and you should be able to remove the meter when necessary without shutting down your system. To take advantage of the ONICON Flow Meter's built-in Hot Tap feature, it must be installed through an isolation valve. The location must allow sufficient overhead clearance for meter removal (for cleaning and preventative maintenance). A full 1" opening is required to clear the turbine assembly. Make sure that your valves and fittings are full port and at least 1" in actual internal diameter. Also, note that an oversized access hole can cause undesirable turbulence.

Try to limit the overall height from the pipe's outside diameter to the top of the valve to 5½" - 6". ONICON calculates the stem length of the flow meter based on pipe size and this nominal height. If your installation requires a taller fitting assembly and the dimension was not specified on the order form, please contact the factory before installation. This way ONICON can offer you credit for your meter if you decide to exchange it for one with a longer stem. Returns may be subject to a restocking fee.

ONICON's *Standard Installation Hardware* kit is for use in a drained, non-pressurized system. The access hole is drilled (1" minimum) prior to installation of the 1" NPT branch outlet, close nipple and full port ball valve. Once the isolation valve is installed, the piping system can be flushed and pressurized. The flow meter may now be inserted or removed by hand without having to drain the system. Please read all instructions before proceeding with meter insertion.

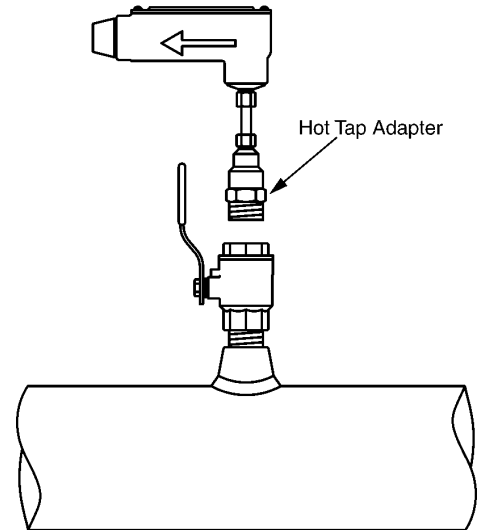
ONICON's *Hot Tap Installation Hardware* kit offers an alternative installation when it is not practical to drain or relieve the pressure in the system. In this case, a 1¼" branch outlet, close nipple and 1¼" full port ball valve are installed first. Then, a hot tap drilling apparatus can be used to drill a 1" diameter hole through the valve, without shutting down or draining the pipe.





**When you are ready to refill the system, make sure that all lines are filled with water before inserting the turbine into the stream. If the lines are not filled, air may interrupt the flowing stream and damage the turbine assembly. A greater danger is that if this is a hot water system, some water may flash into steam and exceed the high temperature limit for the turbine and its mechanical assembly. This flash over could exceed the pressure ratings of the meter and the assembly could fail allowing steam and hot water to escape causing serious injury.**

After fitting the necessary plumbing hardware, flush the entire system so that it is free of flux, solder and slag. Prepare to install the flow meter by loosening the clamping nut and withdrawing the turbine assembly fully into the hot tap adapter. Next, thread the adapter on to the ball valve using a paste type thread sealant. Do not use Teflon tape because torn strands of the tape may wind around the turbine, slowing down or even stopping the turbine.



Check the installation for leaks by slightly opening the ball valve under the hot tap adapter. An 'O' ring in the adapter seals the meter stem against leakage. If there are any leaks around the clamping nut or stem, **DO NOT ATTEMPT TO STOP THE LEAKAGE BY OVERTIGHTENING THE CLAMPING NUT.** Damage to this nut or the clamping ring under the nut may prevent the assembly from properly holding the meter in the pipe. The clamping nut is not part of the sealing mechanism. Any leaks in this area indicate that the 'O' ring is not sealing properly and you must contact the factory for assistance.

**3.3 INSERTION OF THE METER**



**\*\*\*CAUTION\*\*\***  
**SYSTEM MAY BE UNDER HIGH PRESSURE. When adjusting the meter position or removing it, be sure to hold the electronics enclosure firmly by hand before SLOWLY loosening the positioning clamping nut. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe causing serious injury. The meter could also be damaged or break apart causing a break in the water seal with the resultant loss of large amounts of water. The hand effort required to hold the meter will be 0.11 times the pipe pressure.**

Begin by calculating the effort that will be required to hold the meter. Establish adequate footing for this task, taking extra caution when working from a ladder or platform. Use the following formula:

$$E=0.11 \times P$$

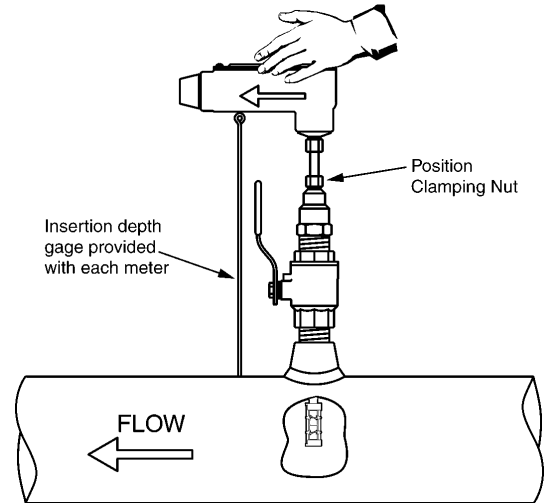
Where: **E** = effort in pounds

**P** = system pressure in pounds per square inch

Example: In a 300 PSI system, 33 pounds of effort is required to insert the meter into the pipe.

- **Installing the meter with a factory supplied depth gage:**

1. Open valve completely, loosen the position clamping nut, and insert the meter until the bottom of the electronics case touches the eye of the depth gage. (Pierce insulation with gage until the tip touches the pipe.)
2. Position the electronics enclosure parallel to the pipe in the direction relative to the flow. This will position the turbine with its axis in line with the flow and in the correct direction.
3. Tighten the position clamping nut.



**Do not release the flow meter until you have tightened the position clamping nut enough to hold the flow meter in the desired position. This will require less torque than you might think, so be careful not to overtighten it and risk damaging the adapter, nut or stem.**

- **Installing the meter without a gage:** (Contact the factory for assistance)

NOTE: For installations with a limited straight run of pipe (less than the recommended distances shown on pages 9 and 10), adjustments in insertion depth may be needed to compensate for velocity flow profile variations. Please contact the factory for information on velocity flow profiling for determining the average velocity location in undeveloped flow locations.

**3.4 REMOVAL OF THE METER**



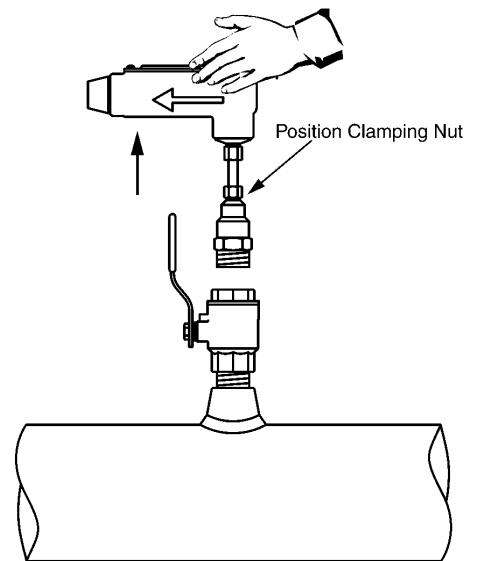
**\*\*\*CAUTION\*\*\***

**Remember, the meter may be under high pressure, and while removal of the meter is basically the reverse of the insertion procedure detailed above, care must be taken to ensure that the meter is supported against the pipe pressure before the position clamping nut is loosened. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe causing serious injury.**



**Prior to removal of the meter, make sure that you are standing on a secure platform and have both hands available to manipulate the flow meter.**

**First support the flow meter against the pipe pressure by holding the electronics enclosure firmly in hand BEFORE loosening the position clamping nut.** The effort which will be required is the same as that required for insertion of the meter and should be calculated according to the formula in the prior section covering insertion of the meter. This effort will be 0.11 times the pipe pressure. **If your footing is not secure, or if your ability to hold the meter limited for any reason, DO NOT loosen the clamping nut.**



**SLOWLY** loosen the position clamping nut and **carefully and slowly** allow the pressure to force the meter out of the pipe. This is not at all difficult, but you must not let go of the meter until it is fully withdrawn into the hot tap adapter. After the meter is completely withdrawn, you may close the isolation ball valve.

The main cause of damage to meters comes from accidentally closing the valve on the turbine assembly. To avoid this, gently rotate the meter by twisting the electronics enclosure back and forth (twist the stem, do not bend it) while you slowly close the valve. If the valve touches any part of the meter, you will feel it as you are twisting the meter. If the valve touches anything, it means the meter is not fully withdrawn. Usually a gentle twisting motion while withdrawing the meter will clear any obstruction and permit the meter to withdraw completely. (Excessive build-up on the stem may require the hot tap 'O' ring to be lubricated with silicone.)

After the valve is completely closed, you can safely unscrew the hot tap adapter from the valve. Partially unscrew the adapter and allow pressure to vent from the hot tap adapter. There will be very little water in the hot tap adapter; however, a small bucket or pan should be held under the valve to catch any spilled water.

**\*\*\*CAUTION\*\*\***

**In hot water systems, even a small amount of water can cause serious personal injury. Use extra caution when working with hot water meters.**

**3.5 ADJUSTMENT OF THE METER**

**\*\*\*CAUTION\*\*\***

**If adjustment of the meter depth is required, the same procedure must be followed as if the meter was being removed. Please carefully read the section above on removal of the meter. Remember, the meter may be under high pressure and failure to follow the procedure may result in serious injury.**

Once the meter has been moved to its new depth, tighten the position clamping nut. Next, place several turns of electrical tape around the stem just above the clamping nut so that at a later time, when the meter is removed for service, it can be easily replaced at the same depth.

**3.6 WIRING CONNECTIONS**

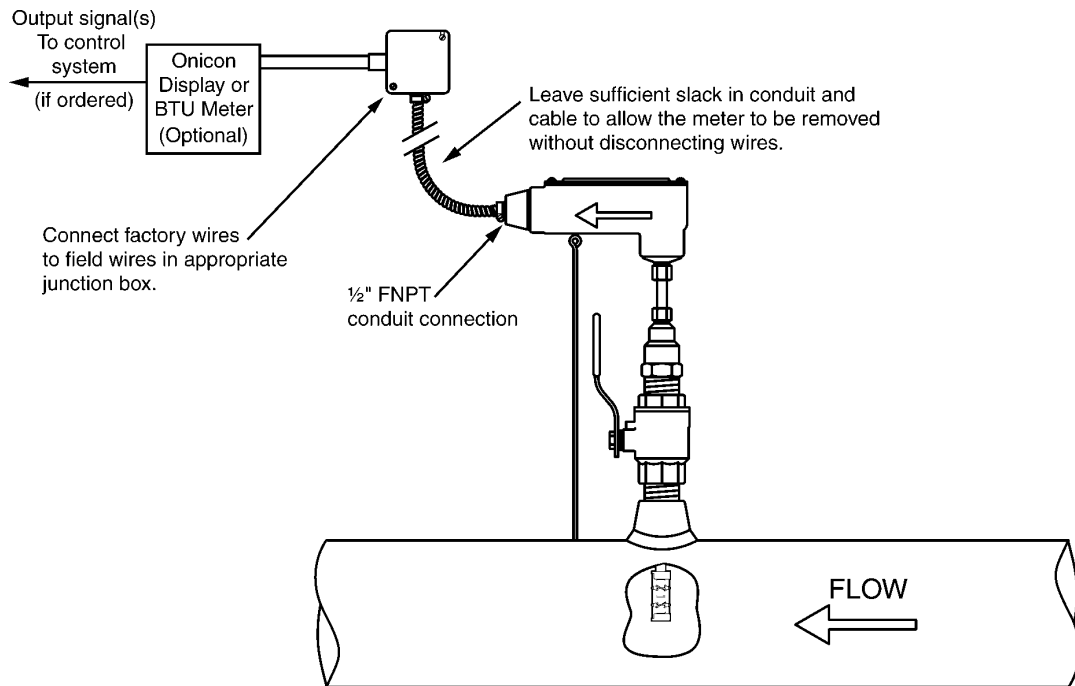
Make connections to the 10' cable, which is supplied by ONICON and is pre-wired to the circuit board.



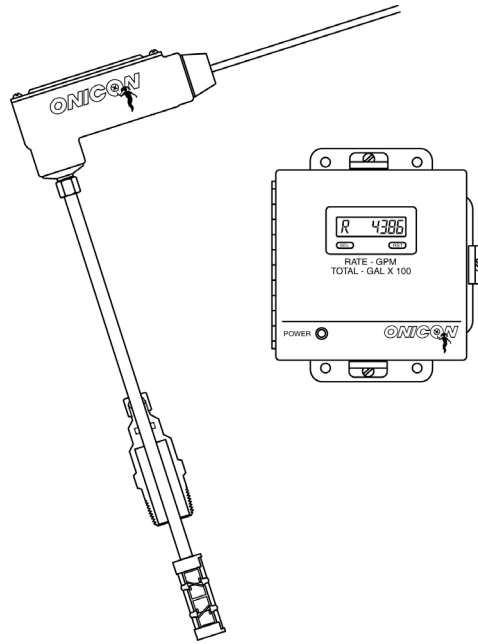
**Do not attempt to make any connections inside the electronics case, or to remove factory installed connection fittings. Damage resulting from these actions may not be covered under warranty.**

The most common cause of electronic failure is incorrect connection. If you will be adding any additional cable, please record any substitution of wire colors. If additional cable is purchased from ONICON, the color code can be maintained. However, cable from other sources will most likely have a different set of colors. Please refer to Appendix A for wiring diagrams and factory color codes.

Only qualified service personnel should make connections between the Insertion Flow Meter and the user's external equipment. Any misapplication of power and/or ground can result in improper operation of the unit or damage to the Insertion Flow Meter, the flow meter circuitry, and to any externally connected equipment.



## **SECTION 4.0: STARTUP & COMMISSIONING FOR ONICON INSERTION TURBINE FLOW METERS**



### **4.1 HELPFUL HINTS FOR START-UP AND COMMISSIONING**

A step-by step procedure and companion worksheet are located on the next two pages. Please read all installation instructions carefully before proceeding with installation, start-up and commissioning.

Please read these helpful hints before proceeding with the start-up and commissioning procedure on the next page.

1. ONICON Flow Meters are individually calibrated for a particular application. Be sure to verify the pipe size and location.
2. The electronic sensing systems will not work in air. Blowing on the turbine(s) will not produce a signal. You can test the meter by holding the turbines under a faucet or carefully moving it back and forth in a bucket of water.
3. When measuring analog output signals, remember that currents (mA) must be measured in series, while voltages are measured in parallel. If the 4-20 mA signal is already connected to a control system, you must break the connection and measure the signal in series.
4. When measuring frequency outputs in hertz, take your multimeter out of “autorange mode” and manually set range for a voltage level above 15 VDC. This will prevent false readings when no turbine signal is present.
5. All wiring connections should be made at the end of the factory cable. Do not attempt to remove the factory installed cable or change the orientation of the electronics enclosure.
6. Never connect power to analog or frequency output signal wires. ONICON flow meters are not “loop powered” devices.



## 4.2 START-UP AND COMMISSIONING

Please read the entire procedure carefully before proceeding. Wiring diagrams are located in the appendix. A worksheet for checking off the following steps and recording measured values is located on the following pages.

1.	Confirm meter location and adequate straight pipe run to achieve desired results	Is the meter located in the correct location as required by the plans?  Compare actual straight pipe upstream and downstream of the meter location to recommended distances identified in the installation manual. Note that the manual is very conservative, assuming worst-case pipe obstructions; contact ONICON's technical support department to discuss specifics of your application. If straight pipe run is very short, consult factory PRIOR to installing a single turbine meter to discuss possibility of upgrade to a dual turbine meter.
2.	Confirm Pipe Size	Confirm that the meter is tagged for the pipe size it is installed in. When in doubt, measure the circumference of the pipe. Pipe O.D. = (circumference / 3.14) – (insulation thickness x 2)
3.	Confirm insertion depth and orientation	Each flow meter comes with an attached insertion gage and instruction tag. Ensure that meter is inserted to correct depth and that the electronics enclosure is parallel with the pipe, with the arrow in the direction of flow.
4.	Confirm control system programming	Confirm that the control system input point is properly configured for the analog range (or binary scale factor) identified on the flow meter calibration tag & certificate.
5.	Confirm connection to correct ONICON display or BTU Meter (if ordered)	Confirm that the flow meter serial number matches the ONICON display or BTU meter serial number (when ordered together)
6.	Verify wiring <b>before</b> connecting power	Prior to connecting the power, verify that wiring is correct as shown in this manual and/or additional wiring diagram provided with ONICON display or BTU meter. If in doubt, call factory for assistance before proceeding further.
7.	Confirm correct supply voltage	Verify that 24 (+/- 4) V is available. Serial Numbers 115692 and later can accept 24 V DC or AC, but earlier meters required 24 VDC. Note: ONICON display module or BTU Meter provides 24 VDC to the flow meter. ONICON display modules and BTU meters are typically powered by 120 VAC, however, low voltage versions are also available.
8.	Connect power	Wait approximately 45 seconds after power-on before proceeding further.
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant if possible, otherwise, take the various output readings as quickly as possible.		
9.	Measure and record frequency output(s):	The average frequency output signal is a 0-15 VDC pulsed output ranging up to 200 Hz and must be measured with a frequency counter or oscilloscope. Measure DC Frequency (Hz) from GREEN(+) to BLACK(-). Also measure DC volts on same wires. 5 to 7 VDC is normal for a spinning turbine, 0 or 14+ VDC indicates a stopped turbine. (1 to 4 VDC could indicate a problem)  $\text{GPM} = \frac{\text{Frequency in Hz} \times 60}{\text{Meter Factor in ppg}}$ (refer to calibration tag for meter factor)  For Dual Turbine Models, also measure and record the top and bottom turbine signals TOP: WHITE(+) to BLACK(-)    BOTTOM: ORANGE(+) to BLACK(-)
10.	Measure and record analog or binary outputs  Current Output:  Voltage Output:  Divided Output:  Scaled Output:	Refer to flow meter wiring diagram for wire colors for the various outputs available, based on your particular flow meter model. Use the following formulas to calculate flow rate from measured analog signals:  $\text{GPM} = \frac{(\text{measured current in mA} - 4)}{16} \times \text{Full Scale Analog Flow Rate}$  $\text{GPM} = \frac{\text{measured DC volts}}{10} \times \text{Full Scale Analog Flow Rate}$  Same calculation as step 9, except use "divided meter factor" (measure and record frequency)  Each contact closure = unit volume identified as "Scale Factor" (measure and record time interval between contact closures)
11.	Compare various output signals to each other and to the flow rate displayed by the control system	The top and bottom turbine frequencies (dual) should be within about 20% of each other and their average should equal the average frequency output.  Compare the flow rates calculated in STEPS 9 and 10 to each other and to the flow rate indicated by the control system. Refer to troubleshooting guide when readings are inconsistent.
End of standard start-up and commissioning. Please contact ONICON's technical service department at (727) 447-6140 with any questions.		

### 4.3 START-UP AND COMMISSIONING WORKSHEET

Please read all installation instructions carefully prior to proceeding with these steps. Wiring diagrams are located in the appendix. Use the following worksheet for checking off the commissioning steps and recording measured values:

STEP	TEST / MEASUREMENT	S/N: _____	S/N: _____	S/N: _____	S/N: _____
1.	Meter location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Confirm pipe size	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
3.	Insertion depth and orientation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Control system programming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Match display or BTU meter serial#(if ordered)	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
6.	Signal Connections Verified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Supply voltage verified	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
8.	Connect power	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant if possible, otherwise, take the various output readings as quickly as possible.					
9.	Frequency output(s): Avg = green, Top = white Bottom = orange				
	Avg Freq. (HZ):	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Avg Freq. (VDC):	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Top Turbine (HZ):	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Top Turbine (VDC):	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Bottom Turbine (HZ):	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Bottom Turbine (VDC):	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Calculated Flow Rate:	_____ GPM	_____ GPM	_____ GPM	_____ GPM
10.	Analog or binary outputs				
	4-20 mA signal:	_____ MA	_____ MA	_____ MA	_____ MA
	0-10 V signal:	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Scaled output interval or divided output frequency	_____	_____	_____	_____
	Calculated Flow Rate:	_____ GPM	_____ GPM	_____ GPM	_____ GPM
11.	Flow rate displayed by control system	_____ GPM	_____ GPM	_____ GPM	_____ GPM

#### 4.4 TROUBLESHOOTING GUIDE

NOTE: Also refer to the START-UP and COMMISSIONING GUIDE located on the preceding pages.

REPORTED PROBLEM	POSSIBLE SOLUTIONS
<b>No Signal</b>	<ul style="list-style-type: none"> <li>• Verify that meter is inserted correctly into the pipe.</li> <li>• Verify that the electronics enclosure is parallel with the pipe.</li> <li>• Verify 24 V supply voltage.</li> <li>• Verify correct wiring to control system (see wiring diagram).</li> <li>• Check turbine(s) for debris.</li> </ul>
<b>Reading is too high or too low</b>	<ul style="list-style-type: none"> <li>• Verify pipe size. Contact factory if pipe size is different from calibration tag.</li> <li>• Verify that meter is inserted correctly into the pipe.</li> <li>• Verify that the electronics enclosure is parallel with the pipe.</li> <li>• Verify correct wiring to control system (see wiring diagram).</li> <li>• Confirm that output signals are consistent (frequency vs. analog, etc.)</li> <li>• Confirm that control system is programmed for correct flow range or scale factor.</li> <li>• Check turbine(s) for debris.</li> </ul>
<b>Analog signal seems high or low and does not correspond to frequency output</b>	<p>Check for ground loop or offset voltage:</p> <ul style="list-style-type: none"> <li>• Disconnect analog signal input to control system and measure analog outputs directly from the flow meter.</li> <li>• Re-connect signal input to control system and measure the analog signals again.</li> <li>• Any difference between these readings indicates a potential ground loop or offset voltage.</li> <li>• Please contact ONICON for further assistance.</li> </ul>
<b>Control system displays flow rate, but no flow rate indication on local display module or BTU Meter</b>	<ul style="list-style-type: none"> <li>• Verify that all wires from flow meter were connected to the display module or BTU Meter.</li> <li>• The frequency output wire (green) must be connected for any ONICON Display or BTU Meter.</li> </ul>

For technical assistance, contact ONICON Incorporated at (727) 447-6140.

## **SECTION 5.0: ANALOG ADJUSTMENT PROCEDURE**

ONICON electronic circuits are designed and tested to ensure long life with minimal drift; therefore, you should not expect to make regular field adjustments or calibrations. However, it will be necessary for you to rescale the analog output under the following conditions:

- The turbine was replaced with a new one having a significantly different meter factor.
- You wish to change the flow rate represented by the analog output.
- An analog output meter is being moved to a different size pipe.

ONICON will do all of these recalibrations at low cost, with a one or two day turnaround. However, we have included this section for those instances where you cannot return the meter or simply want to do the work yourself. We will be happy to work through the procedure with you on the phone, if you desire.

While these adjustments are not complicated, they are crucial to the accuracy of the flow meter. Therefore, any adjustments should be made only by qualified personnel having an understanding of flow equations and experience with control systems.

### **5.1 GENERAL DISCUSSION**

ONICON Insertion Flow Meters contain circuitry which measures the velocity of a flowing stream of water, or water based liquid, by sensing the rotational rate of a freely rotating axial turbine, which is immersed in the flow stream. As each turbine blade passes a fixed electrode, an electronic pulse is produced by the circuitry. In the case of single turbine meters, the pulse rate is then calibrated in terms of the number of pulses per gallon in whatever size pipe the user has selected. This number is called the METER FACTOR. For example an Insertion Flow Meter might have a meter factor of 31.3 PPG (Pulses Per Gallon) in 3" pipe. This is the calibrated frequency output signal.

Dual turbine meters are basically the same except that the pulse rates from the upper and lower turbines are electronically averaged and the calibration is done using this average output signal.

This frequency output signal can be used directly by some data acquisition systems. Other systems require an analog representation of flow rate. For these systems the frequency output signal is processed by the optional analog output card and another calibration is then done on the 4-20 mA and 0-10 V analog output signal.

## 5.2 ANALOG ADJUSTMENT PROCEDURE

This procedure adjusts both 4-20 mA & 0-10 V output signals. It is limited to meters with serial numbers 115692 and higher. Contact the factory for assistance if your meter's serial number is below 115692.

### 5.21 Equipment Required

- Voltmeter
- Pulse Generator
- 24 V Power Supply

### 5.22 Procedure

1. Determine the input frequency required to simulate the desired maximum flow rate using the equation below:

Where:

F = Input Frequency (Hz)

R = Maximum Flow Rate (GPM)

MF = Meter Factor\* (Pulses Per Gallon)

$$F = \frac{R \times MF}{60}$$

\*The meter factor is written on a calibration tag attached to each meter and is also recorded on the calibration data sheet. Please contact the factory if you cannot locate the meter factor, or if you wish to use the meter in a different pipe size.

2. Remove the flow meter from the pipe and make sure the electrode and the surrounding area are dry.
3. Choose the input frequency range (Hz) from the table on the next page and set the appropriate range selection jumper. Refer to Appendix A for the internal wiring diagram of your model.
4. Connect the pulse generator output lead to the test signal input lead on the analog card, and connect the pulse generator ground lead to the black ground wire in the flow meter cable. Set the output to a 15 V P-P square wave at the frequency determined in step #1.
5. Set the DC voltmeter to the 0-10 V scale and connect the (+) lead to the brown wire in the flow meter cable. Connect the (-) lead from the voltmeter to the black ground wire in the flow meter cable.
6. Connect the red and black wires in the flow meter cable to the (+) and (-) terminals of the 24 V power supply respectively. Apply power.

7. Adjust the span potentiometer on the analog card to produce a 10 V reading on the voltmeter.

NOTE: The frequency ranges in the table are a starting point, and since they vary with electronic component tolerance, it may be necessary to change the jumper position once rescaling is started. If the range of adjustment of the span potentiometer is not sufficient to produce the desired 10 VDC, change the jumper position as follows:

VOLTAGE READING TOO HIGH: Choose the next lower jumper position.

VOLTAGE READING TOO LOW: Choose the next higher jumper position.

8. The flow meter is now rescaled. Disconnect all equipment, replace the cover and reinstall the flow meter.

<b>Analog Range Switch Settings</b>		
<b>INPUT FREQUENCY (Hz) AT MAXIMUM FLOW RATE</b>		<b>SWITCH POSITION SINGLE/DUAL TURBINE</b>
Over 248	Hz	1
124 – 248	Hz	2
62 – 123	Hz	3
31 – 61	Hz	4
15 – 30	Hz	5
Under 15	Hz	6

## APPENDIX A

### **User Connections and Internal Wiring Diagrams**

# FLOW METER WIRING INFORMATION

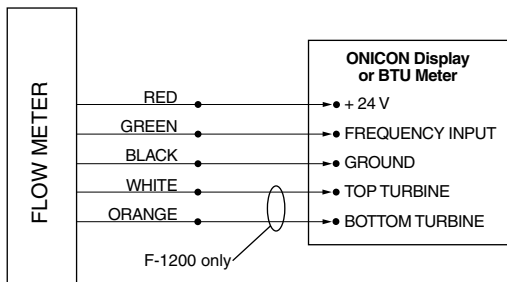
User Connections for Models with Frequency Output

Models: F-1100, F-1200, FB-1200 & F-1300

				<b>Wiring Information</b>		
F-1100 Single Turbine	F-1300 Inline	F-1200 Dual Turbine	FB-1200 Bi-Directional	<b>WIRE COLOR CODE</b>		<b>NOTES</b>
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Output frequency is typically below 200 Hz, but can be up to 300 Hz
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				<b>DIAGNOSTIC SIGNALS</b>		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

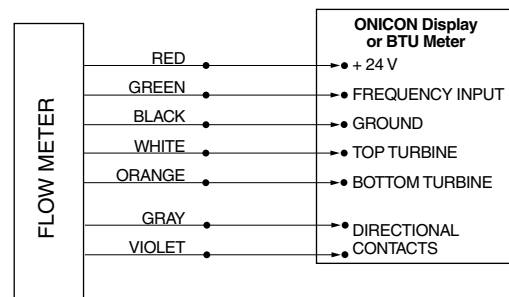
## F-1100 / F-1200 / F-1300 Wiring Diagram

Flow Meter Connections to ONICON Display or BTU Meter



## FB-1200 Wiring Diagram

Connections to ONICON Display or BTU Meter

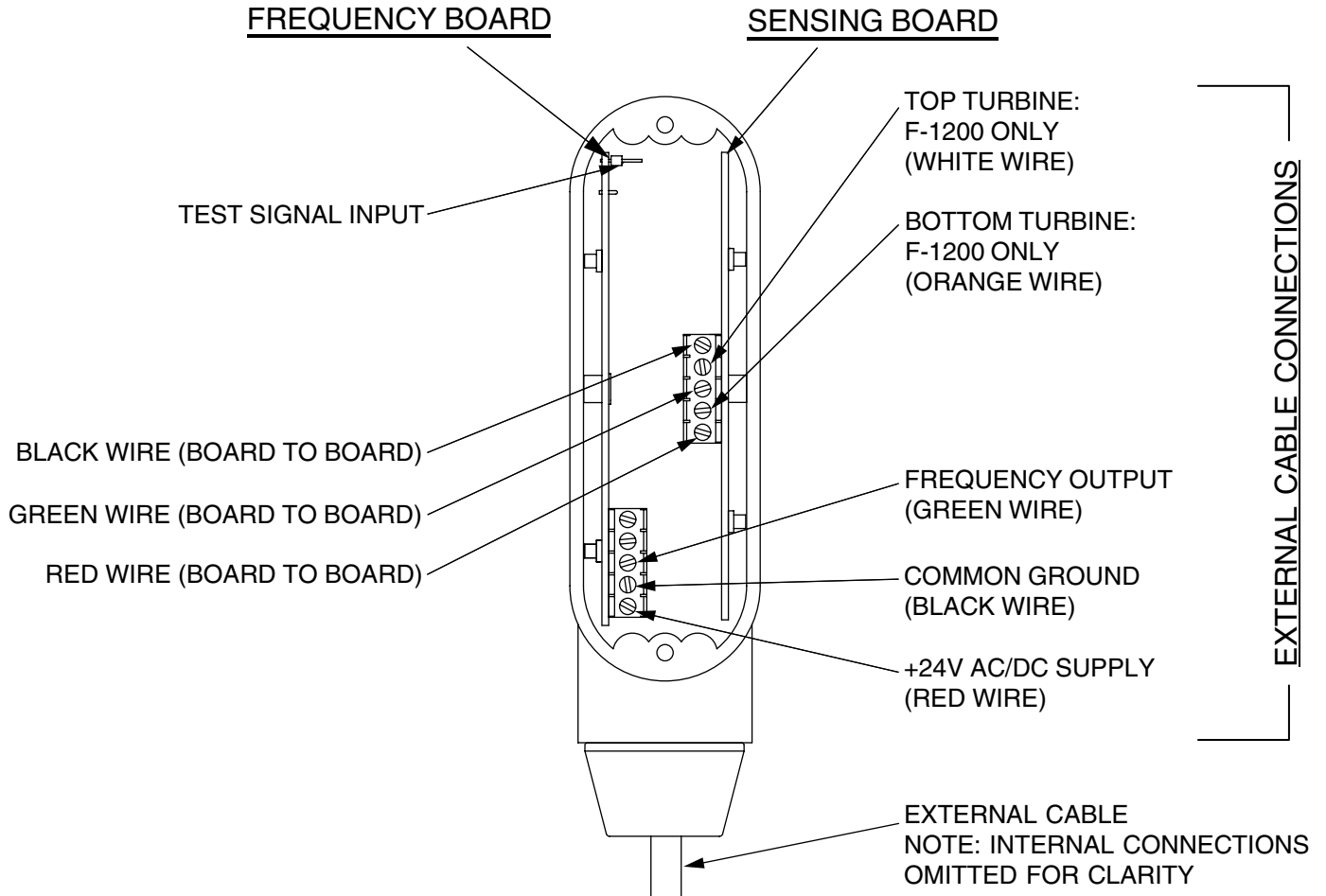


- NOTES:
- \* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
  2. Black wire is common with the pipe (typically earth ground).
  3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.



**WIRING DIAGRAM  
INTERNAL CONNECTIONS FOR  
FREQUENCY OUTPUT  
FLOW METERS  
MODELS F-1100 / F-1200 / F-1300**

For use with serial numbers  
115692 and later



NOTES:

# FLOW METER WIRING INFORMATION

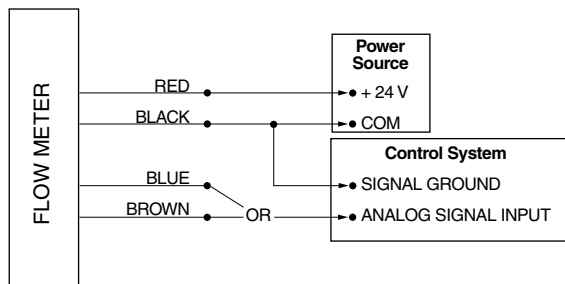
User Connections for Models with Non-Isolated Analog Outputs

Models: F-1110, F-1210, FB-1210 & F-1310

				<b>Wiring Information</b>		
F-1110 Single Turbine	F-1310 Inline	F-1210 Dual Turbine	FB-1210 Bi-Directional	WIRE COLOR CODE	NOTES	
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage Connect to power supply positive	
√	√	√	√	BLACK	(-) Common ground (Common with pipe ground) Connect to power supply negative & analog input ground	
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse Required when meter is connected to local display or BTU meter	
√	√	√	√	BLUE	(+) Analog signal: 4-20 mA (non-isolated) Both signals may be used independently (unless 0-5 V output is ordered)	
√	√	√	√	BROWN	(+) Analog signal: 0-10 V (non-isolated) (Can also be ordered as 0-5 V)	
			√	GRAY	Dry contact directional output - indicates flow direction Contact closed when flow is in direction of arrow on meter	
			√	VIOLET		
<b>DIAGNOSTIC SIGNALS</b>						
		√	√	ORANGE	Bottom turbine frequency These signals are for diagnostic purposes - connect to local display or BTU meter	
		√	√	WHITE	Top turbine frequency	

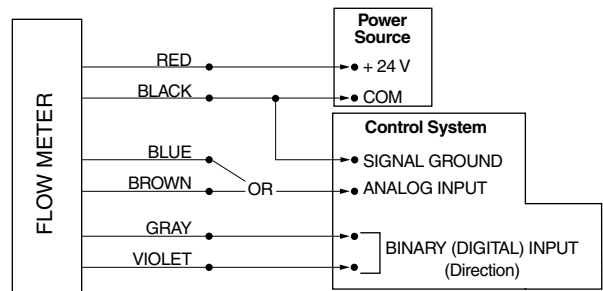
## F-1110 / F-1210 / F-1310 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



## FB-1210 Wiring Diagram

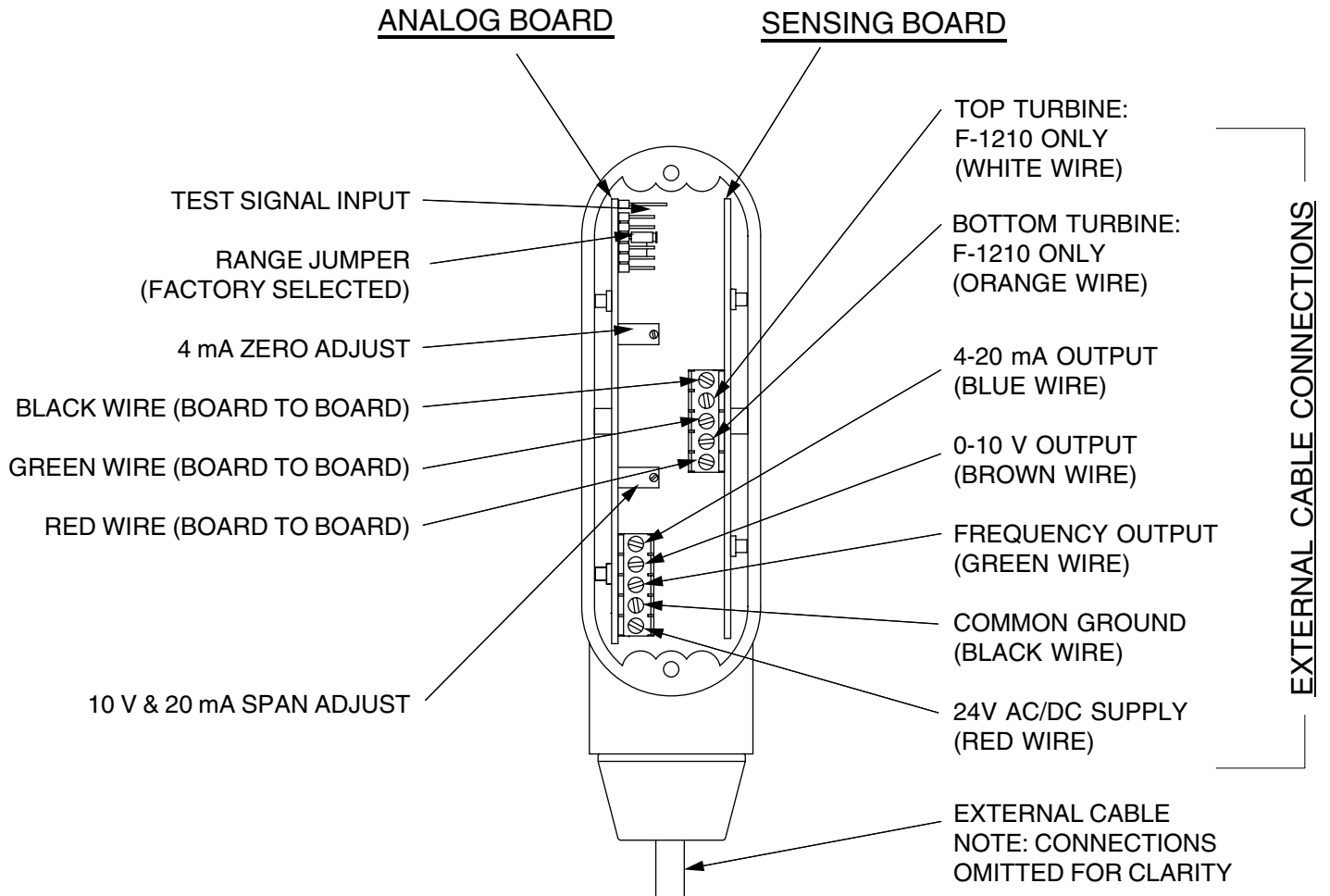
Connections to a Control System (No Display or BTU Meter)



- NOTES: \* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
  3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
  4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)

**WIRING DIAGRAM  
INTERNAL CONNECTIONS FOR  
NON-ISOLATED ANALOG OUTPUT  
FLOW METERS  
MODELS F-1110 / F-1210 / F-1310**

For use with serial numbers  
115692 and later



NOTES:

# FLOW METER WIRING INFORMATION

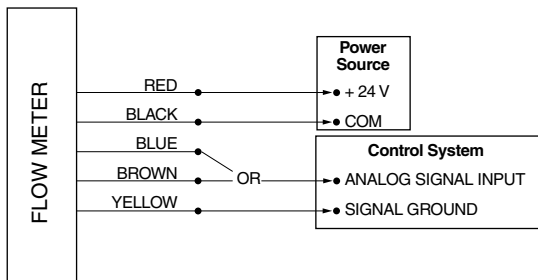
User Connections for Models with Isolated Analog Outputs

Models: F-1111, F-1211, FB-1211 & F-1311

				<b>Wiring Information</b>		
F-1111 Single Turbine	F-1311 Inline	F-1211 Dual Turbine	FB-1211 Bi-Directional	<b>WIRE COLOR CODE</b>		<b>NOTES</b>
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	(+) Analog signal: 4-20 mA (isolated)	Both signals may be used independently (unless 0-5 V output is ordered)
√	√	√	√	BROWN	(+) Analog signal: 0-10 V (isolated) (Can also be ordered as 0-5 V)	
√	√	√	√	YELLOW	(-) Isolated ground	Use for analog signals only
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
<b>DIAGNOSTIC SIGNALS</b>						
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

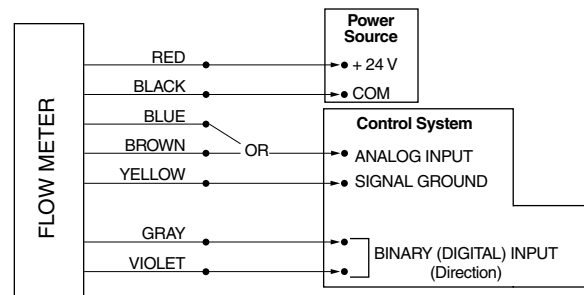
## F-1111 / F-1211 / F-1311 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



## FB-1211 Wiring Diagram

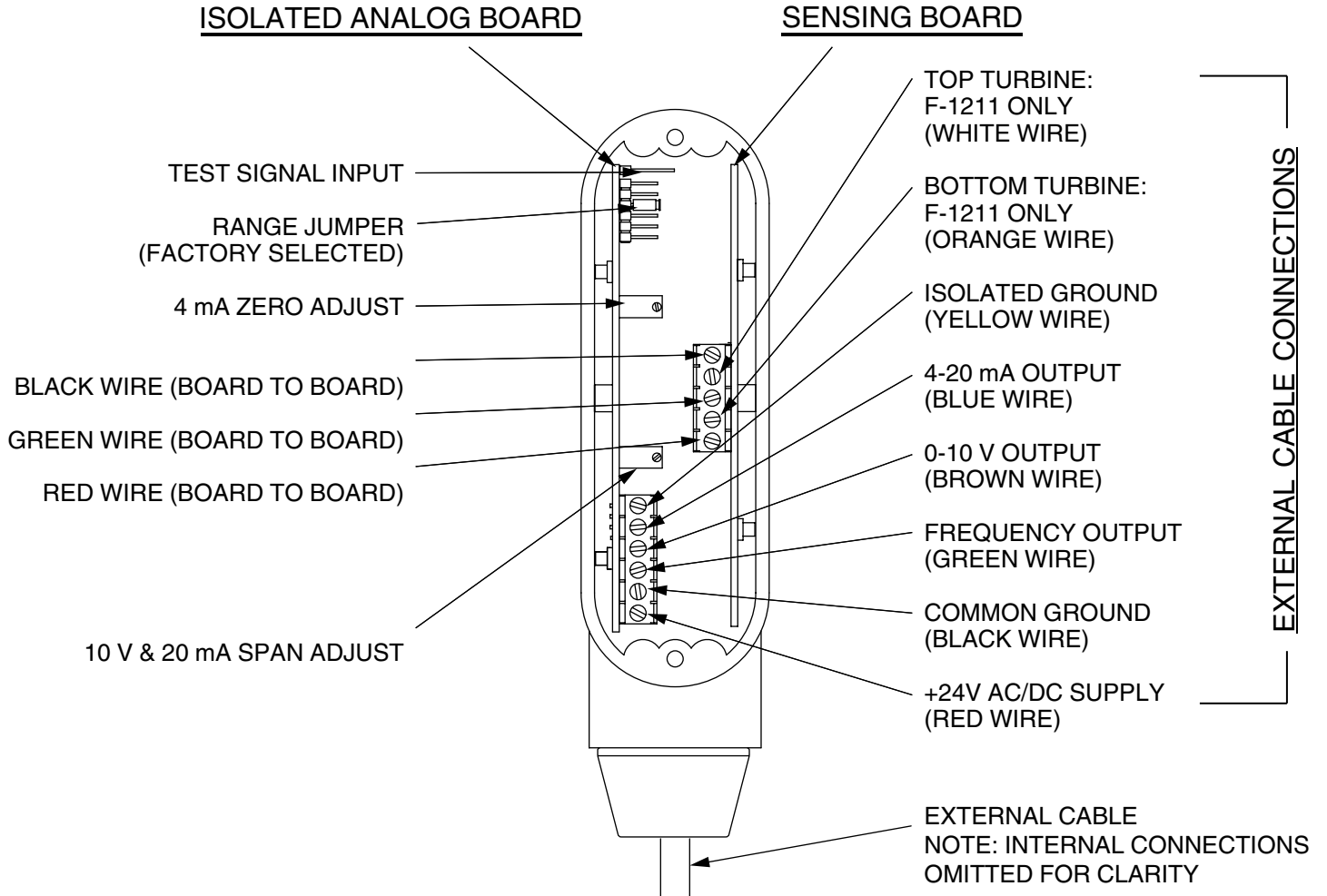
Connections to a Control System (No Display or BTU Meter)



- NOTES: \* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
  3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
  4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)

**WIRING DIAGRAM  
INTERNAL CONNECTIONS FOR  
ISOLATED ANALOG OUTPUT  
FLOW METERS  
MODELS F-1111 / F-1211 / F-1311**

For use with serial numbers  
115692 and later



NOTES:

# FLOW METER WIRING INFORMATION

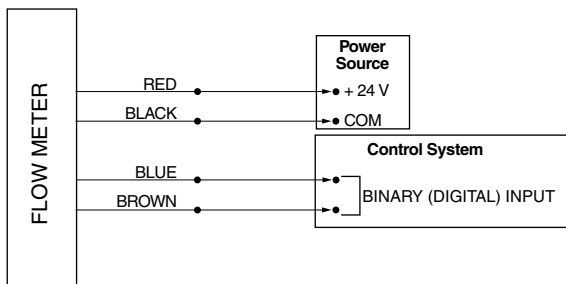
User Connections for Models with Divided Output

Models: F-1120, F-1220, FB-1220 & F-1320

				<b>Wiring Information</b>		
F-1120 Single Turbine	F-1320 Inline	F-1220 Dual Turbine	FB-1220 Bi-Directional	<b>WIRE COLOR CODE</b>		<b>NOTES</b>
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	Dry contact divided output - indicates flow rate	Output can be divided by any binary number up to 4096 to meet frequency limitations of control system
√	√	√	√	BROWN		
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				<b>DIAGNOSTIC SIGNALS</b>		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

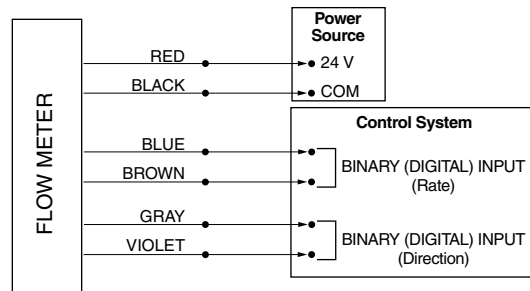
## F-1120 / F-1220 / F-1320 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



## FB-1220 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)

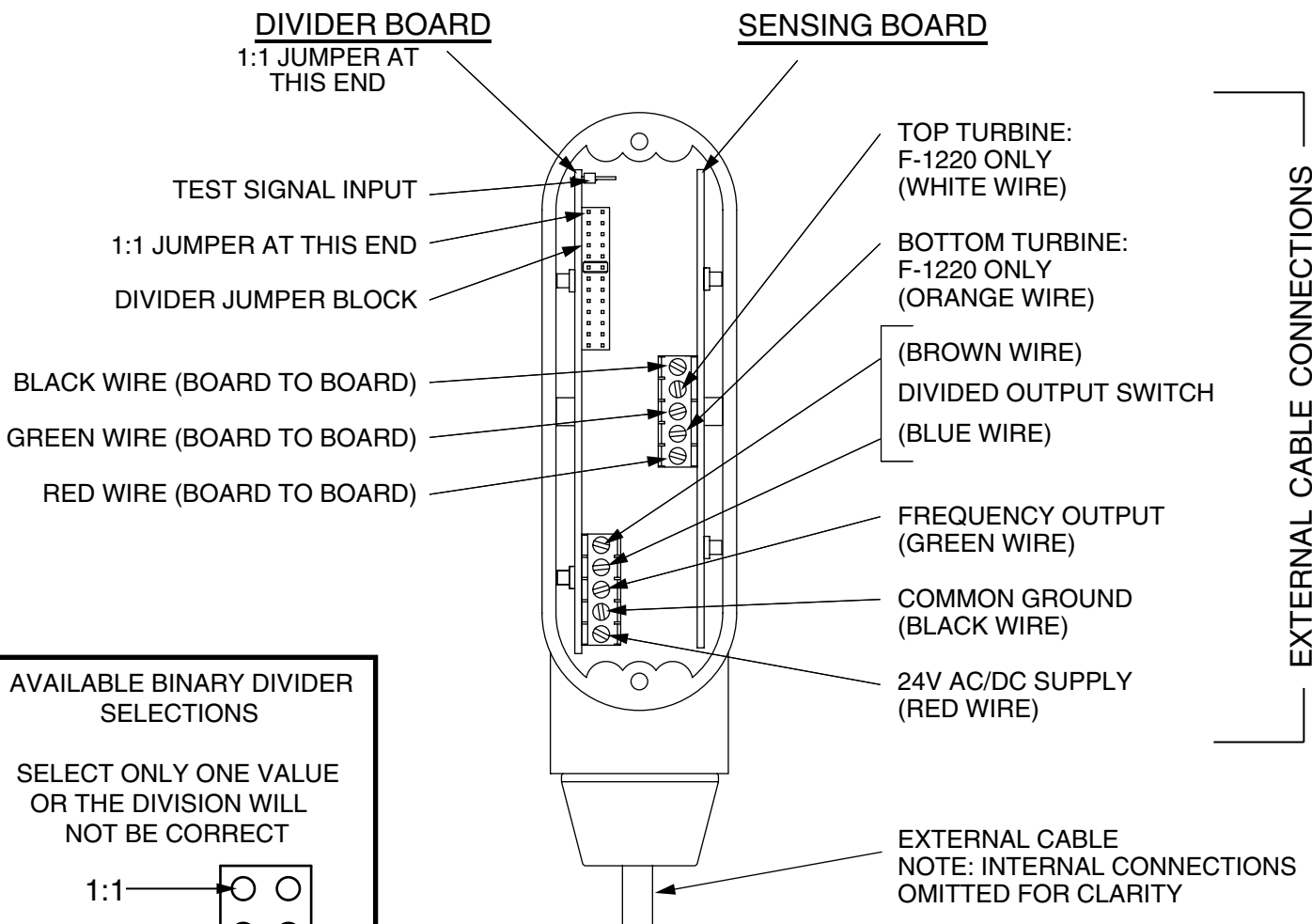


- NOTES: \* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.

# WIRING DIAGRAM INTERNAL CONNECTIONS FOR DIVIDED OUTPUT FLOW METERS MODELS F-1120 / F-1220 / F-1320



For use with serial numbers  
115692 and later



**AVAILABLE BINARY DIVIDER SELECTIONS**

SELECT ONLY ONE VALUE OR THE DIVISION WILL NOT BE CORRECT

1:1	○	○
1:2	○	○
1:4	○	○
1:8	○	○
1:16	○	○
1:32	○	○
1:64	○	○
1:128	○	○
1:256	○	○
1:512	○	○
1:1024	○	○
1:2048	○	○
1:4096	○	○

**NOTES:**

# FLOW METER WIRING INFORMATION

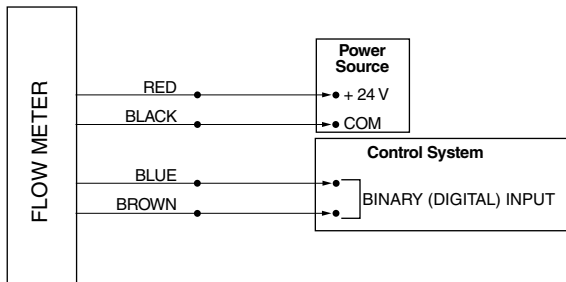
User Connections for Models with Scaled Output

Models: F-1130, F-1230, FB-1230 & F-1330

				<b>Wiring Information</b>		
F-1130 Single Turbine	F-1330 Inline	F-1230 Dual Turbine	FB-1230 Bi-Directional	<b>WIRE COLOR CODE</b>		<b>NOTES</b>
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	Dry contact scaled output	Scaled to provide one pulse per volumetric unit Examples: 1 pulse per 10 gal. 1 pulse per 100 gal.
√	√	√	√	BROWN		
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
<b>DIAGNOSTIC SIGNALS</b>						
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

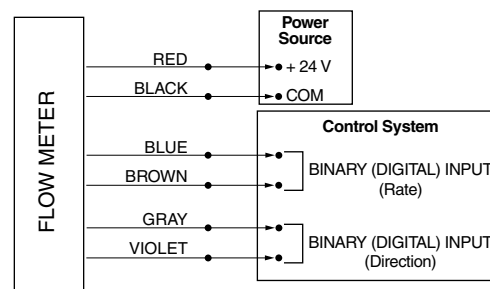
## F-1130 / F-1230 / F-1330 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



## FB-1230 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)

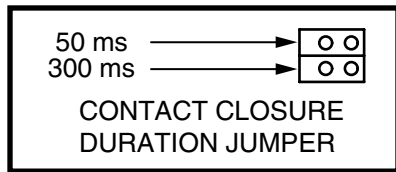
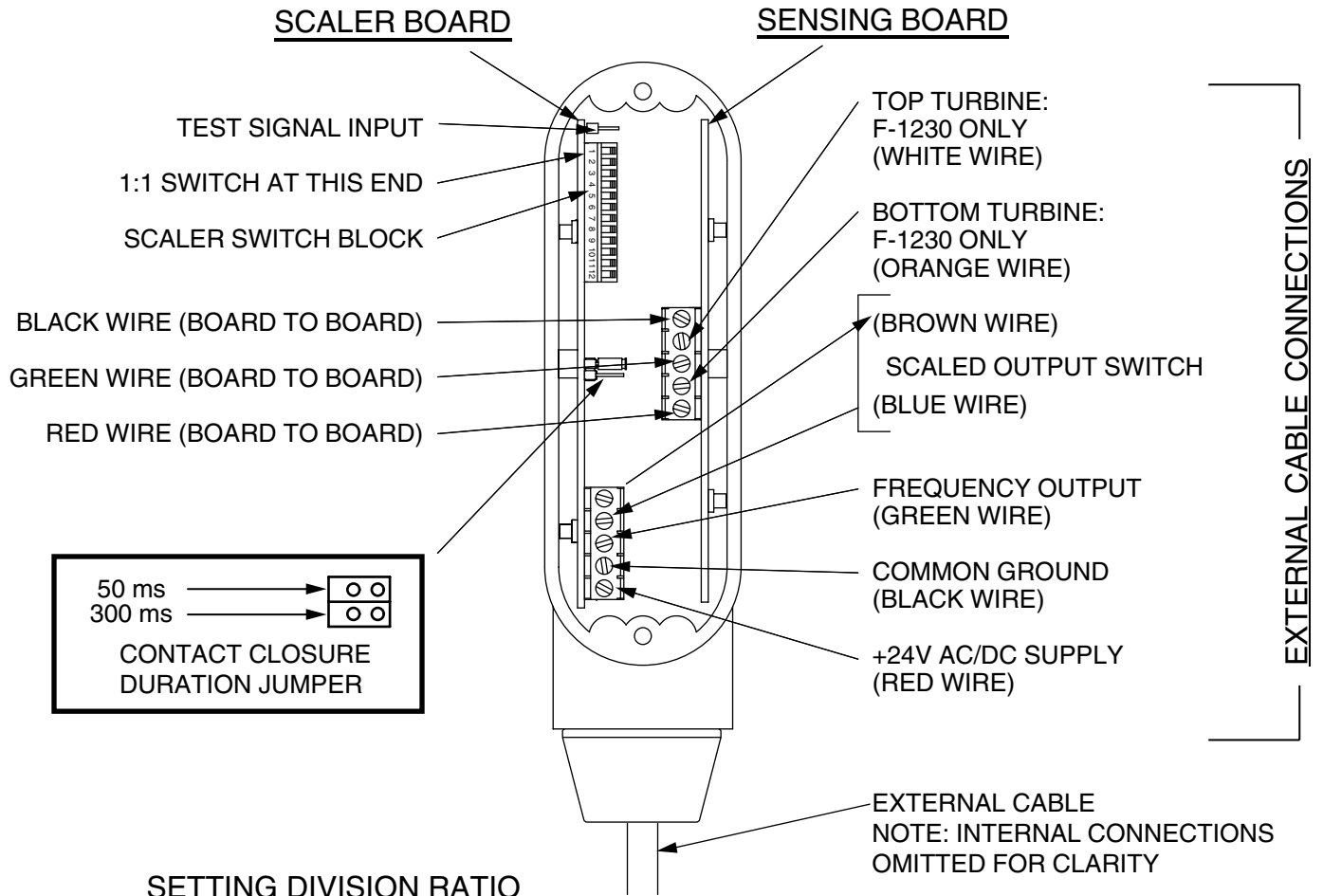


- NOTES:
- \* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
  2. Black wire is common with the pipe (typically earth ground).
  3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
  4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)



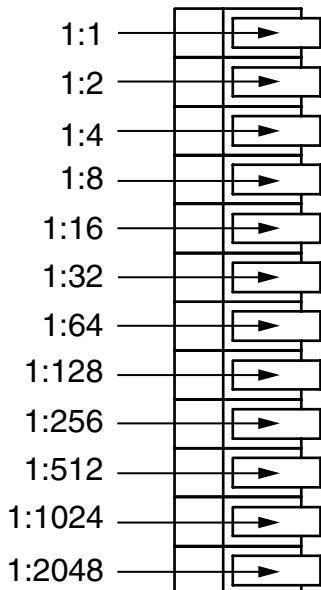
# WIRING DIAGRAM INTERNAL CONNECTIONS FOR SCALED OUTPUT FLOW METERS MODELS F-1130 / F-1230 / F-1330

For use with serial numbers  
115692 and later



## SETTING DIVISION RATIO

Available binary  
scaler selections



To set division ratio, turn ON each  
switch that is required to produce  
an arithmetic sum equal to the  
desired ratio. For example:

SW	VAL
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048

DESIRED RATIO = 629

Subtract the largest  
possible switch value.

$$629 - 512 = 117$$

$$117 - 64 = 53$$

$$53 - 32 = 21$$

$$21 - 16 = 5$$

$$5 - 4 = 1$$

$$1 - 1 = 0$$

$$512 + 64 + 32 + 16 + 4 + 1 = 629$$

SET SWITCHES

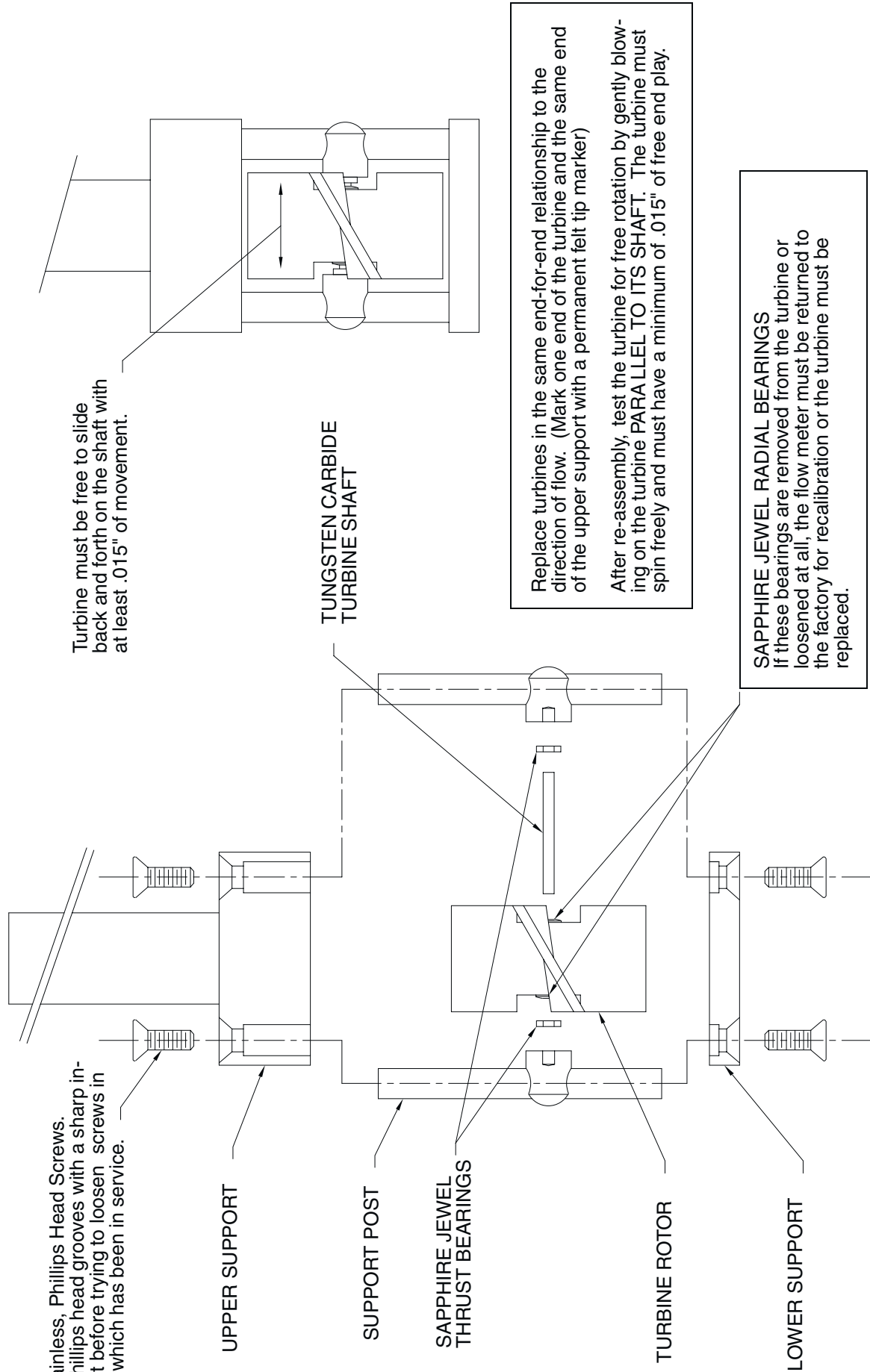
10, 7, 6, 5, 3, & 1  
TO "ON"

NOTES:

**APPENDIX B**

**Turbine Assembly Detail Drawings**

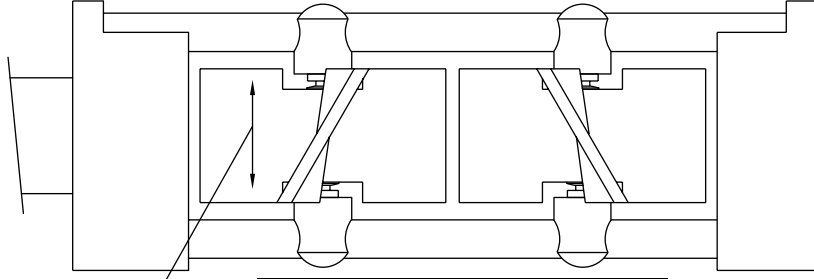
# TURBINE ASSEMBLY DETAILS for ALL MODELS IN F-1100 SERIES





**TURBINE ASSEMBLY DETAILS**  
for  
**ALL MODELS IN F-1200 SERIES**

2-56 STAINLESS, PHILLIPS HEAD SCREWS.  
Clean phillips head grooves with a sharp instrument before trying to loosen screws in a meter which has been in service.

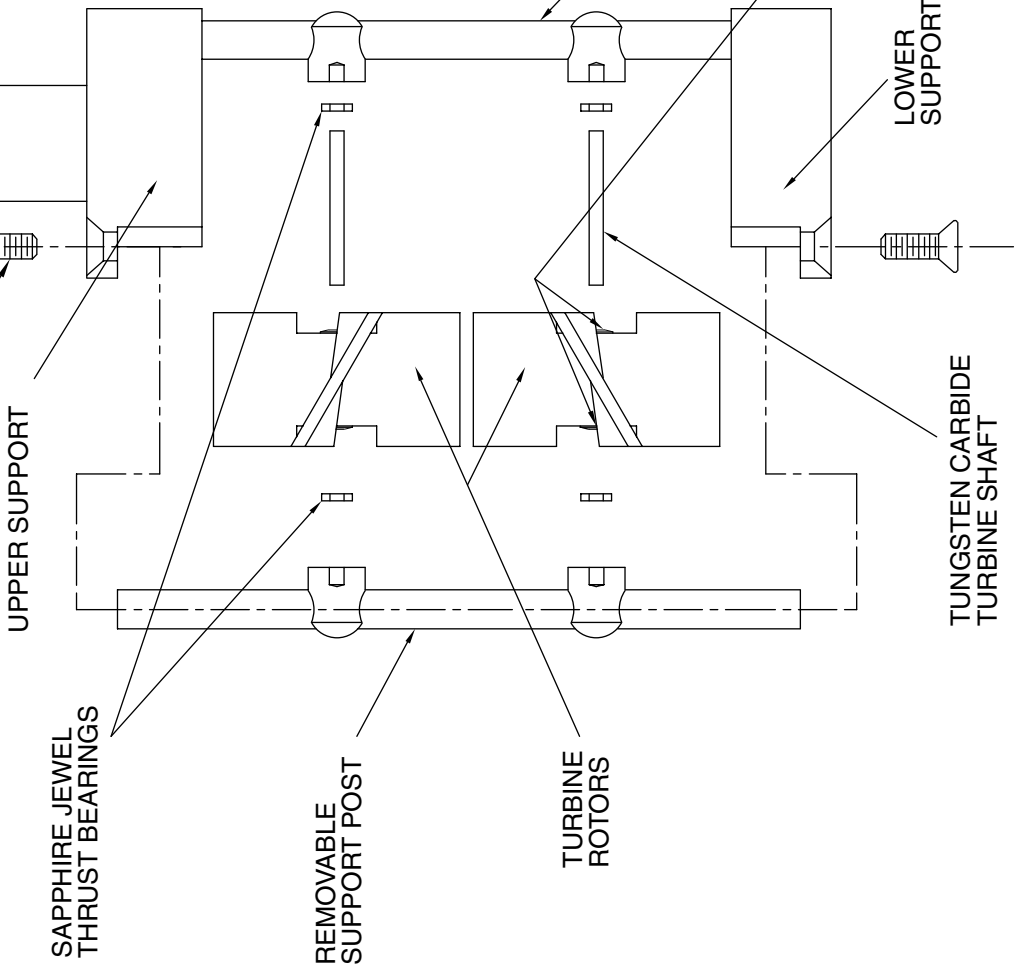


Turbines must be free to slide back and forth on the shaft with at least .015" of movement.

Replace turbines in the same upper or lower location and in the same end-for-end relationship to the direction of flow. (Mark one end of each turbine and the same end of the upper support with a permanent felt tip marker)

After re-assembly, test the turbines for free rotation by gently blowing on the turbines **PARALLEL TO THEIR SHAFTS**. The turbines must spin freely and must have a minimum of .015" of free end play.

**SAPPHIRE JEWEL RADIAL BEARINGS**  
If these bearings are removed from the turbines or loosened at all, the flow meter must be returned to the factory for recalibration or the turbines must be



UPPER SUPPORT

SAPPHIRE JEWEL THRUST BEARINGS

REMOVABLE SUPPORT POST

TURBINE ROTORS

NON-REMOVABLE SUPPORT POST

LOWER SUPPORT

TUNGSTEN CARBIDE TURBINE SHAFT

**APPENDIX C**

**Conditions of Sale**

## CONDITIONS OF SALE

1. **ACCEPTANCE:** The following Conditions of Sale apply to all sales of ONICON's products. These provisions shall apply even if ONICON fails to object to provisions appearing on, incorporated by, referenced in, or attached to Buyer's purchase order form. Buyer's acceptance of delivery of ONICON's products constitutes its acceptance of these Conditions of Sale.

2. **DELIVERY AND TITLE:** All product shipments are F.O.B. shipping point and title passes to the Buyer at the time ONICON delivers the merchandise to the carrier. Risk of loss or damage to the product passes to the Buyer at the time ONICON delivers the product to the carrier. The Buyer immediately upon receipt should inspect all shipments, and should there be any evidence of damage or loss in transit, Buyer must file claims or tracers upon carrier. ONICON will assist in tracing shipments upon request.

3. **LIMITED WARRANTY:** ONICON warrants that for a period of two (2) years following the date of original shipment of an ONICON product: (i) the product will conform to ONICON's standard written specifications applicable to such product in effect on the date of Buyer's order, or as modified by ONICON's quotation or Buyer's purchase order accepted by ONICON, (ii) the product will be free from defects in workmanship, and (iii) that ONICON has title to the product prior to shipment to the Buyer; provided, however, that the warranties provided herein shall be void and may not apply in the event Buyer misuses or damages a product, including, but not limited to, any use by the Buyer of a product for an application other than one of a type approved by ONICON. ONICON's sole liability and Buyer's sole remedy for any breach of the foregoing warranty is for ONICON to repair or replace, at ONICON's option, any defective product that is returned to ONICON during the warranty period. EXCEPT AS MAY BE SPECIFICALLY AGREED BY ONICON IN WRITING IN RELATION TO EACH SALE, NO OTHER WARRANTIES SHALL APPLY, WHETHER EXPRESSED, IMPLIED OR STATUTORY, AND THERE SHALL BE NO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

4. **REMEDIES:** ONICON's OBLIGATION UNDER THE FOREGOING WARRANTIES IS LIMITED SOLELY TO REPAIR OR REPLACEMENT, AT ONICON'S OPTION, OF DEFECTIVE OR NONCONFORMING PRODUCTS. ONICON SHALL NOT BE LIABLE FOR CONSEQUENTIAL, INDIRECT, PUNITIVE, INCIDENTAL, OR SPECIAL DAMAGES WHETHER FOUND ON CONTRACT, TORT OR ANY OTHER THEORY OF LAW. No products shall be returned to ONICON without its prior consent and transportation and insurance costs shall be prepaid. Any repair or replacement of ONICON's products under the foregoing warranty will be at no charge to the Buyer provided such repair is done at the ONICON factory or authorized service center. ONICON products that are repaired or replaced under this warranty will be returned to Buyer via the same method of shipment used to return the product to ONICON. Repair or replacement of ONICON products is conditioned upon ONICON's acknowledgement of any alleged defect or nonconformance during the warranty period and issuance of a Return Authorization number. All product returns must reference the Return Authorization number on the outside of the shipping carton and on any paperwork referencing the return.

5. **PRICES AND PAYMENT TERMS:** The prices set forth in the most recent quote or acknowledgement as applicable, supersede all previous prices or quotations. All quotations are subject to change or withdrawal without notice except as may be specifically noted on the face of the quotation. The prices shown do not include sales, excise or government charges payable by ONICON to Federal, State, or local authority. Any such tax or charge now or hereafter imposed upon the sale or shipment of the products under this contract will be added to the purchase price. Buyer agrees to reimburse ONICON for such tax or charge or provide ONICON with an acceptable exemption certificate. Payment of invoices will be due 30 days from the date of shipment of the products contained therein. In the event that payment of an invoice is not received by the invoice due date, ONICON will assess a late fee not to exceed 1.5% per month or 18% per year, or the maximum allowable by law whichever is lower.

6. **CANCELLATION:** Buyer may cancel its order, or any part of it, by sending written notice of cancellation to ONICON and paying a reasonable cancellation fee as determined by ONICON. The reasonable cancellation fee will reflect, among other factors, the expenses already incurred and commitments made by ONICON, sales and administrative costs and profit as determined by ONICON. If Buyer received a reduced price based on the quantity of products ordered, but has not purchased the applicable quantity at the time of cancellation, Buyer will pay the price it would have paid had ONICON's sale price been based on the quantity actually purchased.

7. **CHANGES:** If Buyer makes any changes in its drawings, designs, or specifications applicable in any contract with ONICON that cause an increase or decrease in the cost of performance of the contract, or if such changes result in rework or obsolescence, an equitable adjustment shall be made to the contract. Such changes are subject to ONICON's prior written consent.

8. **EXCUSABLE DELAY:** ONICON shall under no circumstance be responsible for failure to fill any order or orders when due to: fires, floods, riots, strikes, freight embargoes or transportation delays, shortage of labor, inability to secure fuel, material supplies, or power at current price or on account of shortages thereof, acts of God or of the public enemy, any existing or future laws or acts of the Federal or State Government (including specifically, but not exclusively, and orders, rules or regulations issued by any official or agency of any such government) affecting the conduct of ONICON's business with which ONICON in its judgment and discretion deems it advisable to comply as a legal or patriotic duty, or due to any cause beyond ONICON's reasonable control.

9. **PATENTS:** ONICON shall defend all suits or proceedings brought against Buyer or its customers arising from claimed infringements of any patent, trademark, service mark or copyright for any product furnished by ONICON and shall indemnify it against all costs, fees, and damages on the condition Buyer promptly notifies ONICON in writing and provides information and assistance to enable ONICON to conduct the defense, provided that ONICON shall have no such obligation in case of infringement resulting from ONICON's conformance to special requirements of Buyer. If ONICON is not able to settle any such suit or proceeding on acceptable terms, ONICON may, at its option, require return of the infringing product and refund the purchase price to Buyer less a reasonable allowance for depreciation or use.

10. **FAIR LABOR STANDARDS ACT:** ONICON represents that all products delivered under this contract are furnished in accordance with the applicable provisions of the Fair Labor Standards Act as amended.

11. **APPLICABLE LAW:** This document and any resulting contract shall be governed by and construed in accordance with the laws of the State of Florida. The courts of the State of Florida and the federal courts located in Florida shall have jurisdiction and venue with respect to litigation to this contract. In the event of litigation, the prevailing party shall be entitled to recover attorney's fees and costs from the non-prevailing party, including appellate attorney's fees.

12. **MODIFICATIONS:** These Conditions of Sale along with the prices, quantities delivery schedules and other provisions and instructions in applicable quotations by shall constitute the entire agreement between ONICON and Buyer pertaining to any resulting contract. They can be modified only in writing.