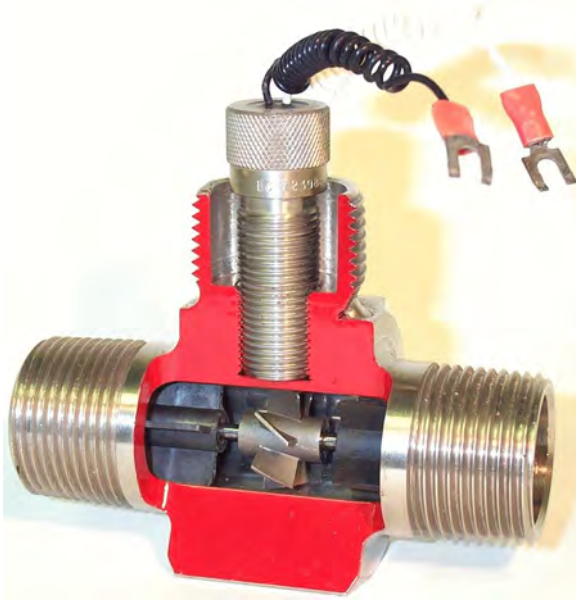


# Daniel™ CRA Series Liquid Turbine Meter

3/4" and 2" sizes



**DANIEL**®

  
**EMERSON**™  
Process Management

## Safety signal words and symbols

Pay special attention to the following signal words, safety alert symbols and statements:



### Safety alert symbol

This is a safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

 **DANGER**

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

---

 **WARNING**

Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

---

 **CAUTION**

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

---

**NOTICE**

Notice is used to address safety messages or practices not related to personal injury.

---

## Important safety instructions

Daniel Measurement and Control, Inc. (Daniel) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel must strictly adhere both to the information printed on the product and to all instructions provided in this manual prior to installation, operation, and maintenance.

Daniel also urges you to integrate this manual into your training and safety program.

**BE SURE ALL PERSONNEL READ AND FOLLOW THE INSTRUCTIONS IN THIS MANUAL AND ALL NOTICES AND PRODUCT WARNINGS.**

### **WARNING!**

**Failure to follow the installation, operation or maintenance instructions for a Daniel product could lead to serious injury or death from explosion or exposure to dangerous substances.**

**To reduce this risk:**

- **Comply with all information on the product, in this manual, and in any local and national codes that apply to the product.**
- **Do not allow untrained personnel to work with this product.**
- **Use Daniel parts and work procedures specified in this manual.**

---

### Product owners (Purchasers):

- Use the correct product for the environment and pressures present. See technical data or product specifications for limitations. If you are unsure, discuss your needs with your Daniel representative.
- Inform and train all personnel in the proper installation, operation, and maintenance of this product.
- To ensure safe and proper performance, only informed and trained personnel should install, operate, repair and maintain this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from: <http://www.daniel.com>
- Save this instruction manual for future reference.
- If you resell or transfer this product, it is your responsibility to forward this instruction manual along with the product to the new owner or transferee.
- **ALWAYS READ AND FOLLOW THE INSTALLATION, OPERATIONS, MAINTENANCE AND TROUBLESHOOTING MANUAL(S) AND ALL PRODUCT WARNINGS AND INSTRUCTIONS.**
- Do not use this equipment for any purpose other than its intended service. This may result in property damage and/or serious personal injury or death.

## Product operation personnel:

- To prevent personal injury, personnel must follow all instructions of this manual prior to and during operation of the product. Follow all warnings, cautions, and notices marked on, and supplied with, this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from: <http://www.daniel.com>
- Read and understand all instructions and operating procedures for this product.
- If you do not understand an instruction, or do not feel comfortable following the instructions, contact your Daniel representative for clarification or assistance.
- Install this product as specified in the INSTALLATION section of this manual per applicable local and national codes.
- Follow all instructions during the installation, operation, and maintenance of this product.
- Connect the product to the proper pressure sources when and where applicable.
- Ensure that all connections to pressure and electrical sources are secure prior to, and during, equipment operation.
- Use only replacement parts specified by Daniel. Unauthorized parts and procedures can affect this product's performance, safety, and invalidate the warranty. "Look-a-like" substitutions may result in deadly fire, explosion, release of toxic substances or improper operation.
- Save this instruction manual for future reference.

## Notice

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PRODUCT NAMES USED HEREIN ARE FOR MANUFACTURER OR SUPPLIER IDENTIFICATION ONLY AND MAY BE TRADEMARKS/REGISTERED TRADEMARKS OF THESE COMPANIES.

## Warranty and limitation of liability

1. **LIMITED WARRANTY:** Subject to the limitations contained in Section 2 herein, Daniel Measurement & Control, Inc. (“Daniel”) warrants that the licensed firmware embodied in the Goods will execute the programming instructions provided by Daniel, and that the Goods manufactured by Daniel will be free from defects in materials or workmanship under normal use and care and Services will be performed by trained personnel using proper equipment and instrumentation for the particular Service provided. The foregoing warranties will apply until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Daniel, whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Daniel from a third party for resale to Buyer (“Resale Products”) shall carry only the warranty extended by the original manufacturer. Buyer agrees that Daniel has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Daniel thereof in writing during the applicable warranty period, Daniel shall, at its option, correct any errors that are found by Daniel in the firmware or Services or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Daniel to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources or environmental conditions, accident, misuse, improper installation, modification, repair, use of unauthorized replacement parts, storage or handling, or any other cause not the fault of Daniel are not covered by this limited warranty, and shall be at Buyer’s expense. Daniel shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Daniel. All costs of dismantling, reinstallation and freight and the time and expenses of Daniel’s personnel and representatives for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Daniel. Goods repaired and parts replaced by Daniel during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Daniel and can be amended only in a writing signed by Daniel. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES. Buyer acknowledges and agrees that corrosion or erosion of materials is not covered by this warranty.

2. **LIMITATION OF REMEDY AND LIABILITY:** Daniel shall not be liable for damages caused by delay in performance. The remedies of buyer set forth in this agreement are exclusive. In no event, regardless of the form of the claim or cause of action (whether based in contract, infringement, negligence, strict liability, other tort or otherwise), shall Daniel’s liability to buyer and/or its customers exceed the price to buyer of the specific goods manufactured or services provided by Daniel giving rise to the claim or cause of action. Buyer agrees that in no event shall Daniel’s liability to buyer and/or its customers extend to include incidental, consequential or punitive damages. The term “consequential damages” shall include, but not be limited to, loss of anticipated profits, revenue or use and costs incurred including without limitation for capital, fuel and power, and claims of buyer’s customers.

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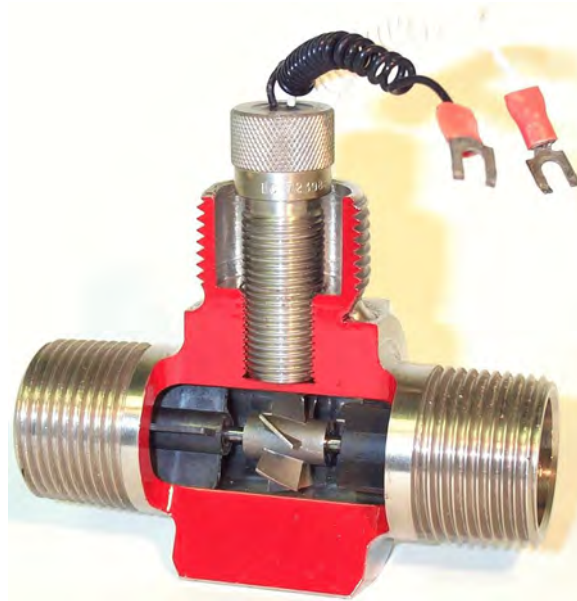
6.0 INSPECTION. .... 6-1

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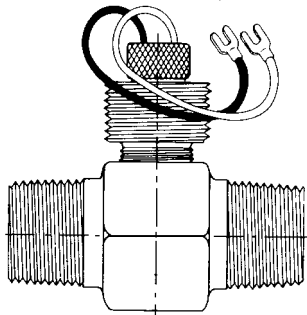


**1.0 DIMENSIONS AND SPECIFICATIONS**

**CRA Meter Dimensions**

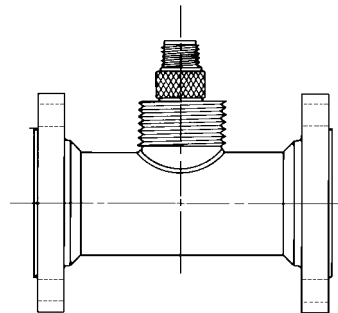


Male NPT



3/4" thru 2"

ANSI Flanged



3/4" thru 2"

<b>STANDARD MATERIALS</b>	
<b>ITEM</b>	<b>SIZES 3/4", 1", 1 1/2", 2"</b>
Flanges	Carbon Steel
Body	316 S.S.
Integral Hangers/Bearings	Ryton
Shaft	Tungsten Carbide
Rotor	25.5 PH S.S.
Thrust Balls	Tungsten Carbide
Hanger Retainer	302 S.S.
Coil Adapter	304 S.S.

Ryton® resins are virtually unaffected by aliphatic and aromatic hydrocarbons, chlorinated and fluorinated hydrocarbons, and most acids and base solutions. The resins, however, may be attacked by hydrochloric acid media above 200°F in concentrations above 10%. Also, some aqueous mineral acids and few chlorinated solvents could somewhat attack the resins.

**Specifications - "CRA" Meters**Linearity:

Industrial Grade:  $\pm 1\%$  of flow rate  
Instrumentation Grade:  $\pm 0.5\%$  of flow rate

Repeatability:

Industrial Grade:  $\pm 0.05\%$   
Instrumentation Grade:  $\pm 0.05\%$

Inductance:

372 mH

Resistance DC:

1200 Ohms  $\pm 10\%$   
(Preamplifier in explosion-proof enclosure can be supplied when required.)

Temperature Ranges:

Meter Temperature Range:  $-50^{\circ}$  to  $+450^{\circ}$ F

Coil Temperature Range:  $-50^{\circ}$ F to  $+225^{\circ}$ F

Standard Coil:  $-50^{\circ}$ F to  $+225^{\circ}$ F

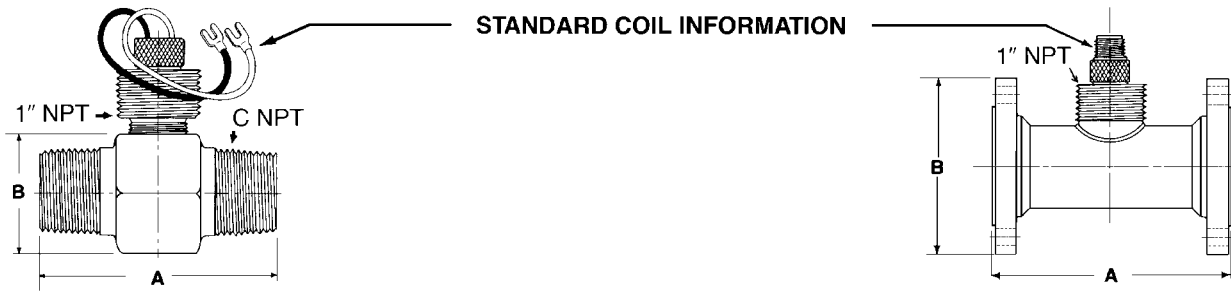
Maximum Temperatures up to  $+350^{\circ}$ F:  
use coil 504-05-398 and connector 504-05-447

Maximum Temperature up to  $+450^{\circ}$ F:  
use coil 504-05-397 with special "CRA" Housing.

No connector required.

**NOTICE**

At temperatures above  $150^{\circ}$ F, the preamp must be remote-mounted.



THREADED END CONNECTIONS					
SIZE	A OVERALL		B WIDTH OF METER BODY	C THREAD SIZE	MAXIMUM WORKING PRESSURE PSI
	MALE NPT				
3/4" x 1"	3 3/4"		1 3/4"	3/4"/1" NPT	5000
1"	4"		1 3/4"	1" NPT	5000
1 1/2"	6"		2 1/2"	1 1/2" NPT	3500
2"	6"		2 1/2"	2" NPT	3500

ANSI FLANGED END CONNECTIONS												
METER SIZE	CLASS 150		CLASS 300		CLASS 600		CLASS 900		CLASS 1500		CLASS 2500	
	A	B	A	B	A	B	A	B	A	B	A	B
3/4"	5 1/2	3 7/8	5 1/2	4 5/8	5 1/2	4 5/8	7	5 1/8	7	5 1/8	7	5 1/2
1"	5 1/2	4 1/4	5 1/2	4 7/8	5 1/2	4 7/8	8	5 7/8	8	5 7/8	8	6 1/4
1 1/2"	6	5	6	6 1/8	6	6 1/8	9	7	9	7	9	8
2"	6 1/2	6	6 1/2	6 1/2	6 1/2	6 1/2	9	8 1/2	9	8 1/2	9	9 1/4

LIQUID FLOW CAPACITY TABLE - "CRA" METER												
METER SIZE	LINEAR FLOW RANGE								EXTENDED FLOW RATE			
	MINIMUM LINEAR				MAXIMUM LINEAR							
	GPM	BPH	BPD	M <sup>3</sup> /HR	GPM	BPH	BPD	M <sup>3</sup> /HR	GPM	BPH	BPD	M <sup>3</sup> /HR
3/4"	4	5.7	137	.91	29	41.4	994	6.6	35	50	1200	7.9
1"	6	8.6	206	1.36	60	85.7	2060	13.6	75	107	2570	17.0
1 1/2"	15	21.4	514	3.41	130	186	4460	29.5	175	250	6000	39.7
2"	25	35.7	857	5.68	225	321	7710	51.1	275	393	9430	62.5

DESIGN PULSES PER UNIT VOLUME BLADE TYPE ROTORS ONLY				DESIGN OUTPUT FREQUENCY AT MAXIMUM FLOW (Hz.)
METER SIZE	GAL	BBL	M <sup>3</sup>	
3/4"	1945	81690	513,869	940
1"	920	38640	243,061	920
1 1/2"	365	15330	96,433	790
2"	115	4830	30,383	430

NOTES:

1. Stated specifications are based on water at 60°F, with a specific gravity of 1.0 and a viscosity of 1.0 centistokes.
2. Meters should be adequately protected from pressure pulsations and excessive surges.
3. Uni-directional industrial grade meters with two coils have a linear flow range as stated above.
4. Uni-directional instrumentation grade meters with two coils have a linear flow range of 20% of maximum linear flow to maximum linear flow.
5. Bi-directional industrial grade meters with two coils have a linear flow range as stated above in one direction of flow and a linear flow range of 20% of maximum flow to maximum linear flow in the other direction of flow.
6. Bi-directional instrumentation grade meters with two coils have a linear flow range of 20% of maximum linear flow to maximum linear flow in both directions of flow.

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## 2.0 INSTALLATION AND INITIAL OPERATION

### Installation

The “CRA” Meter has high resistance to shock while it is operating because of the supporting effect of the fluid. This resistance is greatly reduced when the meter is out of the line or inoperative.

#### **CAUTION**

##### **MECHANICAL EQUIPMENT DAMAGE**

**Great care should be taken to prevent shock.**

Failure to handle the meter with care during installation, removal or shipment may result in damage to the meter.

If sealing compound is used on piping during meter installation, use it sparingly to avoid fouling meter parts. Absolute cleanliness of meter internals is important, and precautions should be taken to prevent entry of foreign matter. Use a strainer upstream of the meter tube section. Another common cause of meter malfunction, due to fouling of the rotor, is objects left inside the pipeline.

#### **CAUTION**

##### **MECHANICAL EQUIPMENT DAMAGE**

**Flush and clean piping system prior to meter installation.**

Failure to maintain absolute cleanliness of meter components may result in damage and improper meter operation.

### Daniel Method of Aligning Meter Tube Flange to “CRA” Meter Flange

Internal alignment throughout the metering section is vital to prevent offsets, steps or gasket protrusion within the bore which could cause disturbance to the flow pattern. Alignment is accomplished by dowel-pinning.

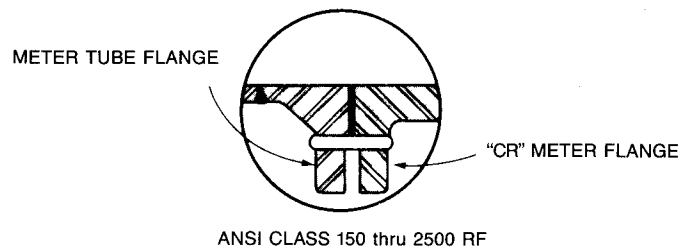
On all Daniel raised face flanged “CRA” Meters and “CRA” Meter Tubes three knock-out dowel pin holes are drilled in each flange for alignment of the bore of the meter to the bore of the meter tube.

On ANSI Class 150 and 300 meters and meter tubes where the dowel pin holes are located tangent to the raised face, female face-type gaskets are used.

On ANSI Class 600 through 2500 meters and meter tubes where the dowel pin holes are located beyond the inner bolt circle, series-type gaskets are used.

Care should be taken not to allow the gasket to protrude into the flow stream upon installation.

It is recommended that dowel pins be removed after flange bolt-up and grease packed in the holes to prevent rust.

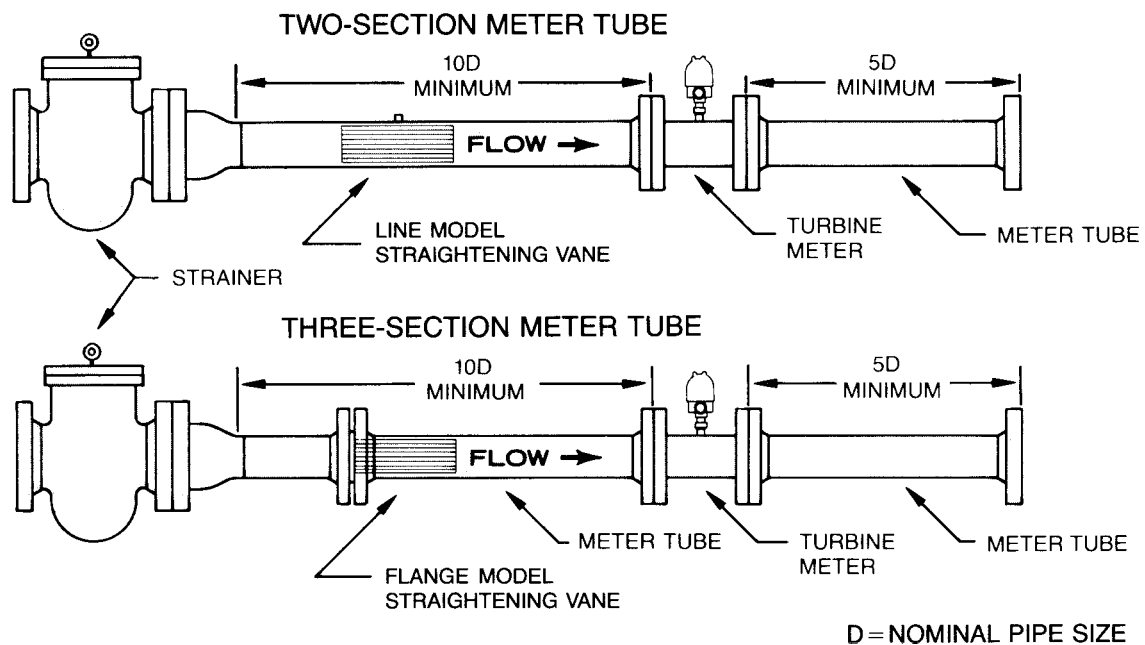




## Recommended Piping Layouts

Maximum accuracy of a turbine meter requires that the fluid stream be as free of swirl as possible. The forward and rear rotor supports provide a slight straightening effect, but for best results it is recommended that the meter be equipped with adequate upstream fluid straightening devices. Flow control valves should be located downstream of the meter.

## Meter Tubes with Straightening Vanes



## Small Diameter Meter Tubes

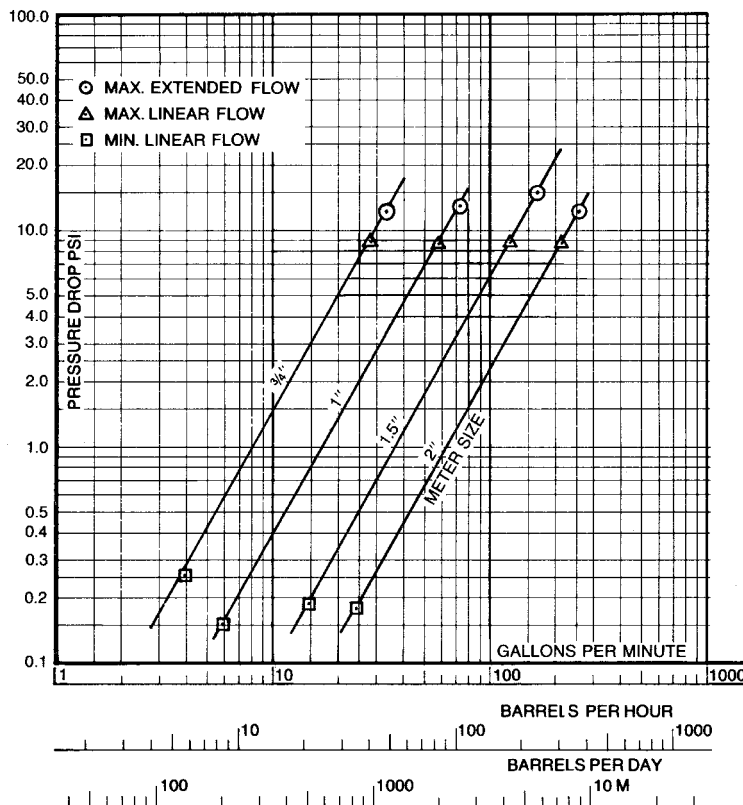
Small diameter meter tubes (under 2") are not normally supplied with straightening vanes. For the average installation, 20 diameters of straight up-stream pipe should be provided for adequate flow straightening.

**Back Pressure**

Back Pressure is the operating pressure measured five pipe diameters downstream of the meter. To prevent cavitation, the minimum back pressure should be twice the pressure drop across the meter at maximum flow plus 1.25 times the absolute vapor pressure (@100°F) of the fluid. This formula should be used until the back pressure reaches 75-100 PSI above the vapor pressure and remain at 100 PSI for anything higher.

Piping should not allow passage of air, or vapor pockets in the flow stream. This will overspin the rotor causing damage to the rotor and bearings.

**“CRA” Meter Pressure Drop Characteristics on Water**



**Viscous Fluids**

At viscosities above 20 centipoise it is recommended that Daniel Measurement engineers be consulted to insure that the proper meter be selected for the exact application.

For low to medium viscosities, the pressure drop through the meter may be estimated by the following formula:

$$\dot{A}P = (PD) \times (\mu)^{1/4} \times (SG)^{3/4}$$

Where:

- $\mu$  = Absolute viscosity in centipoise
- SG = Specific gravity
- PD = Pressure drop for water at expected flow rate (as taken from the chart)

If the kinetic viscosity ( $\nu$ ) is given, convert to absolute viscosity by the formula:

$$\mu = (\nu) \times (SG)$$

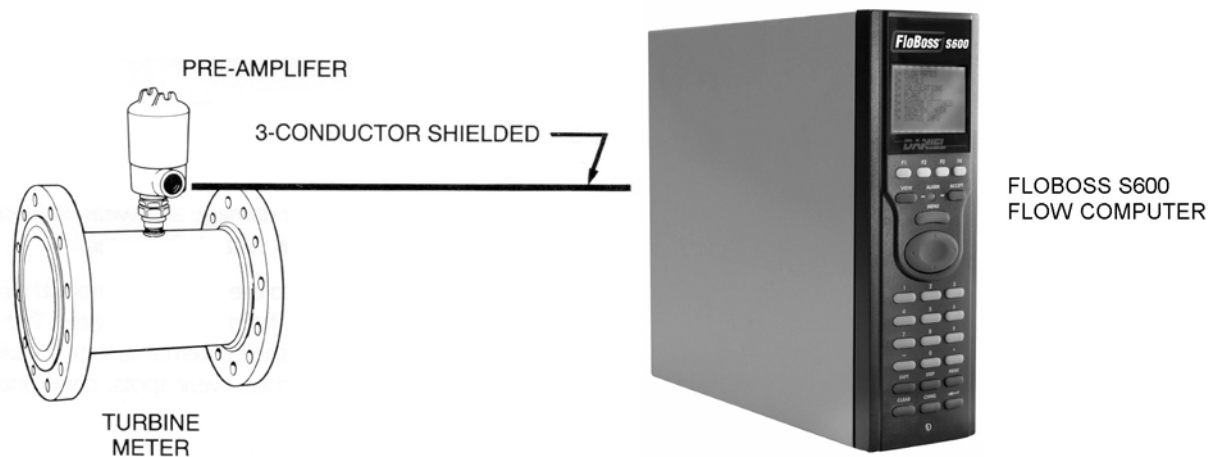
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### 3.0 TURBINE METER INSTRUMENTATION

#### Connecting the Turbine Meter to the Readout Pickup Coil

The pickup coil output is an electrical signal of varying amplitude. In most cases a Daniel preamplifier is mounted on the turbine meter and amplifies this signal to a nominal 12 volt pulse. A two conductor shielded cable is used to connect the pickup coil to the preamplifier, with the shield grounded at one end. This shields the signal from electro-magnetic interference.

The amplified output is a high level signal and can be transmitted for longer distances. All Daniel electronic instruments which operate with the turbine meters also provide filtering of the received amplified signal, and schmitt trigger circuits to eliminate the possibility of noise interference.



SIGNAL WAVEFORM WITHOUT PRE-AMPLIFIER



SIGNAL WAVEFORM WITH PRE-AMPLIFIER

**Benefits of a Preamplifier**

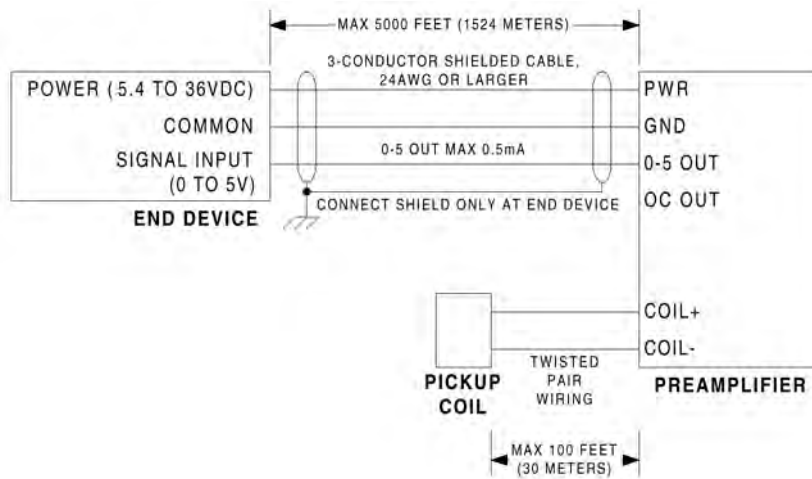
This device shapes and amplifies the coil pulses to a level suitable for transmission up to 5,000 feet using Belden 8770 type cable terminated into Daniel equipment. The input circuitry of all Daniel instruments is designed to accept either the pickup coil output directly, or to accept signals which have been boosted by the preamplifiers.

The preamplifier requires 15-volt power at approximately 0.006 amp. This power is available at the back connections of all Daniel readout instruments. The preamp required three shielded conductors (power, signal, and common) to connect it to the instrument. For multiple-pickup meters a Bi-Directional or combing preamplifier may be used. Normally the preamp is mounted in the electrical coil enclosure on the turbine meter. On high temperature applications, however, the preamp should be mounted far enough from the meter run so that the temperature inside the preamp enclosure does not exceed 150°F.

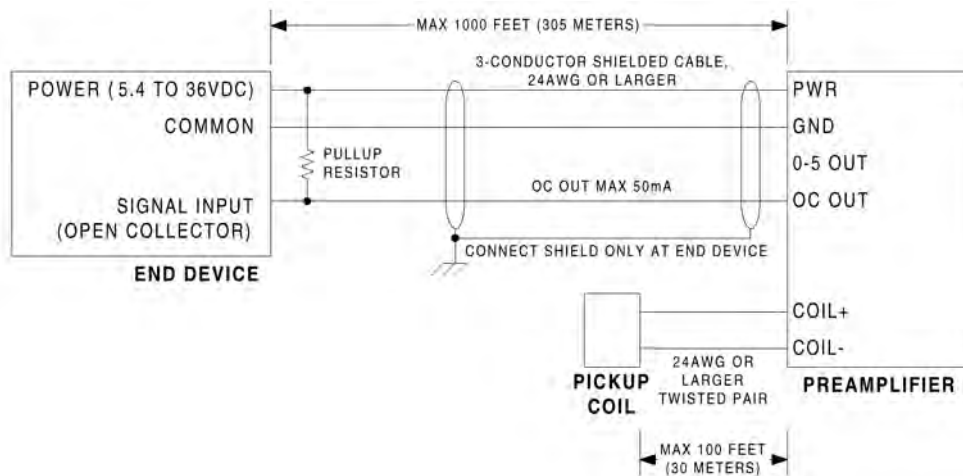
**Connection to a Totalizer**

The “CRA” Meter may be supplied with a Totalizer. If a Totalizer is to be used with the “CRA” Meter, refer to the appropriate Totalizer manual for installation and connection details.

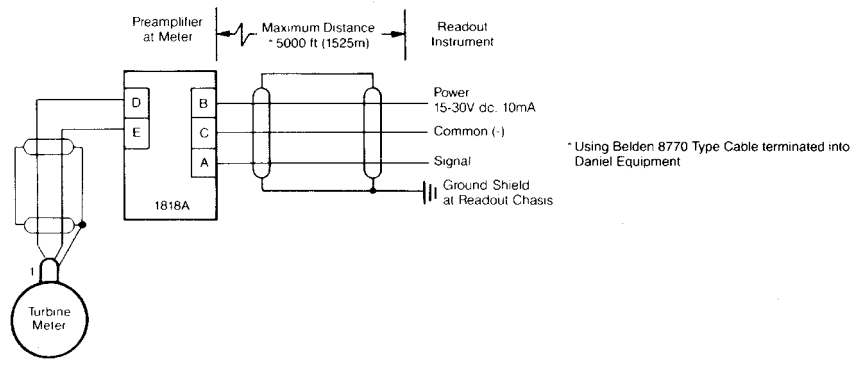
**UNIVERSAL PREAMPLIFIER  
0-5 V OUT CONFIGURATION**



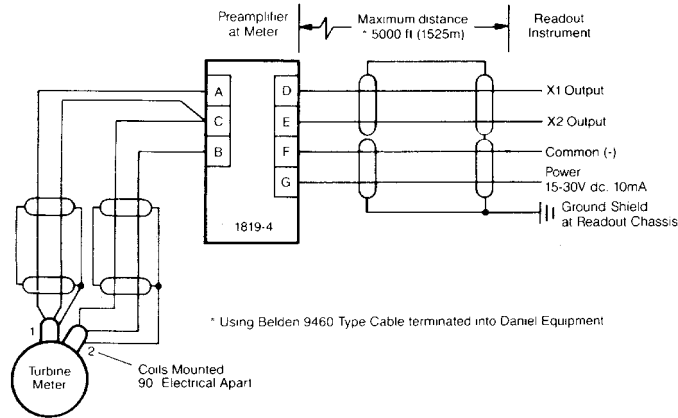
**UNIVERSAL PREAMPLIFIER  
OC OUT CONFIGURATION**



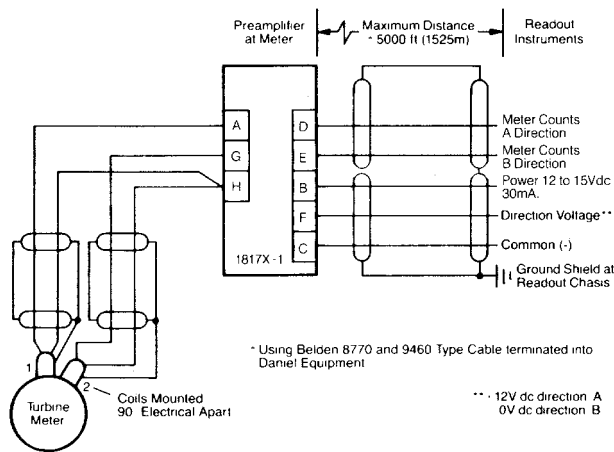
**MODEL 1818A AND 1818AX2 (LOW TEMP)**



**MODEL 1819-4 HI-RESOLUTION**



**MODEL 1817X1 AND 1817X2 (LOW TEMP)**





## 4.0 GENERAL INFORMATION

### “CRA” Meter Guarantee

Daniel guarantees for a period of one year from date of shipment that all “CRA” Meters are free from defective workmanship and material. Within this period any such products or parts will be repaired or replaced free of charge F.O.B. our factory, provided that such products were properly installed and not misused in any manner. The products or parts must be returned to our factory and the foregoing conditions determined by our Engineering Department.

### “CRA” Meter Packaging and Shipping

Daniel “CRA” Meters are fitted with flange protectors to seal off the inside diameter. All meters are carefully boxed or crated for protection during delivery. In some cases, meters can be bolted into the tubes on request, but this method is not recommended. There is an extra charge for export crating.

### Servicing and Storage

Periodic servicing of the “CRA” Meter is desirable to maintain optimum measurement performance.

1. Keep meter clean and free from foreign matter externally and internally.
2. Check freedom of motor rotation.
3. Rotor should be free to move laterally along the shaft from thrust ball to thrust ball.
4. Keep pickup coil and cable connections dry, clean and in good condition.

It is not necessary to disassemble meter for cleaning during normal service conditions unless it is suspected of malfunction or if operational service is discontinued for an extended period of time. The method of cleaning depends on the fluid being measured. It is at the discretion of the operator to adopt the most suitable cleaning operation, with consideration given to the materials of which the meter and its parts are made.

*Steam must not be used*, nor should a higher flow rate than that stipulated for the meter be applied during in-line cleaning processes.

To store the meter, stand it on one end flange with both end flanges and pickup coil covered to protect against foreign matter and temperature extremes. In damp storage areas, damp-proof packaging with silica gel desiccants is recommended.

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**5.0 METER DISASSEMBLY AND METER ASSEMBLY****Meter Disassembly**

1. Remove hanger retainer ring from downstream end of housing.
2. Pull out downstream hanger.
3. If the rotor and shaft assembly did not come out with the hanger, remove the rotor and the shaft assembly from the inside of the housing.
4. Remove the hanger retainer ring from upstream end of housing.
5. Pull out upstream hanger.

**Meter Assembly**

1. Push upstream hanger into the upstream end of the housing. Two hanger fins should fit between two dimples on each side of the housing bore.
2. Install upstream retainer ring in its groove in the body housing.
3. Place one end of the rotor shaft into the bearing on the downstream hanger. Holding the housing and hanger horizontally, push the rotor and the hanger into the downstream end of the housing. Two hanger fins should fit between two dimples on each side of the housing bore.
4. Check that the rotor turns freely.

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**6. INSPECTION**

Clean and inspect all parts for damage and wear. Replace all internal parts if damage or wear is indicated.

The shaft which is swaged into the rotor hub, should have an equal amount protruding from both hub faces. The bearing internal surface and the shaft external surface should be smooth and free of scratches, wear spots, chips, and nicks.

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## NOTES

Emerson Process Management

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