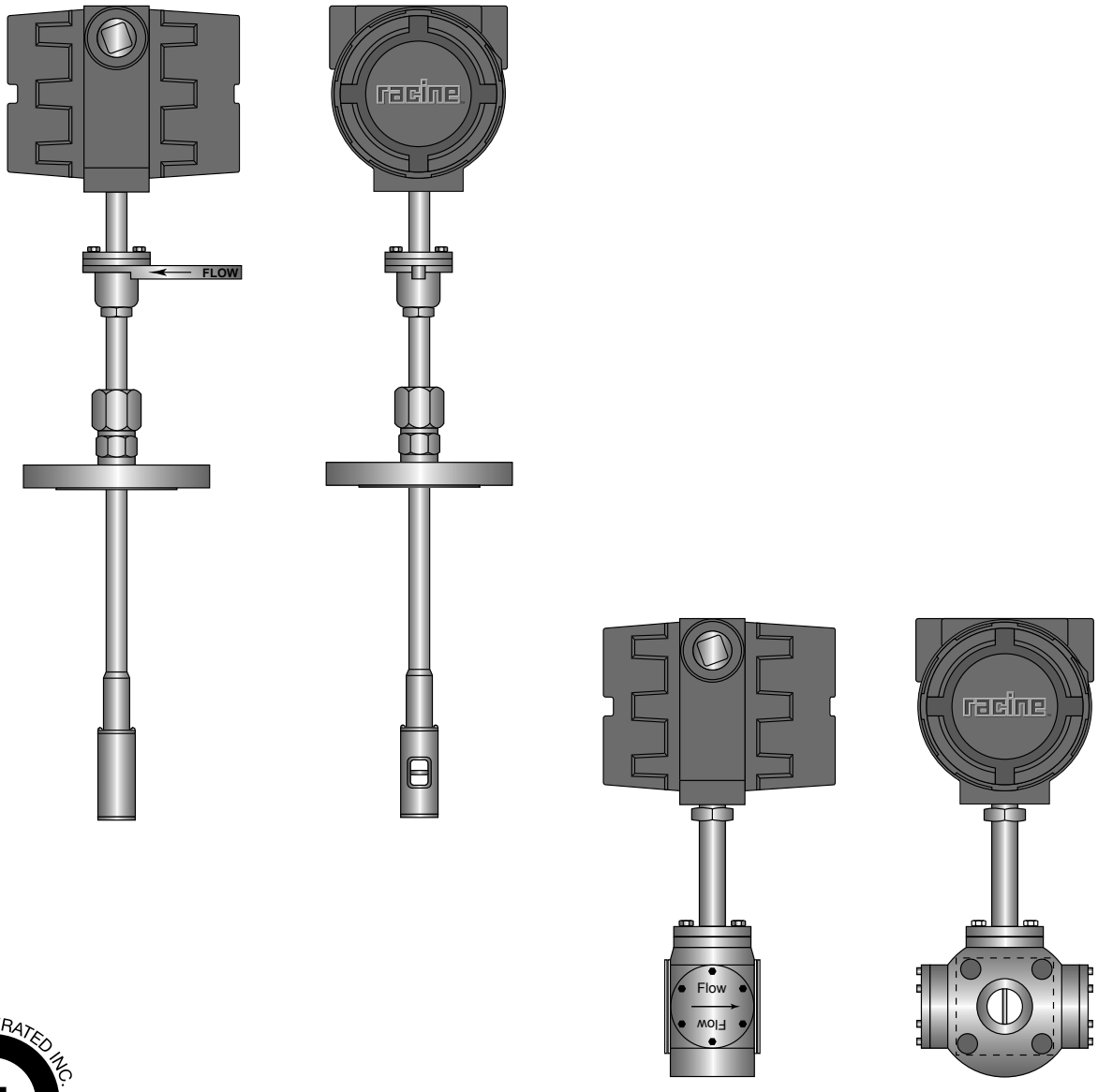
racine™ Operator's Manual

RWG/RWS Wafer-Style Flow Meter
RNG/RNS Insertion-Style Flow Meter



RACINE FEDERATED INC.
UL REGISTERED FIRM
ISO 9001:2008 10001652 QM08

RV-1000-R5

Tel: 262-639-6770 **Toll Free: 888-572-2463**

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIXES

INTRODUCTION

The RNx/RWx series vortex shedding flow meter family is designed to provide accurate and repeatable gas or steam flow measurement. These meters employ a patented ultrasonic technique to measure a form of turbulence created in the flow stream. This turbulence, known as the Von Karman Vortex Street, is related to the flow through the pipe.

The RNx/RWx series flow meter is a digital signal processing device, with HART® compatible communications. The primary output of the meter is a 2 wire, 4-20 milliampere (mA) current which is proportional to the flow.

With HART® Communications, users have the capability to remotely configure the meter. Typical operations, like re-scaling the analog output, can be performed in comfort using a standard PC or HART® 275/375 Communicator.

The **wafer-style** meters are for pipe diameters four inches or less, and are installed between 150 lb. flanges, or are manufactured with pipe extensions and 150 lb. (300 lb. optional) flanges welded on the ends. These meters are calibrated in volumetric flow units, e.g. Actual Cubic Feet per Minute (ACFM). Flow rates for the wafer-style meters are listed in ***Tables 2 and 3***.

The **insertion-style** meters are retractable meters that are installed through the wall of a pipe or duct larger than four inches. These meters can be installed through a 2″ full port valve, which permits the unit to be retracted or inserted manually without shutting down the system.

DANGER: Caution should be used when inserting or retracting at pressures exceeding 60 PSIG (4.14 BARg).

Flow rates for the insertion-style meters are shown in ***Tables 4 and 5***.

TABLE 1 - SPECIFICATIONS

Parameter	Wafer		Insertion	
	Gas / Air	Steam	Steam	Gas / Air
Mounting Requirements	Mounts between two 150 lb. flanges		Options for 2" NPT, 2" 150# Flange, 2" 300# Flange, DN50 Flange	
Operating Pressure	-5 to +250 PSIG (-0.34 to +17 BARg)	-5 to +150 PSIG (-0.34 to +10.3 BARg)		-5 to +250 PSIG (-0.34 to +17 BARg)
Operating Temperature	-20 °F to +360 °F (-28 °C to +182 °C)	-20 °F to +366 °F(-28 °C to +186 °C)		-20 °F to +300 °F (-28 °C to +149 °C)
Ambient Temperature	-20 °F to +155 °F (-28 °C to +68 °C)			
Accuracy	±1% of Reading over the upper 90% of the flow range			
Repeatability	0.5% of Reading			
Input Power	+24 VDC*			
Output	Primary - 4-20 mA (2 wire)			
Load Limits	***See Figure D***			

*The meter requires a minimum of 21 VDC for HART® Communications with a 250 Ω resistor and no load

TABLE 2: *FLOW RANGE FOR RWG SERIES*

Gas / Air Application

Model	Pipe Size inch (mm)	Flow ACFM (m³/hr)	
		Minimum	Maximum
RWG05	0.5 (13)	0.4 (0.7)	16 (27)
RWG10	1 (25)	1.2 (2.0)	45 (77)
RWG15	1.5 (38)	2.0 (3.4)	100 (170)
RWG20	2 (50)	5.0 (8.5)	200 (340)
RWG30	3 (76)	10.0 (17.0)	400 (680)
RWG40	4 (102)	20.0 (34.0)	600 (1019)

TABLE 3: *FLOW RANGE FOR RWS SERIES*

Steam Application

Model	Pipe Size inch (mm)	Flow ACFM (m³/hr)	
		Minimum	Maximum
RWS05	0.5 (13)	0.40 (0.7)	10 (17)
RWS10	1 (25)	1.25 (2.1)	35 (59)
RWS15	1.5 (38)	3 (5.1)	100 (170)
RWS20	2 (50)	5 (8.5)	160 (272)
RWS30	3 (76)	13 (22.1)	320 (544)
RWS40	4 (102)	23 (39.0)	480 (816)

TABLE 4: *VELOCITY RANGE FOR RNG SERIES*

Gas / Air Application

Model	Pipe Size inch (mm)	Velocity - fps (mps)	
		Minimum	Maximum
RNG	4 (102)	2 (0.6)	140 (43)
	6 (152)		
	8 (203)		
	10 (254)		

TABLE 5: *VELOCITY RANGE FOR RNS SERIES*

Steam Application (see Notes)

Model	Pipe Size inch (mm)	Velocity - fps (mps)	
		Minimum	Maximum
RNS	6 (152)	5 (1)	125 (38)
	8 (203)		
	10 (254)		
	12 (305)		

Flow measured in feet / second @ 14.69 PSIA, 60 °F (meter / second @ 1.013 BAR, 16 °C)

Notes for Table 5 *When pressure is 0 to 25 PSIG, the range is 5 to 125 FPS (1 to 38 MPS).*
When pressure is 25 to 60 PSIG, the range is 5 to 158 FPS (1 to 48 MPS).
When pressure is greater than 60 PSIG, the range is 5 to 175 FPS (1 to 53 MPS).

INSTALLATION

The flow meter is shipped completely assembled, tested and ready to install in its permanent location. ***See Figures B1 thru B5*** for the applicable outline dimensions for specific meters.

Installation Location

The RNx/RWx series meters use ultrasonics to measure flow. An ultrasonic noise can interfere with this technique, therefore high intensity, ultrasonic noise sources should not be located upstream or downstream from the meter. Common mechanical ultrasonic noise sources include the following:

- Slightly cracked valves operating with large pressure drops.
- Small pipe leaks in high pressure systems.
- Venturies operating at near-sonic flow rates.
- Sonic nozzles.

If these ultrasonic noise sources cannot be eliminated, the meter should be mounted with at least one elbow between the flow meter and the noise source.

Mechanical Installation

The meter should be installed with at least 20 pipe diameters of straight pipe upstream and 10 pipe diameters downstream. This condition provides the fully developed, symmetrical flow profile that is necessary to obtain accurate and repeatable results. Shorter upstream/down-

stream piping may be used although a shift in calibration may occur. If severe turbulence or distorted flow profiles are present, flow straighteners should be used. ***See Appendix A*** for additional installation information.

Meter Installation

The labeling of the flow direction on the meter should be aligned with the flow in the pipe. If liquids or condensate can be present in the flow, the meter should be installed so that liquids will not accumulate on the ultrasonic transducers (the small buttons on either side of the vortex strut).

The RWG/RWS series **wafer** meters are designed to mount between two ANSI 150 lb. flanges. The meter should be mounted so its inside diameter is centered inside the pipe (***see Figure A***).

Note: *Gaskets (not provided) are necessary between the sensor and the ANSI flanges. Ensure that these gaskets are properly installed and do not protrude into the flow stream.*

CAUTION: Avoid bending the vortex strut or damaging the transducers during installation. Do not remove cover plates while unit is operating.

The RNS/RNG series **insertion** meters are designed to mount on a standard ANSI 150 lb., 2″ pipe flange. The measuring window should be installed in the center of the line for line sizes 12 inches or less (***see Figures B4 and B5***). For line sizes larger than 12 inches, the measuring window should be installed 25% to 50% of the way into the pipe. It is recommended that the internal dimensions of the line be measured for accurate readings.

Insertion meters can be used in any size pipe four inches and larger in diameter. In order to calculate accurate volumetric, mass, and standard flow measurements, it is recommended to enter the exact pipe size into the meter. Normally this operation, along with overall meter configuration, is performed at the factory. However, the user can enter the pipe diameter on site using the Racine HART Interface or a HART® 275/375 communicator.

Note: *The torque requirement for the fitting is 50-60 ft. lbs. (**see Figures B4 & B5**). **See Appendix A** for additional installation information and flow profiling.*

The RWGxxF/RWSxxF series **flanged** meters are designed to mount between two ANSI 150 lb. flanges (300 lb. optional) (***see Figure B3***).

Note: *Gaskets (not provided) are necessary between the ANSI flanges. Ensure that these gaskets are properly installed and do not protrude into the flow stream.*

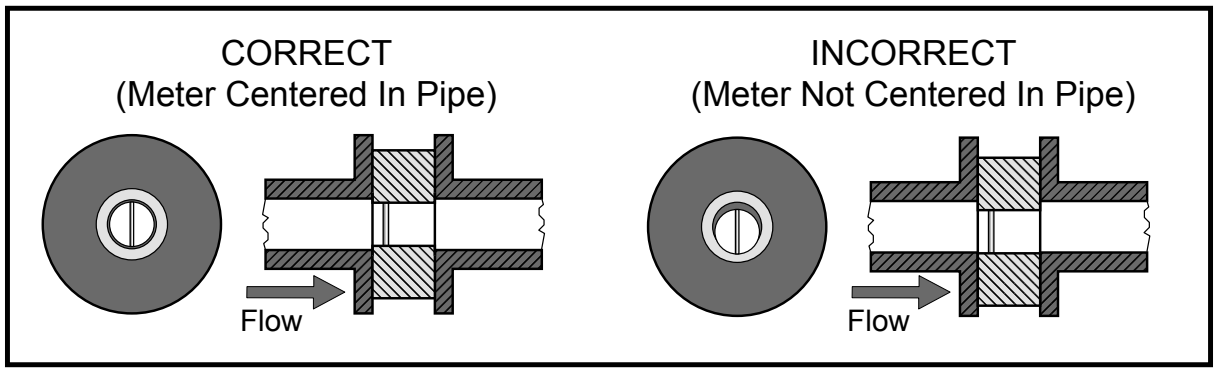
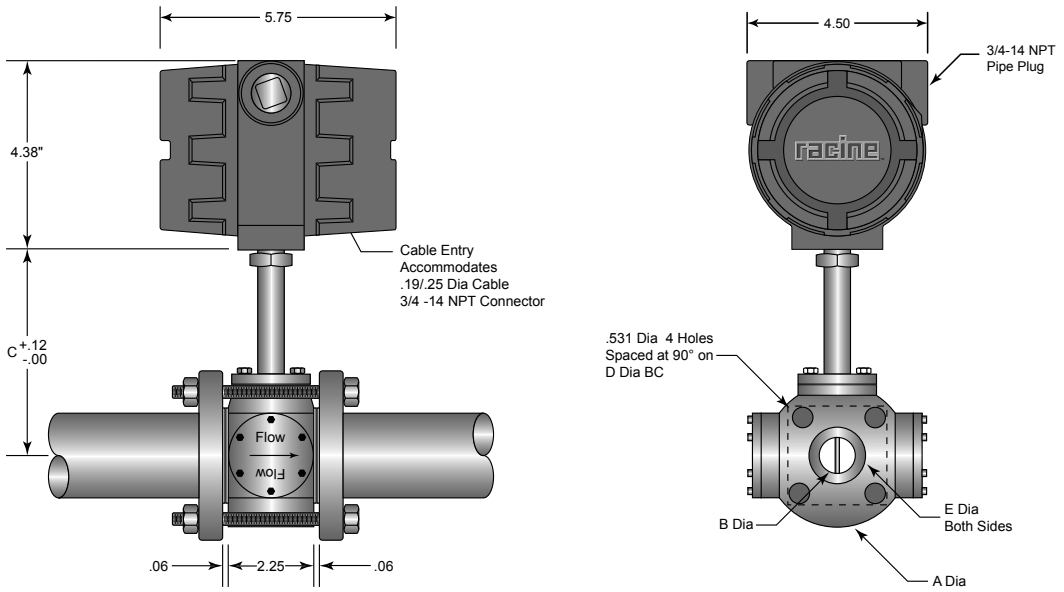
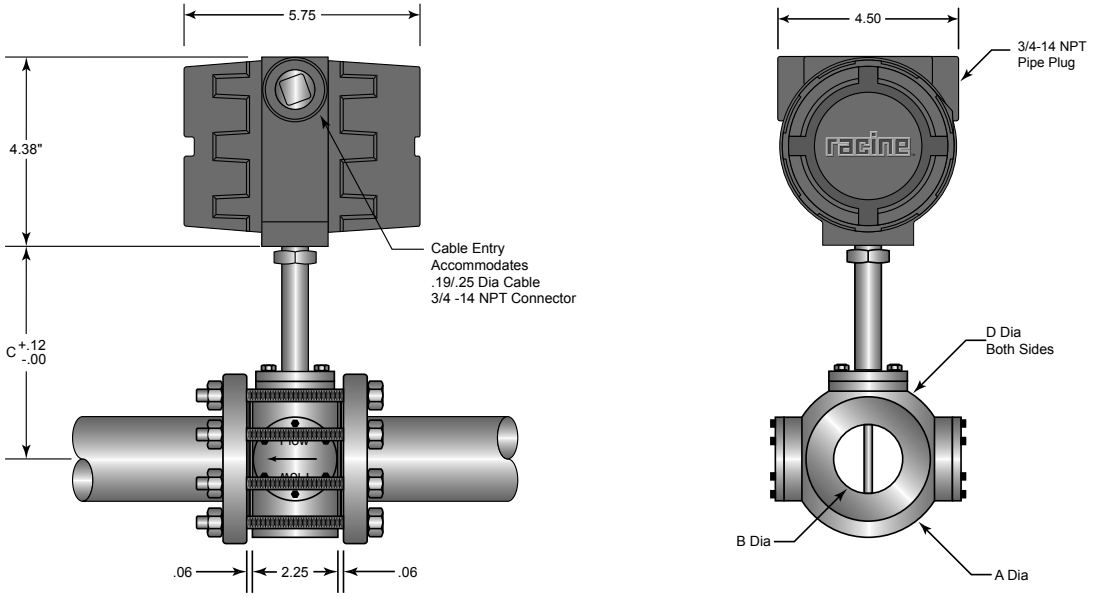


FIGURE A - INTERNAL ALIGNMENT OF WAFER STYLE FLOW METERS



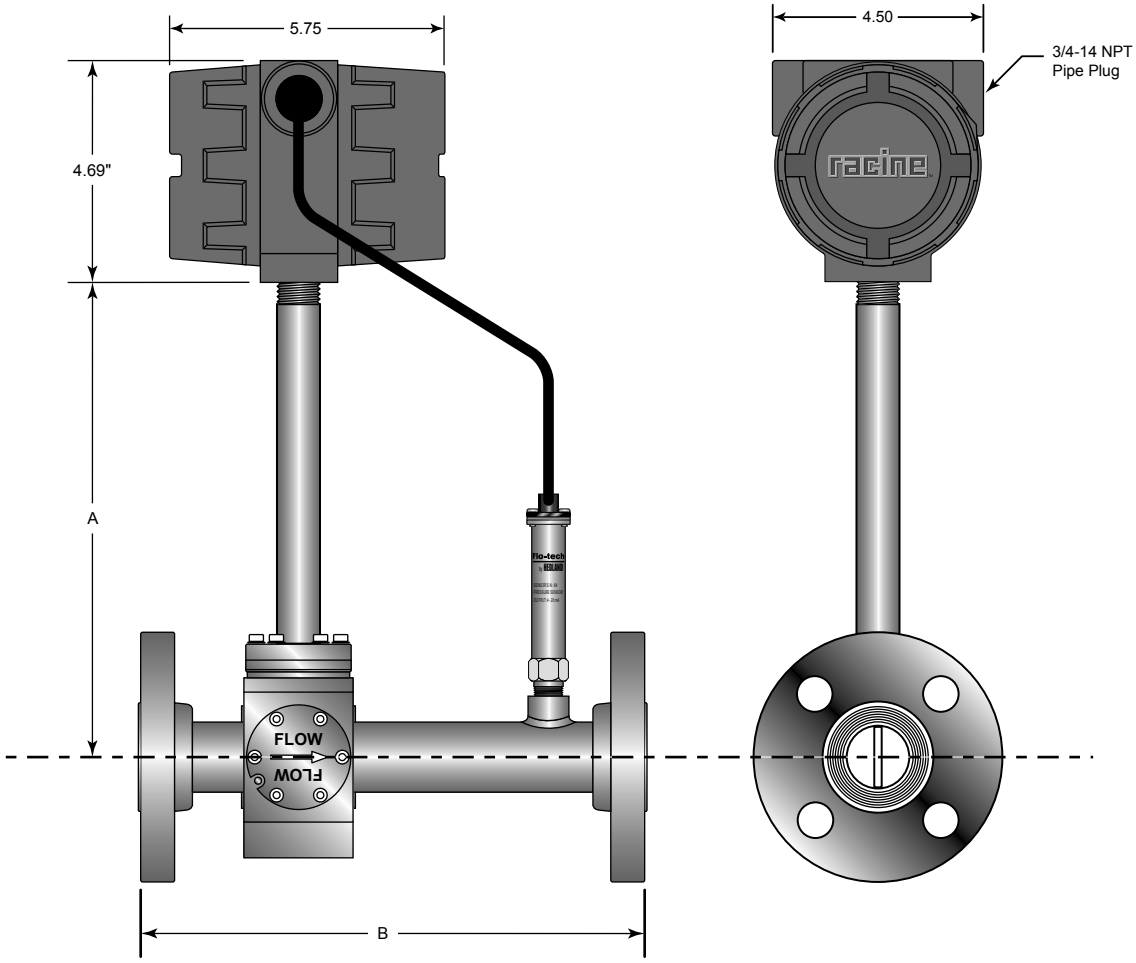
Diameter A	Diameter B	GAS/AIR		STEAM		Dimension D	Dimension E	Dimension F
		Model	Dimension C	Model	Dimension C			
3.50 (89)	0.50 (13)	RWG05	5.60 (142)	RWS05	9.47 (241)	2.38 (61)	2.25 (57)	1.38 (35)
3.97 (101)	0.88 (22)	RWG10	5.78 (147)	RWS10	9.65 (245)	3.12 (79)	2.12 (54)	2.00 (51)
4.72 (120)	1.38 (35)	RWG15	6.34 (161)	RWS15	10.21 (259)	3.88 (99)	2.12 (54)	2.88 (73)
All dimensions are in inches (mm)								

FIGURE B1 - ½", 1", AND 1½" METERS



Diameter A	Diameter B	GAS/AIR		STEAM		Diameter D
		Model	Dimension C	Model	Dimension C	
3.97 (101)	1.75 (45)	RWG20	5.92 (150)	RWS20	9.79 (249)	3.15 (80)
5.22 (133)	2.75 (70)	RWG30	6.62 (168)	RWS30	10.49 (267)	4.55 (116)
6.87 (174)	3.75 (95)	RWG40	7.52 (191)	RWS40	11.39 (289)	6.19 (157)
All dimensions are in inches (mm)						

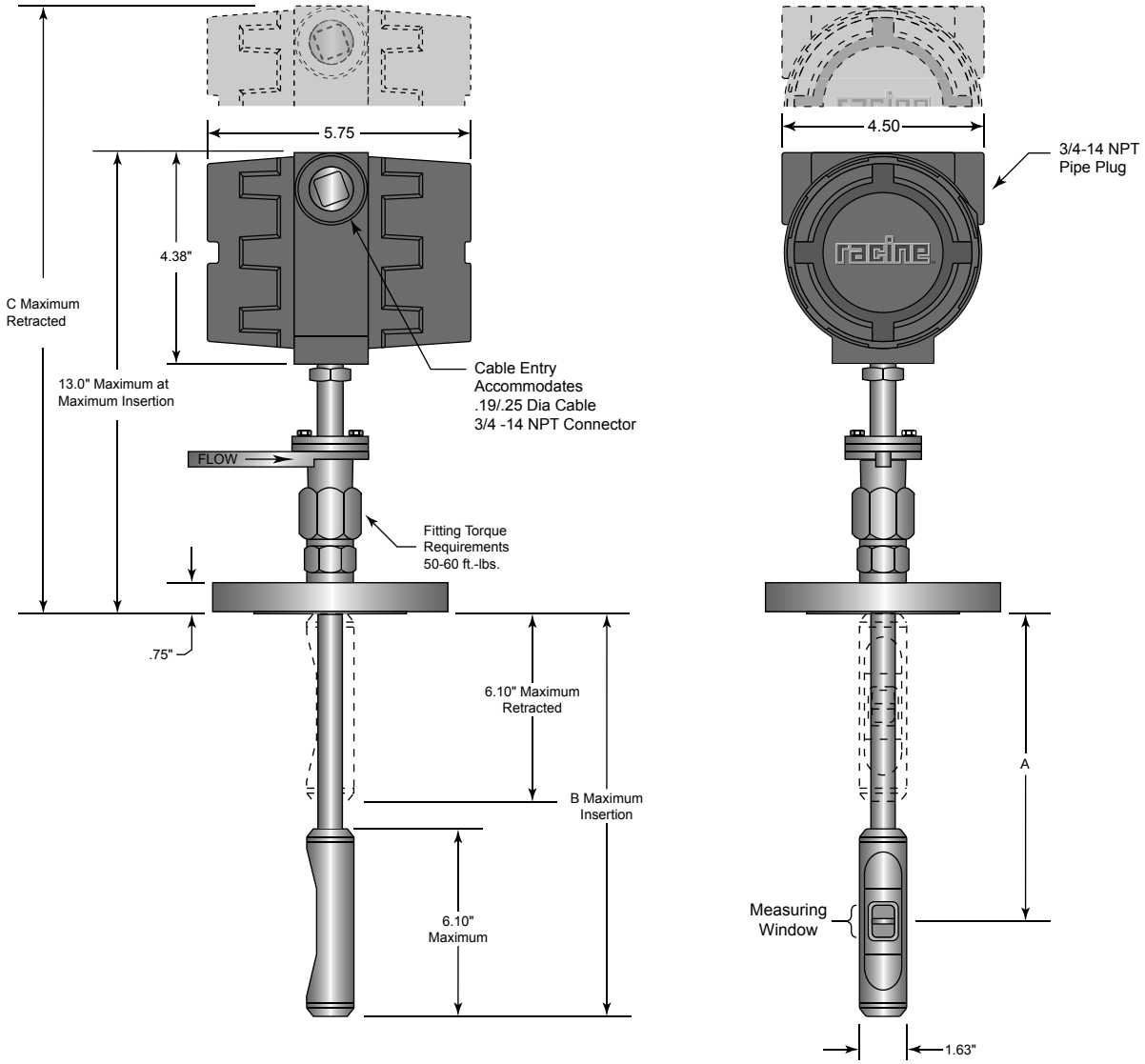
FIGURE B2 - 2", 3", AND 4" METERS



SIZE	DIM B	DIM A			
		GAS/AIR		STEAM	
½″	9.88 - 10.00 (250- 254)	RWG05F15*	5.60 (142)	RWS05F15*	9.47 (241)
1″	9.88 -10.00 (250- 254)	RWG10F15*	5.78 (147)	RWS10F15*	9.65 (245)
1½″	9.88 -10.00 (250- 254)	RWG15F15*	6.34 (161)	RWS15F15*	10.21 (259)
2″	9.88 -10.00 (250- 254)	RWG20F15*	5.92 (150)	RWS20F15*	9.79 (249)
3″	11.88 - 12.00 (301- 304)	RWG30F15*	6.62 (168)	RWS30F15*	10.49 (267)
4″	11.88 - 12.00 (301- 304)	RWG40F15*	7.52 (191)	RWS40F15*	11.39 (289)
All dimensions are in inches (mm)					

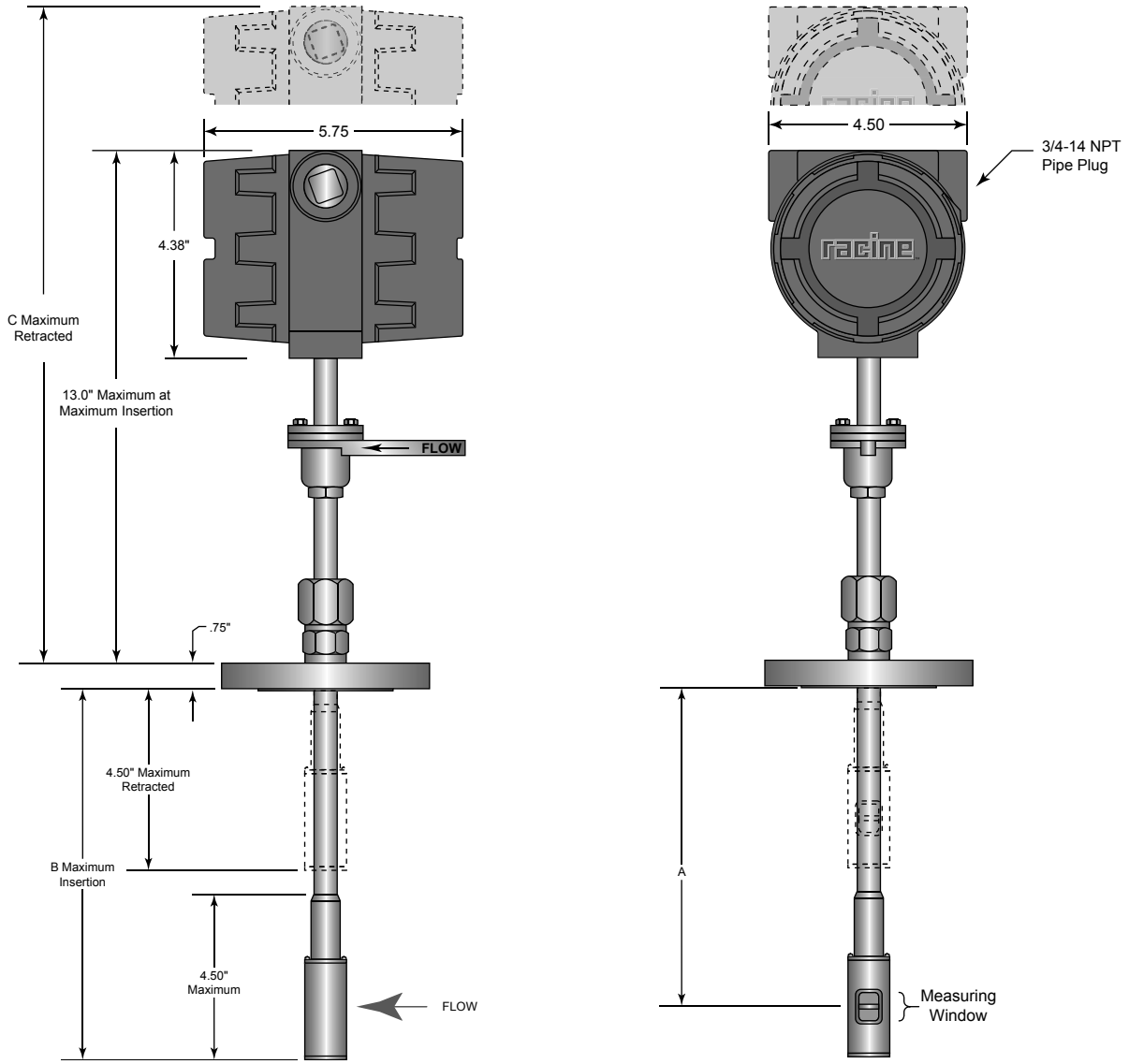
FIGURE B3 - OUTLINE DIMENSIONS FOR FLANGED SERIES METERS

**150 lb. RF ANSI Flange - 300 lb. RF ANSI Flange optional*



Model	Dimension A	Dimension B	Dimension C
RNS12	12.00 (305)	15.0 (381)	21.5 (546)
RNS24	24.00 (609)	27.0 (685)	33.5 (850)
RNS36	36.00 (914)	39.0 (990)	45.5 (1154)
RNS48	48.00 (1218)	51.0 (1295)	57.5 (1459)
RNS60	60.00 (1524)	63.0 (1600)	69.5 (1765)
All dimensions are in inches (mm)			

FIGURE B4 - OUTLINE DIMENSIONS FOR RNS INSERTION STEAM METERS



Model	Dimension A	Dimension B	Dimension C
RNG12	12.00 (305)	12.88 (327)	21.50 (546)
RNG24	24.00 (609)	24.88 (632)	33.50 (851)
RNG36	36.00 (914)	36.88 (937)	45.50 (1156)
RNG48	48.00 (1218)	48.88 (1242)	57.50 (1461)
RNG60	60.00 (1524)	60.88 (1546)	69.50 (1765)
All dimensions are in inches (mm)			

FIGURE B5 - OUTLINE DIMENSIONS FOR RNG INSERTION AIR/GAS METERS

ELECTRICAL INSTALLATION

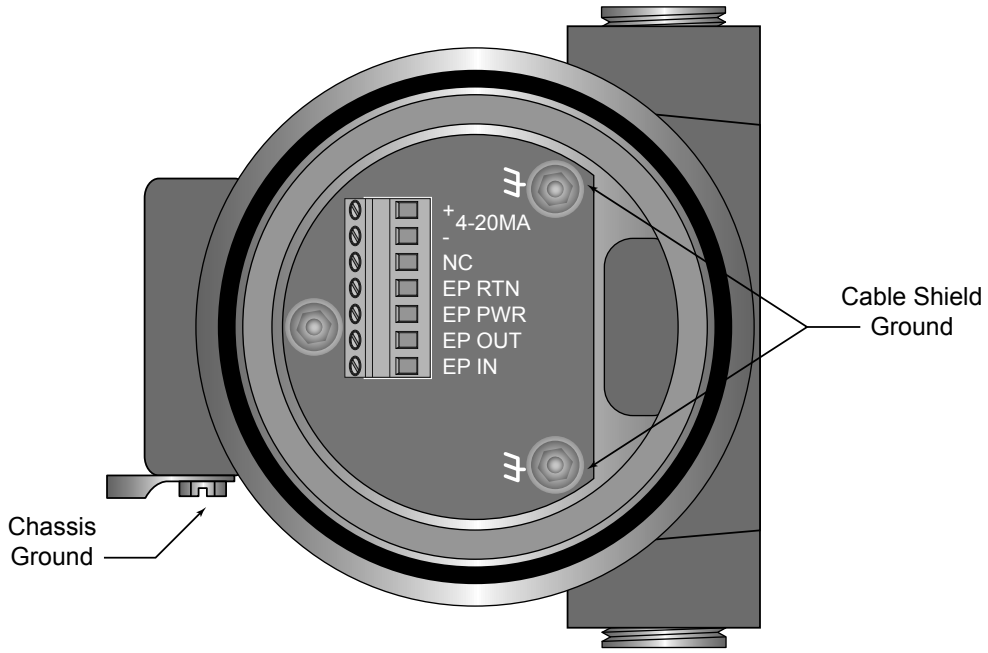
Electrical connections for the meter are made using screw terminals located inside the enclosure. To access these terminals, remove the lid from the enclosure. The functions of these terminals are illustrated in ***Figure C***.

To install the cable, route it through the cable entry located on either side of the enclosure and attach the wires to the appropriate terminals.

It is recommended that a wire be attached from the external flow meter ground terminal to chassis ground, if the pipe is not connected to chassis ground.

EMC NOTIFICATION

The ultrasonic sensing technology employs a 160 KHz carrier frequency and the flow meter is sensitive to radiated and conducted noise at or near this frequency. Precautions must be taken not to subject the flow meter or associated cabling to sources of RF noise that could interfere with the ultrasonic carrier. Any such interference can cause degradation in flow meter performance.



TERMINAL DESIGNATOR	FUNCTION
4-20mA +	LOOP POWER (+15 to 24 VDC)
4-20mA -	LOOP POWER (-)
NC	not used
EP RTN	PRESSURE SENSOR POWER SUPPLY RETURN
EP PWR	PRESSURE SENSOR POWER
EP OUT	POWER OUT TO PRESSURE SENSOR
EP IN	PRESSURE SENSOR INPUT

FIGURE C - FLOW METER TERMINAL FUNCTIONS

WIRING

A two conductor foil shielded cable made of 14 to 22 AWG solid or stranded wire is required to make connections to the flow meter (e.g. Consolidated Wire P/N 5573-CL).

The shield is required to be attached to one of the shield ground points as illustrated in ***Figure C***. The other end of the shield **should not** be grounded.

The flow meter requires a minimum of +15 VDC for proper operation. The maximum load resistance for the power depends on the supply voltage (***see Figure D***).

Note: *The When used with HART® Communication, the minimum input voltage is 21 VDC.*

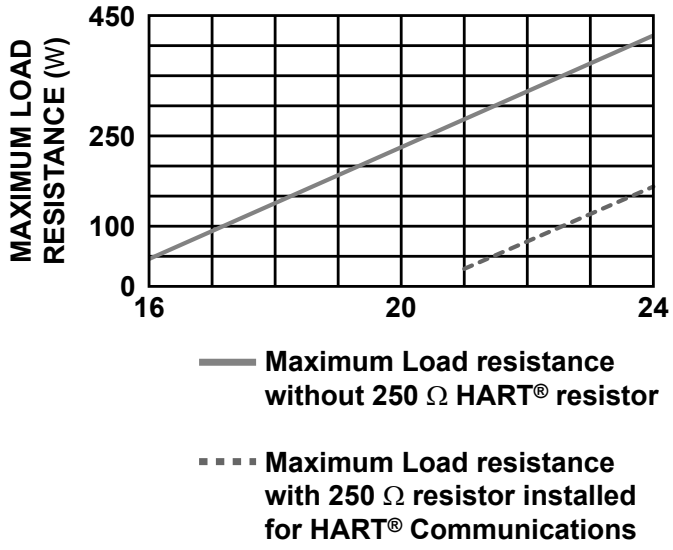


FIGURE D - MAXIMUM LOAD RESISTANCE

The external pressure sensor is limited to a 5 foot cable length.

Various wiring configurations are shown in ***Figures E & F.***

OPERATION

Power Terminals

The 4-20 mA terminals (+ and -) are used for the flow meter's power supply.

Current Output

The current output is accessed through the 4-20 mA + and - terminal loop and provides an output current proportional to the flow measured by the meter. This output is a standard 4-20 mA output, where 4 mA corresponds to no flow and 20 mA indicates 100 percent (full scale) flow. The current output will not be accurate if the load resistance on the current output terminal is too high. The maximum load resistance that the meter can drive versus the power supply voltage is shown in ***Figure D***.

$$R_L = 46V_S - 690$$

Where: R_L = Load Resistance
V_S = Supply Voltage

HART® Communication

The Racine vortex meter has the capability of HART® Communication. However, it is not required that it be used. In most cases, the meter is configured at the factory per the customer's specifications. The user need only install the meter and connect power.

If HART® Communication is desired, it is required that a resistor be placed in the current loop.

The value of the resistor can range from 250 to 350 Ω and be rated at ¼ watt or larger. The placement of the resistor is illustrated in the wiring diagrams. The resistor will add to the total loop resistance and will raise the value of the required power supply voltage. With a resistor in place, Racine Vortex recommends a maximum of 24 VDC supply. This power supply voltage will accommodate 164 Ω of loop resistance in addition to a 250 Ω communication resistor. For high loop resistance, consult ***Figure D*** for the required supply voltage.

There are two ways to communicate to the meter via the HART® interface: the Racine HART Interface or a HART® Communicator. The Racine HART Interface is a PC based software program that runs on Windows 98, Windows NT, Windows ME, Windows XP, Windows Vista® and Windows® 7 operating systems.

This program will provide access to all the settings that can be configured by the user. It also provides tools for diagnostics and trimming the analog output.

The Racine HART Interface requires a HART® modem to convert the modulated HART® signal to the RS-232 communication standard. See the Racine HART Interface User's Manual for more information about the Racine HART Interface.

The HART® 275/375 Communicator is a handheld device that can communicate with any HART® device that is registered with the HART® Communication Foundation. The HART® 275/375 Communicator also provides access to all settings that can be configured by the user. The 275 provides a menu driven interface. ***See Figure G*** to view the menu map for the HART® 275 Communicator.

Note: *HART® 275 Communicator requires Racine vortex drivers for proper communications. (See communicator owner's manual for driver listing).*

WIRING DIAGRAMS

The wiring diagrams illustrated below are for installations where no 4-20 mA pressure sensor is used.

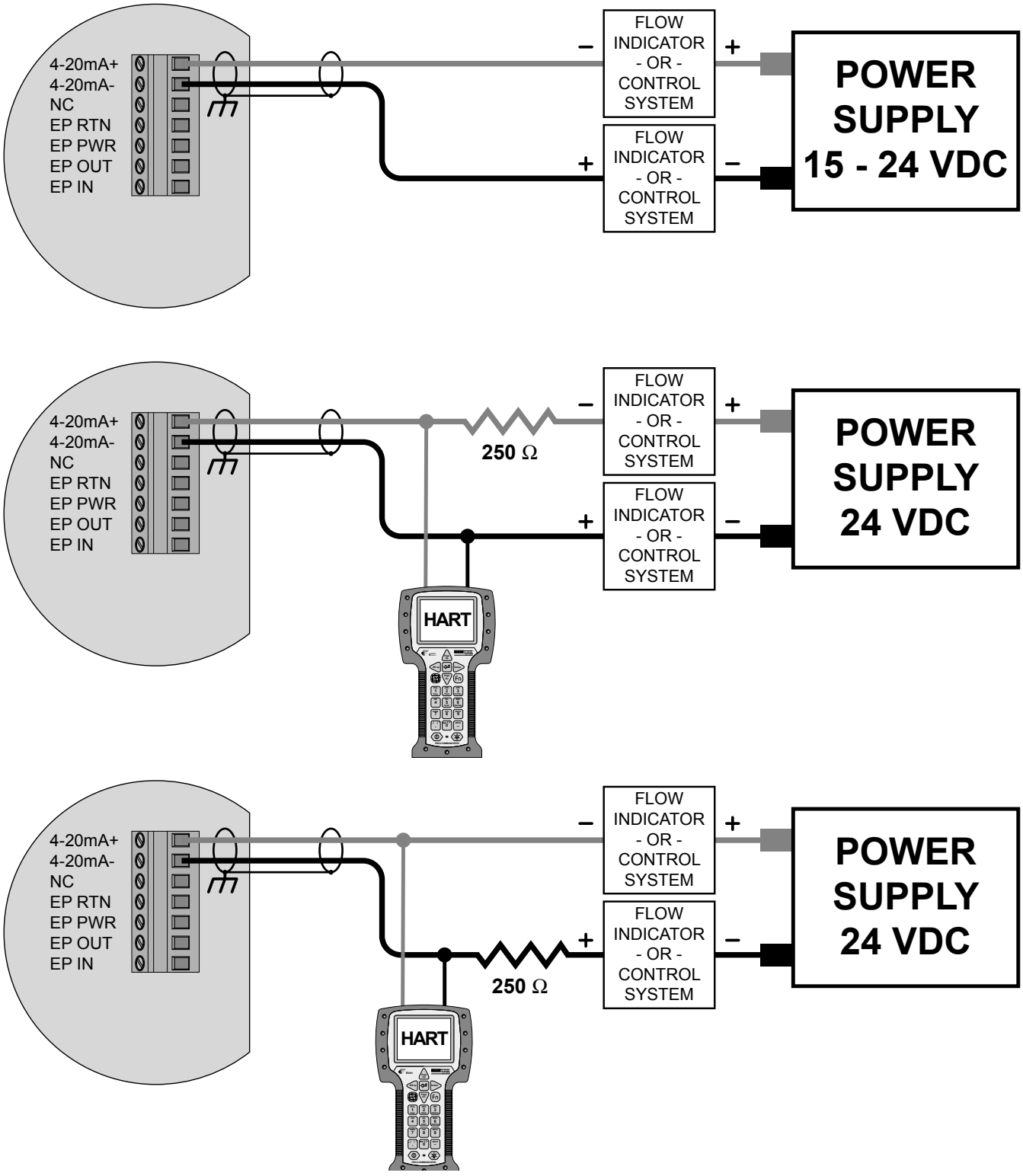
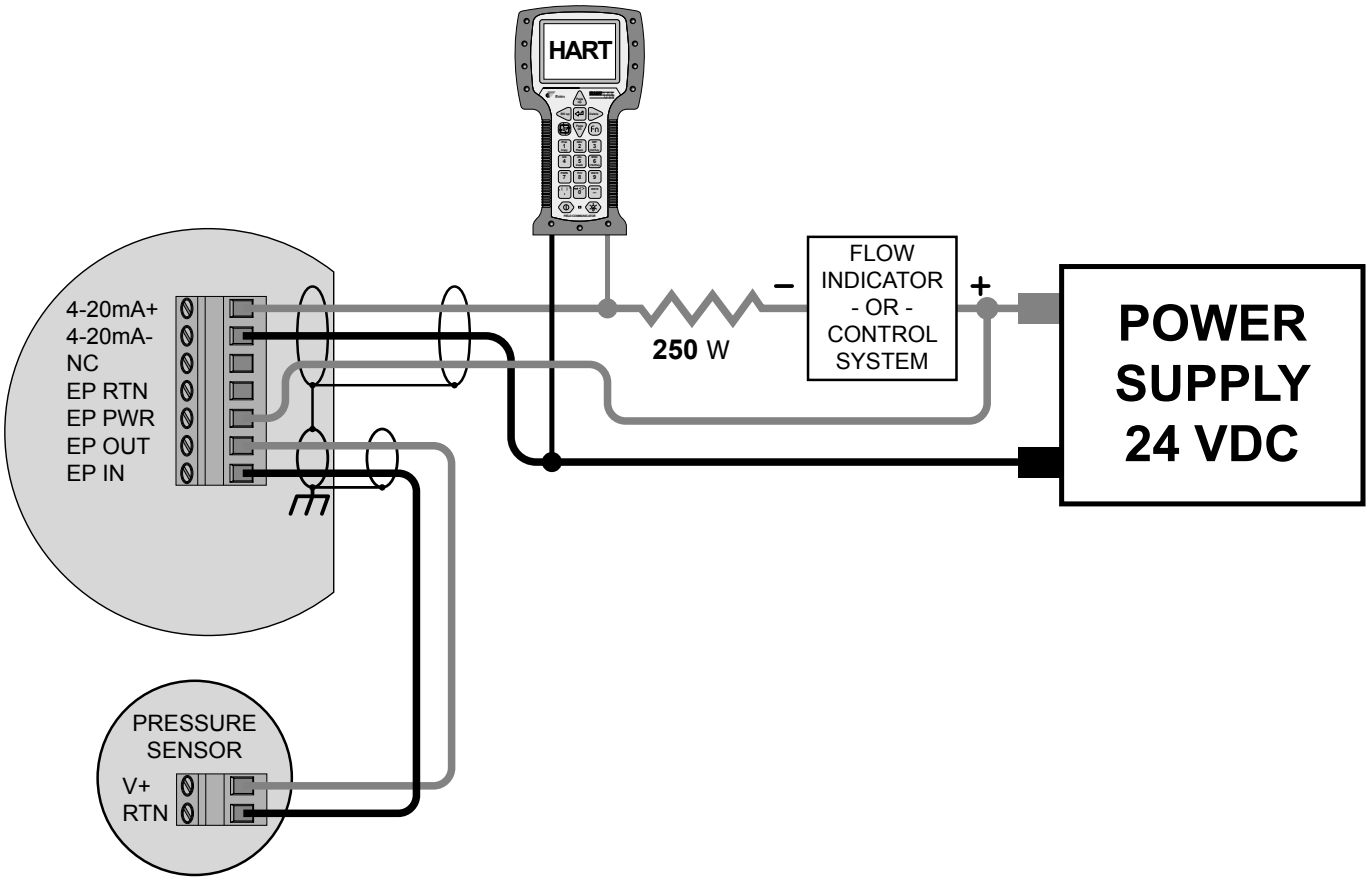


FIGURE E - WITHOUT 4-20 mA OUTPUT PRESSURE TRANSDUCER

If an analog pressure sensor is used, it must be wired as shown below to avoid inadvertent current paths.

A single supply can be used to power the flow meter and the external pressure sensor. The 4-20 mA flow indication must be taken from the source side of the loop.



Note: *Pressure sensor's cable length is limited to 5 feet (1.5 m).*

FIGURE F - WITH 4-20 mA OUTPUT PRESSURE SENSOR

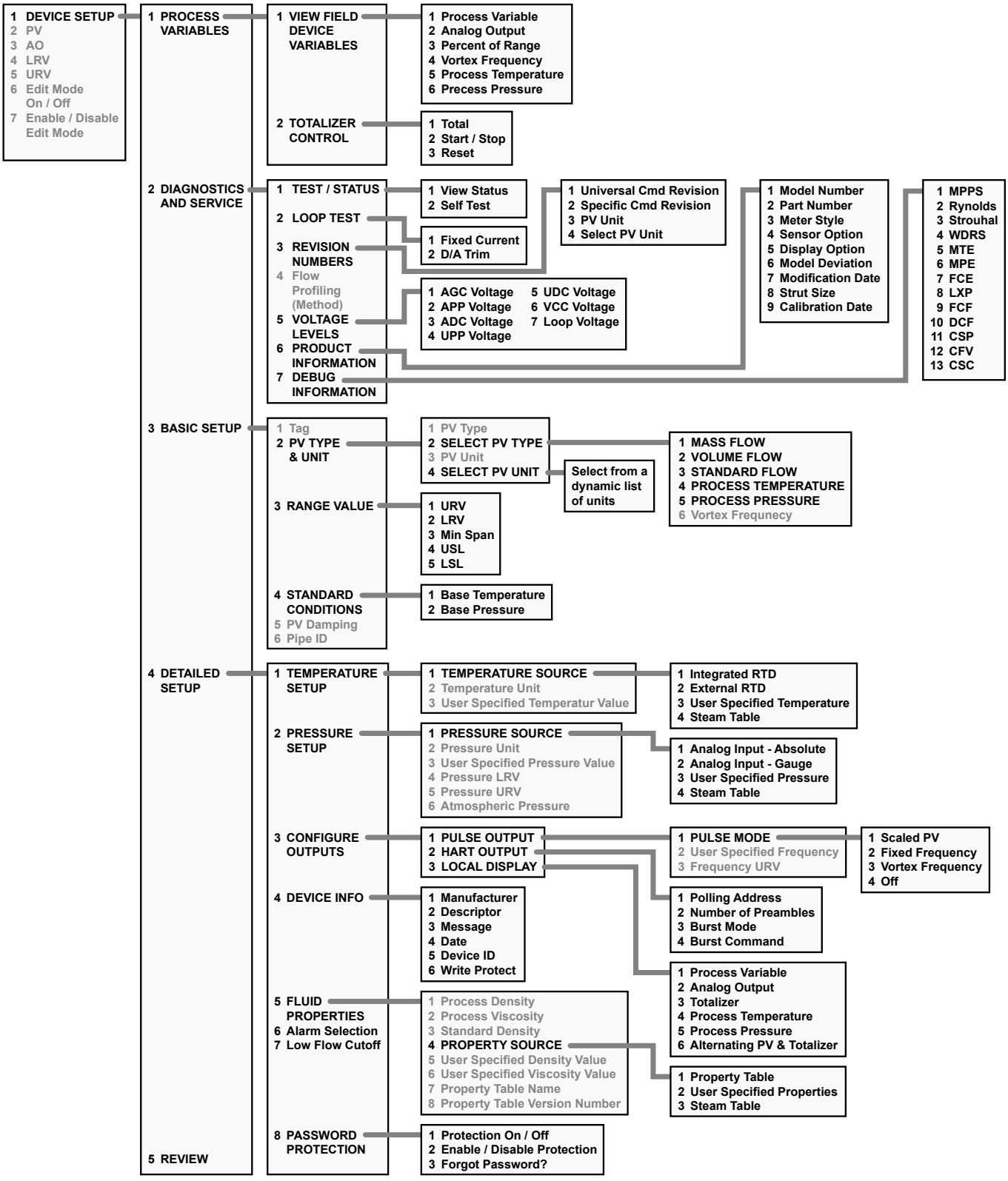


FIGURE G - HART® COMMUNICATOR MENU TREE V4.0

TROUBLESHOOTING

Racine Vortex flow meters are designed to ensure long term accuracy and reliability. The stainless steel body and self-cleaning strut are specifically designed to withstand the rigors of industrial environments. As a result, periodic adjustment or re-calibration is not required. Technical assistance is available directly from Racine Vortex, providing complete re-calibration and repair service for the flow meter at a reasonable cost.

Preliminary Checks

Note: *Do NOT open enclosure in hazardous areas with power applied.*

1) Is the flow meter cable installed correctly?
2) Is the proper power supplied to the proper terminals?
3) Is the flow meter wired for 2 wire 4-20 mA operation?

APPENDIX A - ADDITIONAL INSTALLATION REQUIREMENTS

Introduction

Installing a flow meter is something which requires careful consideration. It cannot just be placed in a line somewhere and be expected to fulfill its purpose adequately. The geometry and condition of the pipe runs in the area of the installation must be considered to ensure the best and most accurate operation of the flow meter. This appendix provides suggestions for optimum installations.

Most flow meter manufacturers define installation conditions in terms of upstream and downstream straight pipe lengths from the point of installation. Unfortunately this is not the only requirement, and one needs to consider other peripheral conditions, such as proximity and style of bends, and other equipment installed in the line. By doing this, you avoid problems of turbulence, swirl, and sonic noise.

Turbulence

Turbulence is a disturbance of the flow caused by bends and obstructions in the flow stream (it is this phenomena which makes the vortex flow meter work). Fortunately turbulence dies out fairly quickly, so by positioning the flow meter well away from bends and obstructions this potential problem of measuring flow in turbulent conditions is overcome (***see Figure H1***).

Swirl

Unlike turbulence, swirl will not die away. Once created it will continue until dissipated on the next pipe bend in the system. Swirl occurs after two bends, in close proximity, which are at an angle to each other. When designing an installation, keep the flow meter out of any line which has two adjacent bends upstream (***see Figure H2***).

Sonic Noise

Sonic noise is created by valves (either flow control or pressure control valves) which are slightly open. Like swirl, sonic noise will only dissipate on a bend, so it is important to install flow meters out of the line of sight of valves. Sonic noise is caused by liquid attaining sonic velocities through a slightly open valve that has a pressure difference across it. This noise travels both upstream and downstream from the valve so you have to ensure that the flow meter is installed well away from the valve, preferably around a bend (***see Figure H3***).

Velocity Profile

When using an RNG/RNS series insertion flow meter, it is necessary to consider the effects of the velocity profile across the pipe or duct to optimize accuracy.

In large pipes, the flow moves slowly at the pipe walls but is at maximum velocity in the center of the pipe creating a continuously variable velocity across the pipe ***(see Figure J***). This velocity variation is called the velocity profile of the pipe, and can be measured and plotted by using the insertion flow meter to measure velocities at various noted positions across the pipe. As the maximum velocity is in the center of the pipe, it follows that if the flow meter is positioned in the center, it will not measure average flow. The “rule of thumb” position is 25% of the way into the pipe, but the optimum position can only be obtained by measuring the profile and working out the correct position from that.

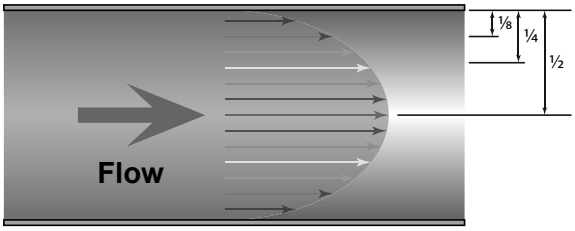


FIGURE J - TYPICAL VELOCITY PROFILE

Straight-Run Piping Considerations

The sensor should be installed with 20 diameters, or more, of straight, unobstructed, full area pipe upstream of the flow meter installation and 10 diameters, or more, downstream. This condition provides the fully developed, symmetrical flow profile that is necessary to obtain accurate and repeatable results. The first obstruction upstream and downstream should be a full area elbow. If the minimum straight run is not possible, the general rule is to have 80% of the straight run upstream and 20% downstream from the flow meter installation.

High intensity ultrasonic noises should not be located upstream or downstream from the sensor. Common ultrasonic noise sources include the following:

- Slightly cracked valves operating with large pressure drops.
- Small pipe leaks in high pressure systems.
- Venturies operating at near-sonic flow rates.
- Sonic nozzles.

If these ultrasonic noise sources cannot be eliminated, the meter should be mounted with at least one elbow between the flow meter and the noise source.

Temperature and Pressure Tap Locations

User supplied pressure and temperature sensors should be mounted downstream from the flow meter. The pressure sensor should be approximately 3-5 pipe diameters and the temperature sensor approximately 4-8 pipe diameters downstream.

Wafer-Style Sensor Installation

The flow meter is shipped completely assembled, tested and ready to install and operate in its permanent location. The RWG/RWS wafer-style flow meters are designed to mount between two ANSI flanges. The flow meter should be mounted so its inside diameter is centered inside the pipe. The labeling of the flow direction of the flow meter should be aligned with the flow in the pipe.

Note: *Gaskets (not provided) are necessary between the sensor and ANSI flange. It is recommended that the customer conduct a flow profile survey prior to installing flow meter.*

Insertion-Style Meter Installation

The flow meter is shipped completely assembled, tested and ready to install and operate in its permanent location.

If the main line can be depressurized easily, then a simple installation, consisting of a 2″ (51 mm) nozzle and a standard ANSI 150 lb., 2″ pipe flange may be used. This permits the shortest shaft length to be used, which keeps clearance space requirements for insertion and removal to a minimum.

Note: *Gaskets (not provided) are necessary between the sensor and ANSI flange. It is recommended that the customer conduct a flow profile survey prior to installing flow meter.*

DANGER - Caution should be used when inserting or retracting at pressures exceeding 60 PSIG (4.14 BARg).

Hot Tap Insertion Flow Meter Installation

Where de-pressurizing the line for flow meter maintenance is impossible or undesirable, the “hot tap” method of installation is used. This method involves inserting the flow meter through a 2″ (51 mm) spool piece and a 2″ (51 mm) full port valve and will require a longer shaft length as well as greater clearance space for removal and installation.

DANGER - Caution should be used when inserting or retracting at pressures exceeding 60 PSIG (4.14 BARg).

Figures K & L show a sample hot tap installation. With the exception of the spool piece, which must be a minimum of 6″ (152.4 mm) ***Figure K*** in length, or a minimum of 4.5″ (114.3 mm) ***Figure L***, all of the dimensions are suggestions only. Actual dimensions may vary depending on customer’s own hot tap configuration.

To calculate the required insertion flow meter's stem length:

For pipe diameters less than or equal to 24″ (609 mm):
Calculate the distance from the center line of the pipe to the top of the flow meter mounting flange.

For pipe diameters greater than 24″ (609 mm):
Calculate the distance from the top of the flow meter flange to a point ¼ of the pipe diameter into the pipe.

When flow profiling is required, calculate the distance from the bottom of the pipe to the top of the flow meter mounting flange and subtract 2″ (51 mm). Next round this distance up to the next largest 12″ (305 mm) increment. This is the stem length that should be ordered.

Flow Profiling

If the flow meter is long enough to be inserted to the far side of the pipe, the flow through the pipe may be profiled at various flow rates. The goal is to find a point in the pipe that remains a consistent percentage of the average flow rate over a wide range of flow. A sample flow profile is shown in ***Table 6***. In this example, the flow rate of a 48″ pipe is measured every six inches across the diameter of the pipe beginning and ending 3″ from the near and far sides of the pipe. The distance in inches from the near-side of the pipe is shown. Measurements are taken at a low, medium and high average flow. In ***Table 7*** the flow rate at each measurement point has been converted to a percentage of the average flow. It can be seen that point number three (15″ from the near side of the pipe) reads a consistent 102 percent of the average flow. The meter should be placed in this position and the output should be divided by 1.02 to obtain the correct reading. Flow profiling will generally improve measurement quality in insertion meter installations.

Reducing the Pipe Diameter

To decrease the variation of flow profile, the piping can be narrowed at the flow meter as shown in **Figures M & N**. This will smooth the flow and increase the effectiveness of flow profiling. Nearly any angle can be used on the downstream side of the meter to restore the original pipe diameter. However, if the angle of piping is seven degrees or less, nearly all the pressure drop caused by the narrow pipe section will be recovered.

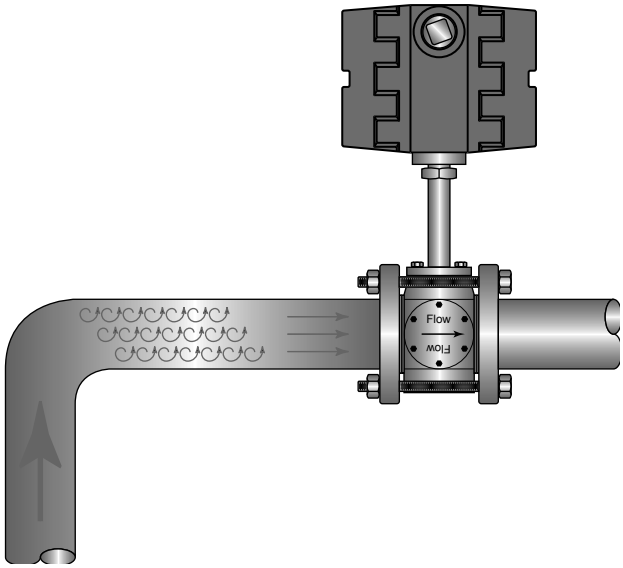


FIGURE H1 - TURBULENCE CAUSED BY BEND OR OBSTRUCTION

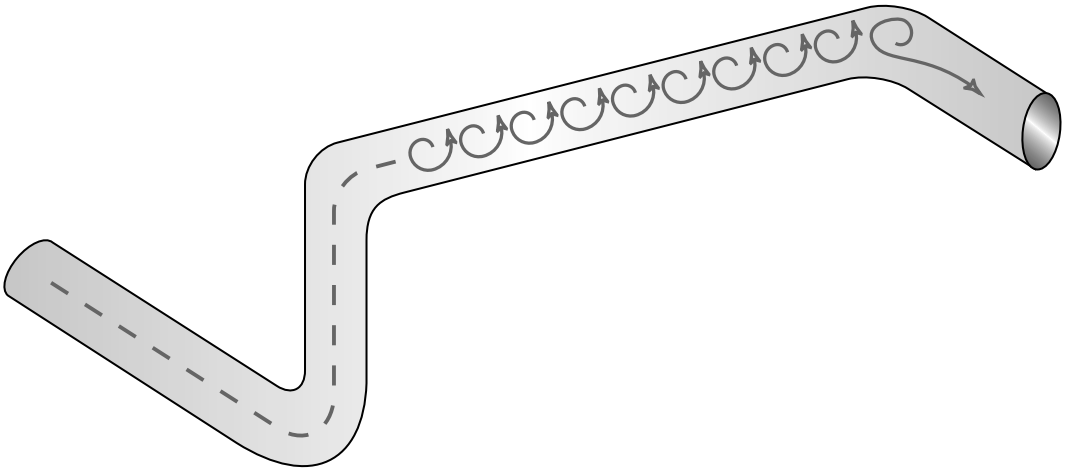


FIGURE H2 - SWIRL CAUSED BY TWO BENDS IN DIFFERENT PLANES AND IN CLOSE PROXIMITY TO ONE ANOTHER

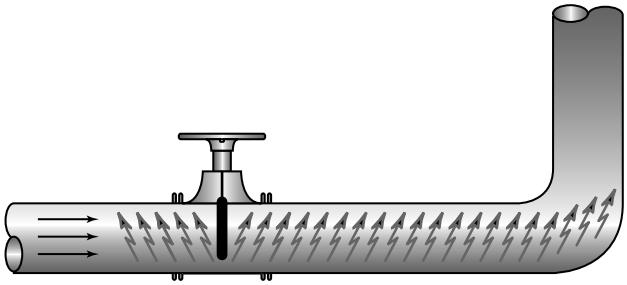


FIGURE H3 - UPSTREAM/DOWNSTREAM SONIC NOISE CAUSED BY SLIGHTLY OPENED CONTROL VALVES

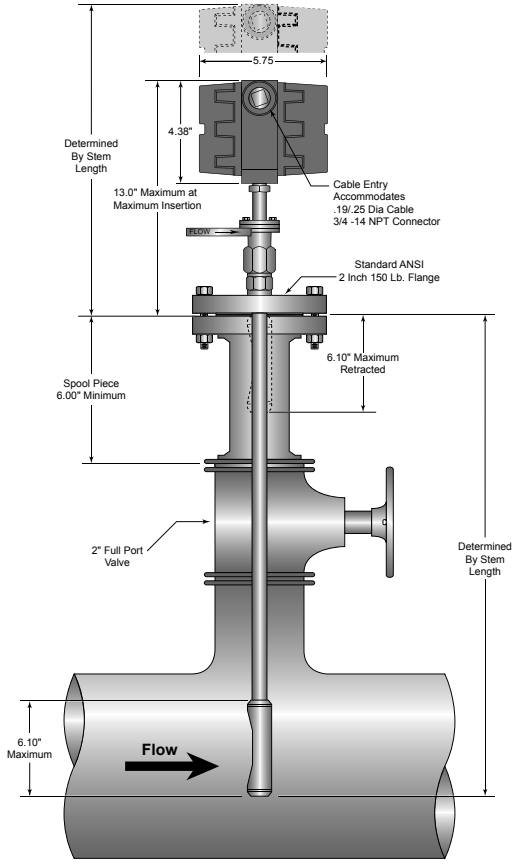


FIGURE K - HOT TAP CONFIGURATION RNS INSERTION STEAM METERS

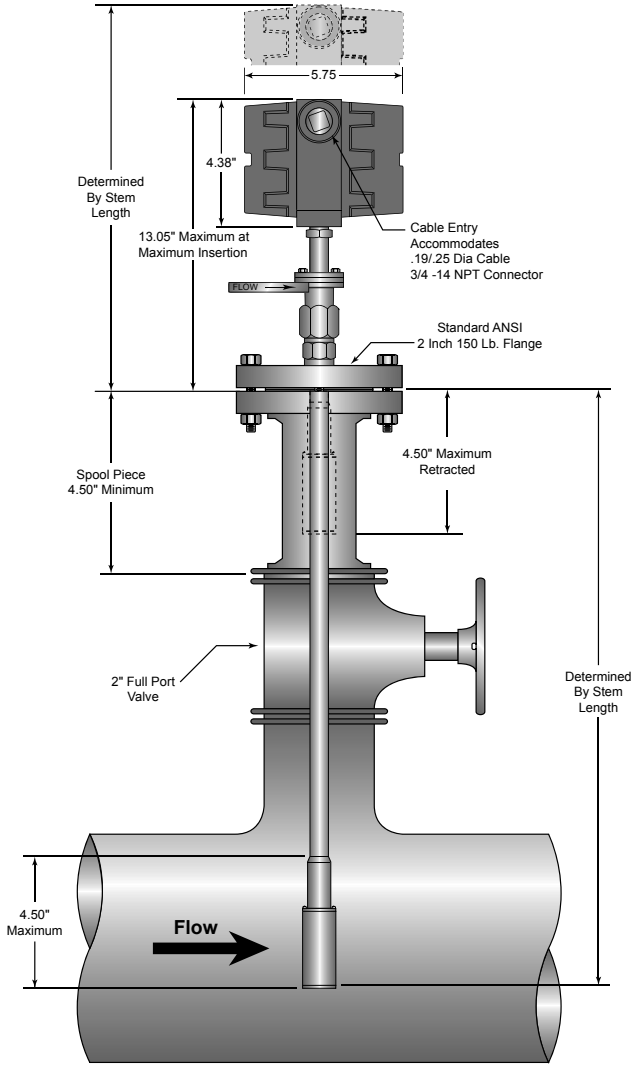


FIGURE L - HOT TAP CONFIGURATION RNG INSERTION GAS METERS

DANGER - Caution should be used when inserting or retracting at pressures exceeding 60 PSIG (4.14 BARg).

TABLE 6 - FLOW PROFILE (RAW DATA)									
FLOW	**FLOW RATE AT MEASUREMENT POINT (FPS)**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVERAGE (FPS)**
LOW FLOW	1.90	2.00	2.04	2.06	2.06	2.04	2.00	1.90	2.0
MEDIUM FLOW	5.58	5.91	6.12	6.21	6.24	6.18	6.06	5.70	6.0
HIGH FLOW	10.92	11.70	12.24	12.48	12.60	12.48	12.18	11.40	12.0
DISTANCE (in)	**3**	**9**	**15**	**21**	**27**	**33**	**39**	**45**	

TABLE 7 - FLOW PROFILE (NORMALIZED DATA)								
FLOW	**FLOW RATE AT MEASUREMENT POINT (%)**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
LOW FLOW	95.0	100.0	102.0	103.0	103.0	102.0	100.0	95.0
MEDIUM FLOW	93.0	98.5	102.0	103.5	104.0	103.0	101.0	95.0
HIGH FLOW	91.0	97.5	102.0	104.0	105.0	104.0	101.5	95.0

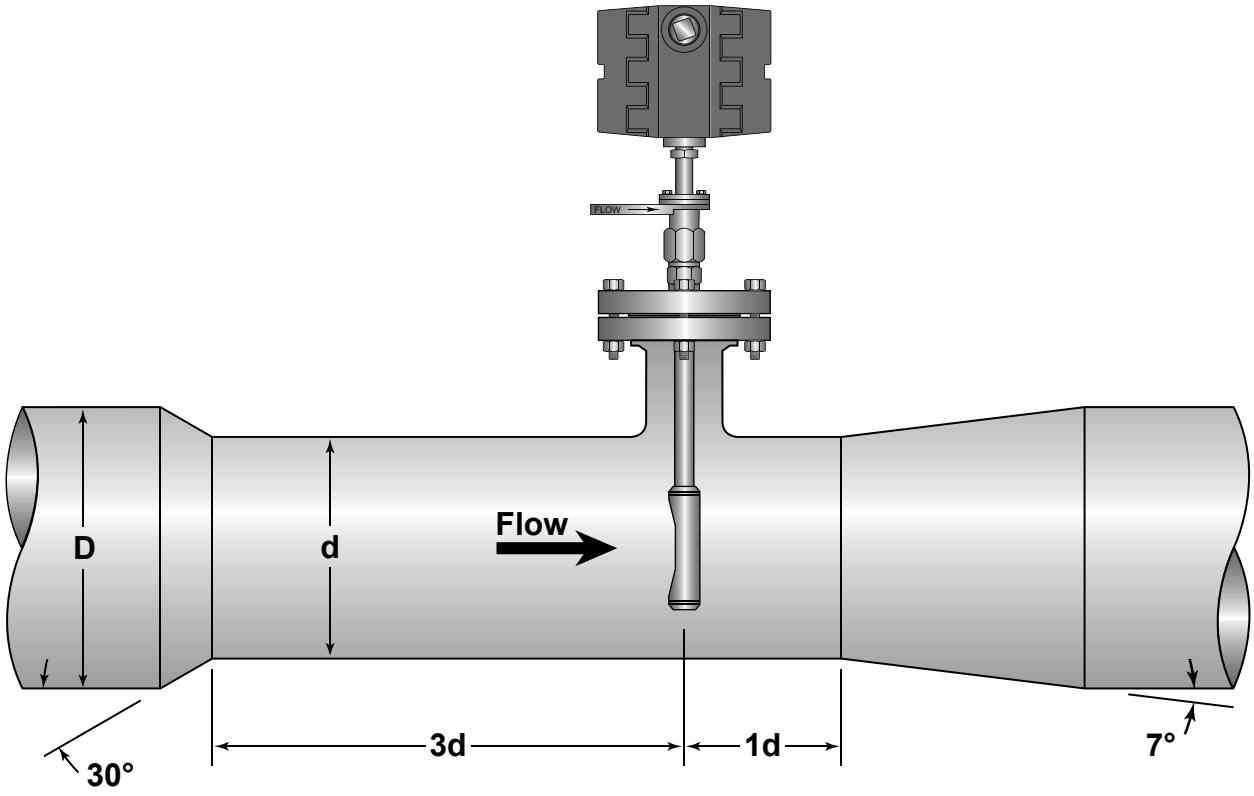


FIGURE M - RNS INSERTION STEAM METER INSTALLED IN A REDUCED PIPE

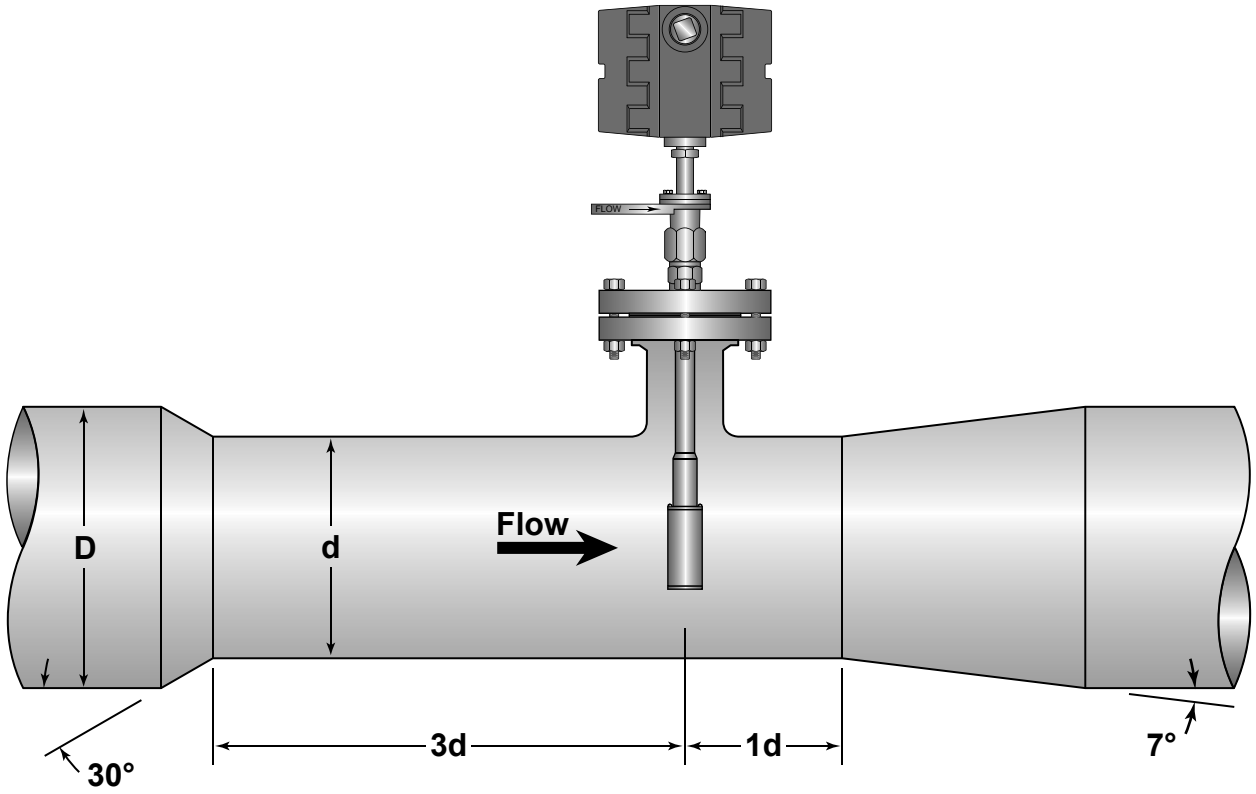


FIGURE N - RNG INSERTION GAS METER INSTALLED IN A REDUCED PIPE

Pressure Drop Data for Wafer Style Gas Meters

Flow Range in SCFM for Air at 60 °F																	
Flow Range in Nm^3/hr for Air at 15.6 °C																	
PSI (Bar)	0 (0)		25 (1.7)		50 (3.5)		75 (5.2)		100 (6.9)		150 (10.3)		200 (13.8)		250 (17.2)		Pressure Drop at 50% of Maximum Flow*
Pipe Size	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	in H_2O (Bar)
½″ 13 mm	0.4	16	1	43	2	70	2	82	3	83	4	82	6	82	7	82	1.40 (3.47×10^{-3})
	1	27	2	73	3	119	3	139	5	141	7	139	10	139	12	139	
1″ 25 mm	1	45	3	121	6	198	8	274	10	351	14	504	18	507	23	507	1.00 (2.49×10^{-3})
	2	76	5	206	10	336	14	466	17	596	24	856	31	861	39	861	
1½″ 38 mm	2	100	7	270	11	440	15	610	20	780	28	1120	37	1253	45	1253	0.65 (1.62×10^{-3})
	3	170	12	459	19	748	25	1036	34	1325	48	1903	63	2129	76	2129	
2″ 50 mm	5	200	14	540	22	880	31	1220	39	1560	56	2030	73	2030	90	2030	0.35 (8.72×10^{-4})
	8	340	24	917	37	1495	53	2073	66	2650	95	3449	124	3449	153	3449	
3″ 76 mm	10	400	27	1080	44	1760	61	2441	78	3121	112	4247	146	4247	180	4247	0.25 (6.23×10^{-4})
	17	680	46	1835	75	2990	104	4147	133	5303	190	7216	248	7216	306	7216	
4″ 102 mm	20	600	54	1620	88	2641	122	3662	156	4682	224	6724	292	7897	360	7897	0.25 (6.23×10^{-4})
	34	1019	92	2752	150	4487	207	6222	265	7955	381	11424	496	13417	612	13417	
* Pressure drop data for air at 14.696 PSI at 60 °F (0 Bar at 15.6 °C)																	

RACINE FEDERATED INC.

8635 Washington Avenue, Racine, WI 53406-3738
Phone: (262)-639-6770 • Fax: (262)-639-2267 • Website: www.racinefed.com

Declaration of Conformity

Manufacturer's Name:	Racine Federated Inc.
Manufacturer's Address:	8635 Washington Avenue Racine, WI 53406 USA
Declares that the Products:	RWG05, RWG10, RWG15, RWG20, RWG30, RWG40, RWS05, RWS10, RWS15, RWS20, RWS30, RWS40, RNG, RNL (Formerly J-Tec Associates Models: JW7nnn, JW7nnnS, JI7000, JI8000)

Conform to the following Standards:

Safety:	Directive 94/9/EC
Emissions:	EN 55022
Immunity:	IEC 61000-4-2: 2001 IEC 61000-4-3: 2002 IEC 61000-4-4: 1995 IEC 61000-4-5: 2001 IEC 61000-4-6: 2001

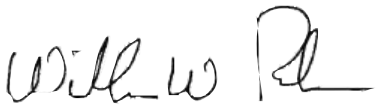
The products listed above are in conformity with the requirements of the EMC Directive 89/336/EEC.

Reference Documents:

SIRA Assessment Report No. R52A18641A
EMC Test Report No. 3042281.011, April 30, 2003, by Intertek Testing Services
EMC Test Report, May 13, 2003, conducted at Intertek Testing Services
Test Report, Order No. 200251303, February 19, 2003 by NEMKO

Supplementary Information:

Date: March 29, 2010

Signature: 

Its: VP

Divisions of Racine Federated Inc.

Blancett® DYNASONICS® Flo-tech™ HEDLAND® PRESO® racine™ wyco®

Division of Racine Federated Inc.

Limited Warranty and Disclaimer

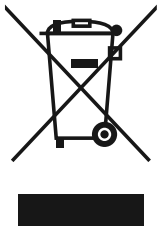
Racine, division of Racine Federated Inc. warrants to the end purchaser, for a period of one year from the date of shipment from the factory, that all flow meters, electronic accessories and other products manufactured by it are free from defects in materials and workmanship. This warranty does not cover products that have been damaged due to misapplication, abuse, lack of maintenance, or improper installation. Racine's obligation under this warranty is limited to the repair or replacement of a defective product, at no charge to the end purchaser, if the product is inspected by Racine and found to be defective. Repair or replacement is at Racine's discretion. A returned goods authorization number must be obtained from Racine before any product may be returned for warranty repair or replacement. The product must be thoroughly cleaned and any process chemicals removed before it will be accepted for return.

The purchaser must determine the applicability of the product for its desired use and assumes all risk in connection therewith. Racine assumes no responsibility or liability for any omissions or errors in connection with the use of its products. Racine will under no circumstances be liable for any incidental, consequential, contingent or special damages or loss to any person or property arising out of the failure of any product, component or accessory.

All expressed or implied warranties, including **the implied warranty of merchantability and the implied warranty of fitness for a particular purpose or application are expressly disclaimed** and shall not apply to any products sold or services rendered by Racine.

The above warranty supersedes and is in lieu of all other warranties, either expressed or implied and all other obligations or liabilities. No agent or representative has any authority to alter the terms of this warranty in any way.

Waste Electrical and Electronic Equipment (WEEE) Directive



In the European Union, this label indicates that this product should not be disposed of with household waste. It should be deposited at an appropriate facility to enable recovery and recycling.

For information on how to recycle this product responsibly in your country, please visit:

www.racinefed.com/recycle/

Division of Racine Federated Inc.
8635 Washington Avenue • Racine, WI 53406-3738 USA
Tel: 262-639-6770 or 888-572-2463
Fax: 262-639-2267
e-mail: vortex@racinefed.com
www.racinevortex.com

RFI Racine Flow Meter Group | Blancett | DYNASONICS | Flo-tech | HEDLAND | PRESO | racine

Printed in USA
Form No. RV-1000-R5 11/10