

# Daniel™ “PT” Liquid Turbine Meters

3" through 24" sizes



#### Flow Lifecycle Services for Daniel products

Location	Telephone number	Fax number
North America/Latin America	+1.713.467.6000	+1.713.827.4805
Flow Lifecycle Services for Daniel products	+1.713.827.6314	+1.713.827.6312
USA (toll free)	+1.888.356.9001	+1.713.827.3380
Asia Pacific (Republic of Singapore)	+65.6777.8211	+65.6777.0947.0743
Europe (Stirling Scotland, UK)	+44 (0)1786.433400	+44 (0)1786.433401
Middle East Africa (Dubai, UAE)	+971 4 8118100	+971 4 8865465
Daniel Measurement and Control, Inc. (Headquarters) 11100 Brittmoore Park Drive Houston, TX 77041 USA <a href="http://www.emerson.com">http://www.emerson.com</a>		

#### Email

- Customer Service: [DanielCST.Support@Emerson.com](mailto:DanielCST.Support@Emerson.com)
- Customer Support: [Daniel.TechnicalSupport@Emerson.com](mailto:Daniel.TechnicalSupport@Emerson.com)
- Field Lifecycle Services: [Tech.Service@Emerson.com](mailto:Tech.Service@Emerson.com)
- Asia-Pacific: [danielap.support@emerson.com](mailto:danielap.support@emerson.com)
- Europe: [danielEMA.cst@emerson.com](mailto:danielEMA.cst@emerson.com)

#### Return Material Authorization (RMA)

A Return Material Authorization (RMA) number must be obtained prior to returning any equipment for any reason. Access and fill in the RMA form for Daniel products clicking on the link below.  
<http://go.emersonprocess.com/RMAOnlineForm>

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



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

Important is a statement the user needs to know and consider.

---

### Tip

Tip provides information or suggestions for improved efficiency or best results.

---

### Note

Note is “general by-the-way” content not essential to the main flow of information.

---

### 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 the risk:

- Comply with all information on the product, in this manual, and in any local and national codes that apply to this 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: <https://www.emerson.com/en-us/automation/daniel>.
- 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.
- System should be designed to avoid over pressure conditions or exceeding maximum safe flow rate if meter losses measurement.
- 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: <https://www.emerson.com/en-us/automation/daniel>.
- 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 appropriate pressure and electrical sources when and where applicable. Never operate meter above the maximum working pressure stated on the nameplate.
- 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

THE CONTENTS OF THIS PUBLICATION ARE PRESENTED FOR INFORMATIONAL PURPOSES ONLY, AND WHILE EVERY EFFORT HAS BEEN MADE TO ENSURE THEIR ACCURACY, THEY ARE NOT TO BE CONSTRUED AS WARRANTIES OR GUARANTEES, EXPRESSED OR IMPLIED, REGARDING THE PRODUCTS OR SERVICES DESCRIBED HEREIN OR THEIR USE OR APPLICABILITY. ALL SALES ARE GOVERNED BY DANIEL'S TERMS AND CONDITIONS, WHICH ARE AVAILABLE UPON REQUEST. WE RESERVE THE RIGHT TO MODIFY OR IMPROVE THE DESIGNS OR SPECIFICATIONS OF SUCH PRODUCTS AT ANY TIME.

DANIEL DOES NOT ASSUME RESPONSIBILITY FOR THE SELECTION, USE OR MAINTENANCE OF ANY PRODUCT. RESPONSIBILITY FOR PROPER SELECTION, USE AND MAINTENANCE OF ANY DANIEL PRODUCT REMAINS SOLELY WITH THE PURCHASER AND END-USER.

TO THE BEST OF DANIEL'S KNOWLEDGE THE INFORMATION HEREIN IS COMPLETE AND ACCURATE. DANIEL MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THIS MANUAL AND, IN NO EVENT, SHALL DANIEL BE LIABLE FOR ANY INCIDENTAL, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PRODUCTION, LOSS OF PROFITS, LOSS OF REVENUE OR USE AND COSTS INCURRED INCLUDING WITHOUT LIMITATION FOR CAPITAL, FUEL AND POWER, AND CLAIMS OF THIRD PARTIES.

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

## Warranty and Limitations

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.



# Contents

## Part I Plan

<b>Chapter 1</b>	<b>Dimensions and specifications.....</b>	<b>13</b>
	1.1 Exploded view of “PT” Meter assembly.....	13
	1.2 “PT” Meter dimensions.....	13
	1.3 “PT” Meters specifications.....	15
	1.4 Liquid capacity reference tables.....	18
	1.5 Approvals and certifications.....	19
<b>Chapter 2</b>	<b>Product handling.....</b>	<b>21</b>
	2.1 Packaging and shipping of the “PT” Meter.....	21
	2.2 Meter service and storage.....	21

## Part II Install

<b>Chapter 3</b>	<b>Installation and initial operation.....</b>	<b>25</b>
	3.1 Intallation requirements.....	25

## Part III Operate

<b>Chapter 4</b>	<b>Turbine meter instrumentation.....</b>	<b>33</b>
	4.1 Connection of the Turbine Meter to the Readout.....	33

## Part IV Maintain

<b>Chapter 5</b>	<b>Disassembly and assembly instructions.....</b>	<b>39</b>
	5.1 3" through 24" PT Meter disassembly.....	39
	5.2 3" through 24" PT Meter assembly.....	47
	5.3 Parts inspection.....	53



# Part I

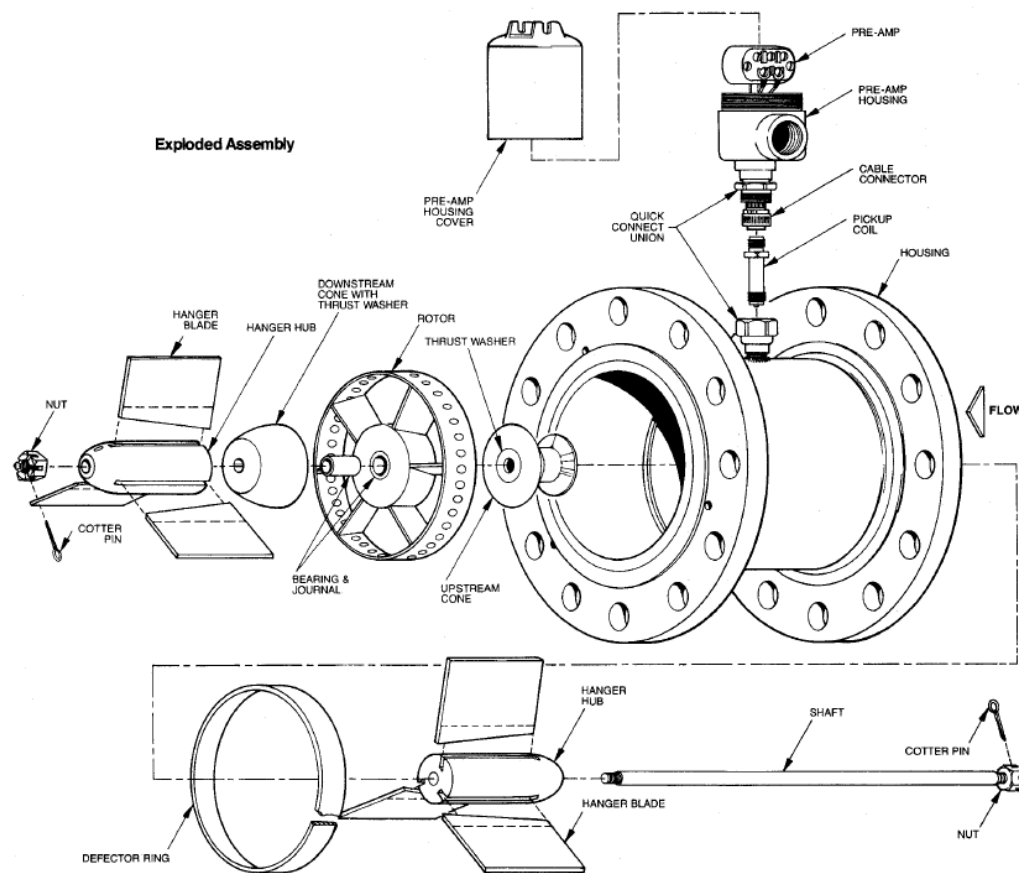
## Plan



# 1 Dimensions and specifications

## 1.1 Exploded view of “PT” Meter assembly

Figure 1-1: "PT" Meter exploded assembly



## 1.2 “PT” Meter dimensions

### NOTICE

Daniel “PT” Meters, preamplifier assemblies and Model GMPA-H-24 outlet boxes are listed by Underwriters Laboratories, Inc. and the Canadian Standards Association for use in hazardous locations Class 1, Groups B, C and D, and raintight.

Dimensions approximate; do not use for detailed piping layouts. Daniel preamplifier enclosure may be rotated to any position desired. Dimension C may be adjusted  $\pm 1/4$ ".

Figure 1-2: "PT" Meter dimensions

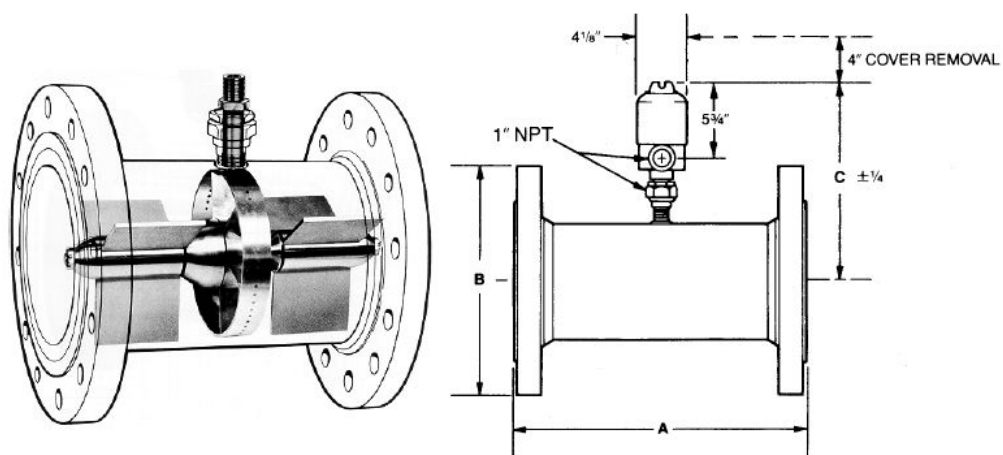


Table 1-1: Nominal line size

DIMENSIONS IN INCHES WEIGHT IN POUNDS		NOMINAL LINE SIZE									
		3"	4"	6"	8"	10"	12"	16"	18"	20"	24"
150# ANSI	A	10	12	14	16	20	24	32	36	40	48
	B	7 1/2	9	11	13 1/2	16	19	23 1/2	25	27 1/2	32
	C	11 13/16	12 1/4	13 5/16	14 1/4	15 5/16	16 1/4	18 1/2	19 3/8	20 1/2	22 1/8
	WEIG HT <sup>(1)</sup>	28	45	72	105	190	335	530	720	940	1,435
300# ANSI	A	10	12	14	16	20	24	32	36	40	48
	B	8 1/4	10	12 1/2	15	17 1/2	20 1/2	25 1/2	28	30 1/2	36
	C	11 13/16	12 1/4	13 5/16	14 1/4	15 5/16	16 1/4	18 1/2	19 3/8	20 1/2	22 1/8
	WEIG HT <sup>(1)</sup>	30	60	112	150	270	440	860	1,150	1,400	2,150
400# ANSI	A	10	12	14	16	20	24	32	36	40	48
	B	8 1/4	10	12 1/2	15	17 1/2	20 1/2	25 1/2	28	30 1/2	36
	C	11 13/16	12 1/4	13 5/16	14 1/2	15 5/16	16 1/4	18 1/2	19 3/8	20 1/2	22 1/8
	WEIG HT <sup>(1)</sup>	42	68	120	180	290	470	950	1,200	1,420	2,300
600# ANSI	A	10	12	14	16	20	24	32	36	40	48
	B	8 1/4	10 3/4	14	16 1/2	20	22	27	29 1/4	32	37

**Table 1-1: Nominal line size (continued)**

DIMENSIONS IN INCHES WEIGHT IN POUNDS		NOMINAL LINE SIZE									
		3"	4"	6"	8"	10"	12"	16"	18"	20"	24"
	C	11 13/16	12 1/4	13 5/16	15	16 1/16	17	18 1/2	19 3/8	20 1/2	22 1/8
	WEIG HT <sup>(1)</sup>	42	88	205	300	450	580	1,250	1,650	2,100	3,200
900# ANSI	A	10	12	14	16	20	24	--	--	--	--
	B	9 1/2	11 1/2	15	18 1/2	21 1/2	22	--	--	--	--
	C	11 13/16	13	13 5/16	15	16 1/16	17	--	--	--	--
	WEIG HT <sup>(1)</sup>	78	125	255	400	625	850	--	--	--	--

(1) Weight is without preamplifier assembly. Add 4 lbs. for each preamplifier assembly.

Above dimensions subject to change without notice.

## 1.3 “PT” Meters specifications

"PT" Meter, rim and blade type, when installed with meter tube and straightening sections and calibrated on water.

### Linearity

3" and larger:

±0.25% normal linearity
±0.5% over extended minimum to extended maximum flow range.
±0.15% premium linearity
±0.10% premium + linearity
±0.07% premium ++ linearity

### Repeatability

±0.02% at any point throughout the extended minimum to extended maximum flow range.

### Pressure drop

At maximum flow of normal flow range on water 4 psi.

### Pressure Range

ANSI 150-1500# depending upon size

### Viscosity

High viscosities will reduce flow range of meter. Consult Daniel Measurement engineers.

### Pickup Coil

Nominal open circuit peak to peak voltage output:

	BLADE	RIMMED
Minimum flow	4.0v	5.0v
Maximum flow	0.3v	0.1v

**Table 1-2: Materials of construction**

Item		Standard	Optional
Meter Body		304SS	316SS
Flanges (Slip on)		Carbon Steel	304SS or 316SS
Suspension		304SS	316SS
Rotor Blades (Rim Type)		304SS	316SS
Rotor Blades (Blade Type)*		430SS	Nickel 200*
Sleeve Bearings		Cemented Tungsten Carbide	†
Journal Bearings		Cemented Tungsten Carbide	†
Rotor Hub			
	1"-6"	430SS	316SS or 304SS
	8"-12"	430SS	430SS and 7075AL
	16"-24"	430SS and 7075AL	†
Rotor Rim			
	2"-4"	316SS	†
	6"-24"	304SS	316SS
Rim Buttons		Hi Mu 80	†
Cones		304SS	316SS
Shaft		17-4 PH Heat Treated Stainless Steel	
* Recommended for salt water service; blade type meters with 316SS body, 316SS suspension, 316SS cones and Nickel 200 blades.			
† No option available.			
<b>Note</b>			
Consult Daniel engineers for unique applications.			



**Table 1-3: Meter temperature limit**

Size	Rotor Hub Materials	
	304SS or 316SS	430SS
3" thru 6"	-50°F to +250°F*	-50°F to +800°F
8" thru 12"	-50°F to +800°F	-50°F to +800°F
16" thru 24"	-50°F to +700°F	-50°F to +800°F

\* Standard materials (All others by special design)

**Table 1-4: Standard "PT" meter pulses per unit volume**

Meter size	Design pulses per 42 gallon barrel	Design per gallon	Design pulses per M <sup>3</sup>	Design output Freq. at Max. Flow (HZ.)
3" BT	2,016	48.0	12,682	520
3" RT	4,620	110	29,062	1,192
4" BT	1,000	23.8	6,290	496
4" RT	3,000	71.4	18,864	1,487
6" BT	235	5.6	1,478	271
6" RT	1,000	23.8	6,290	1,150
8" RT	500	11.9	3,145	1,031
10" RT	250	6.0	1,572	800
12" RT	200	4.8	1,258	960
16" RT	100	2.4	629	720
18" RT	100	2.4	629	964
20" RT	100	2.4	629	1,180
24" RT	100	2.4	629	1,600

BT = Blade Type

RT = Rim Type

#### NOTICE

Output frequency is nominal for maximum normal flow. Output frequency is essentially linear with flow so that frequency for other flow rates may be determined by ratio of flow to maximum flow rate.

## 1.4 Liquid capacity reference tables

**Table 1-5: Normal flow range**

Meter size	Normal flow range							
	Minimum linear				Maximum linear			
	GPM	BPH	BPD	M <sup>3</sup> PH	GPM	BPH	BPD	M <sup>3</sup> PH
3"	55	79	1,886	12.5	650	929	22,286	148
4"	85	121	2,914	19.3	1,250	1,786	42,857	284
6"	240	343	8,229	55	2,900	4,143	99,429	659
8"	475	679	16,286	108	5,200	7,429	178,286	1,181
10"	800	1,143	27,429	182	8,000	11,429	274,286	1,817
12"	1,330	1,900	45,600	302	12,000	17,143	411,429	2,725
16"	2,140	3,057	73,371	486	18,000	25,714	617,143	4,088
18"	2,860	4,086	98,057	650	24,100	34,429	826,286	5,474
20"	3,500	5,000	120,000	795	29,500	42,143	1,011,429	6,700
24"	4,700	6,714	161,143	1,067	40,000	57,143	1,371,429	9,085

**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. Generally, the PT Turbine should not be used in continuous service from the normal maximum to the extended maximum flow rates. Consult Daniel Measurement engineers for proper sizing and consideration.
4. All specifications are subject to change without notice as part of a continuing program of product improvement.
5. Bi-directional meters have a linear flow range as stated in one direction of flow. The minimum linear flow rate in the reverse direction is 20% of its normal maximum linear flow rate.

**Table 1-6: Extended flow range**

Meter size	Minimum extended flow range				Maximum extended flow range			
	GPM	BPH	BPD	M <sup>3</sup> PH	GPM	BPH	BPD	M <sup>3</sup> PH
3"	36	51	1,234	8.18	800	1,143	27,429	182
4"	55	79	1,886	12.5	1,500	2,143	51,429	341
6"	156	223	5,349	35.4	3,600	5,143	123,429	818

**Table 1-6: Extended flow range (continued)**

Meter size	Minimum extended flow range				Maximum extended flow range			
	GPM	BPH	BPD	M <sup>3</sup> PH	GPM	BPH	BPD	M <sup>3</sup> PH
8"	389	556	13,337	88.4	6,400	9,143	219,429	1,454
10"	664	949	22,766	151	9,800	14,000	336,000	2,226
12"	1,183	1,690	40,560	269	15,000	21,429	514,286	3,407
16"	1,400	2,000	48,000	318	22,500	32,143	771,429	5,110
18"	1,900	2,714	65,143	432	30,000	42,857	1,028,571	6,814
20"	2,350	3,357	80,571	534	36,900	52,714	1,265,143	8,381
24"	3,200	4,571	109,714	727	51,400	73,429	1,762,286	11,674

**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. Generally, the PT Turbine should not be used in continuous service from the normal maximum to the extended maximum flow rates. Consult Daniel Measurement engineers for proper sizing and consideration.
4. All specifications are subject to change without notice as part of a continuing program of product improvement.
5. Bi-directional meters have a linear flow range as stated in one direction of flow. The minimum linear flow rate in the reverse direction is 20% of its normal maximum linear flow rate.

## 1.5 Approvals and certifications

XIHl outlet box certification: EExd IIB T6	
GUB2 outlet box certification: EExd IIB T6	
“CE” marked units comply with the following directives:	
	Pressure Equipment Directive 97/23/EC
	ElectroMagnetic Compatibility Directive 89/336/EEC
	ATEX Directive 94/9/EC



## 2 Product handling

### 2.1 Packaging and shipping of the “PT” Meter

Daniel “PT” 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.

### 2.2 Meter service and storage

Periodic servicing of the “PT” 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 washer to thrust washer.
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.

---

#### NOTICE

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.



# Part II

# Install





## 3 Installation and initial operation

### 3.1 Intallation requirements

On installations which are required to comply with the European Union Pressure Equipment Directive (PED) 97/23/EC, it is the responsibility of the end user to ensure that all Essential Safety Requirements of this directive are met.

The “PT” 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.

It is the responsibility of the end user to install the fitting in a well designed piping system taking due regard of the following.

- Internal/external pressure
- Ambient and operational temperatures
- Static pressure and mass of contents in operating and test conditions
- Traffic, wind and earth loading
- Reaction forces and moments which result from supports, attachments, piping, etc.
- Corrosion, erosion, fatigue, etc.
- Decomposition of unstable fluids
- Possible damage from external fire

### 3.1.1 Alignment of Meter Tube flange to “PT” 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.

#### Procedure

1. On all Daniel raised face flanged “PT” Meters and “PT” 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.
2. On ANSI Class 150 lb. and 300 lb. meters and meter tubes where the dowel pin holes are located tangent to the raised face, female face-type gaskets are used.
3. On ANSI Class 400 lb. through 2500 lb. meters and meter tubes where the dowel pin holes are located beyond the inner bolt circle, series-type gaskets are used.
4. Care should be taken not to allow the gasket to protrude into the flow stream upon installation.
5. It is recommended that dowel pins be removed after flange bolt-up and grease packed in the holes to prevent rust.

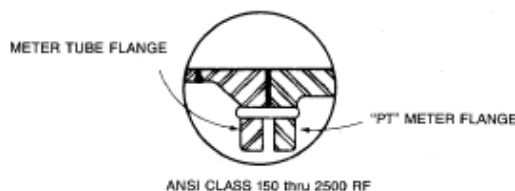
### 3.1.2 Meter tube recommendations

Experience has confirmed the necessity of adequate upstream and downstream straight pipe adjacent to the meter. Daniel “PT” Meter Tubes and Straightening Vanes are fabricated to proper dimensions and tolerances to assure that the flow pattern through the meter is undisturbed by piping configuration.

The table of recommended dimensions for “PT” Meter Tubes takes into account piping design, where swirls and disturbances are introduced by fittings, valves, etc., adjacent to the meter tube section. The recommended lengths shown (with a straightening vane) are for the maximum flow disturbance conditions. The illustrations show proper positioning of straightening vanes.

The vanes may be eliminated if adequate straight pipe exists upstream and downstream. For pipe lengths not requiring vanes, see Daniel Catalog Section “D”, AGA Report No.3, the ASME Power Test Code, or API Standard 2534.

**Figure 3-1: Meter tube and PT Meter flanges alignment**



### 3.1.3 Meter tube recommendations

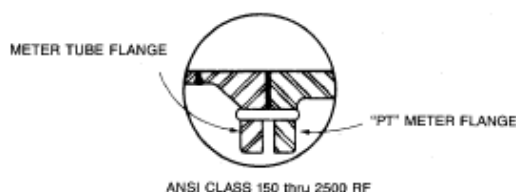
Experience has confirmed the necessity of adequate upstream and downstream straight pipe adjacent to the meter. Daniel “PT” Meter Tubes and Straightening Vanes are

fabricated to proper dimensions and tolerances to assure that the flow pattern through the meter is undisturbed by piping configuration.

The table of recommended dimensions for "PT" Meter Tubes takes into account piping design, where swirls and disturbances are introduced by fittings, valves, etc., adjacent to the meter tube section. The recommended lengths shown (with a straightening vane) are for the maximum flow disturbance conditions. The illustrations show proper positioning of straightening vanes.

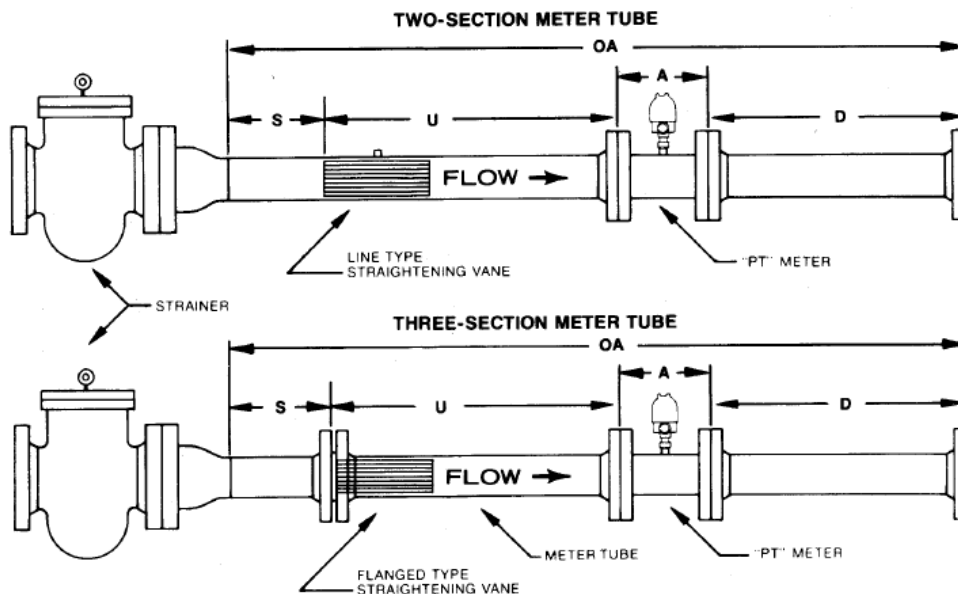
The vanes may be eliminated if adequate straight pipe exists upstream and downstream. For pipe lengths not requiring vanes, see Daniel Catalog Section "D", AGA Report No.3, the ASME Power Test Code, or API Standard 2534.

**Figure 3-2: Meter tube and PT Meter flanges alignment**



## Meter tubes with straightening vanes

**Figure 3-3: Meter Tubes with Straightening Vanes**



**Table 3-1: Minimum recommended dimensions**

Minimum recommended dimensions					
Nominal line size	S	U	A	D	OA
3"	1' - 0"	2' - 0"	10"	1' - 3"	5' - 1"
4"	1' - 0"	2' - 8"	1' - 0"	1' - 8"	6' - 4"
6"	1' - 6"	3' - 6"	1' - 2"	2' - 6"	8' - 8"
8"	2' - 0"	4' - 8"	1' - 4"	3' - 4"	11' - 4"
10"	2' - 6"	5' - 10"	1' - 8"	4' - 2"	14' - 2"
12"	3' - 0"	7' - 0"	2' - 0"	5' - 0"	17' - 0"
16"	4' - 0"	9' - 4"	2' - 6"	6' - 8"	22' - 8"
18"	4' - 6"	10' - 6"	3' - 0"	7' - 6"	25' - 6"
20"	5' - 0"	11' - 8"	3' - 4"	8' - 4"	28' - 4"
24"	6' - 0"	14' - 0"	4' - 0"	10' - 0"	34' - 0"

Meter Tubes can be supplied with any type of line connection, in special materials and to any specified length.

Illustrations show a two-section meter tube with a line type vane and a three-section tube with a flange type vane. It is recommended that the flange type be used, as it can be easily removed for inspection; and, by using the three-section tube with the spacer and jack screws, the meter can also be easily removed from the line. The Illustration shows flanged outer ends. Other end connections may be supplied.

#### NOTICE

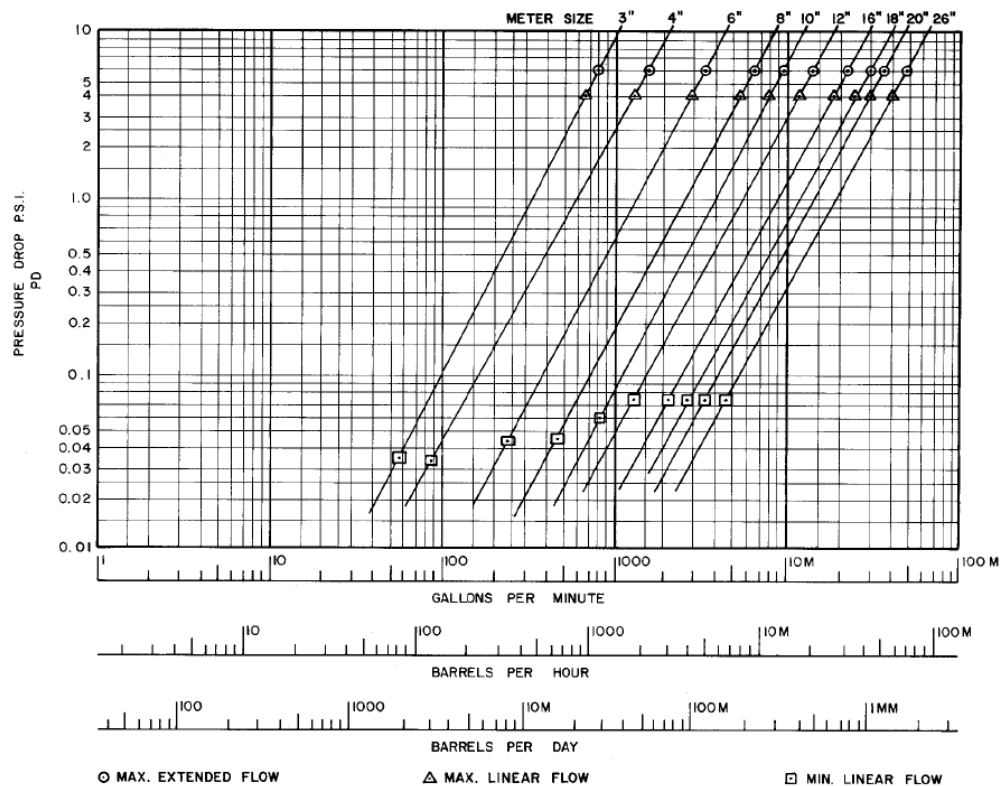
Daniel recommends installation of strainers upstream of the meter. Flow control valves should be located downstream of the meter.

### 3.1.4 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.

Figure 3-4: "PT" Meter Pressure Drop Characteristics on Water



### 3.1.5 Viscous fluids

At viscosities in centistokes greater than the line bore in inches 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 one of the following formulas:

$$\Delta P = (PD) \times (\mu)^{\frac{1}{4}} \times (SG)^{\frac{3}{4}}$$

or

$$\Delta P = (PD) \times (v)^{\frac{1}{4}} \times (SG)$$

Where

$\Delta P$  = Estimated pressure drop

PD = Pressure drop for water at expected flow rate (as taken from the chart)

$\mu$  = Absolute viscosity in centipoise

$v$  = Kinematic viscosity in centistokes

SG = Specific gravity

---

**Note**

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

---

# Part III

## Operate





## 4 Turbine meter instrumentation

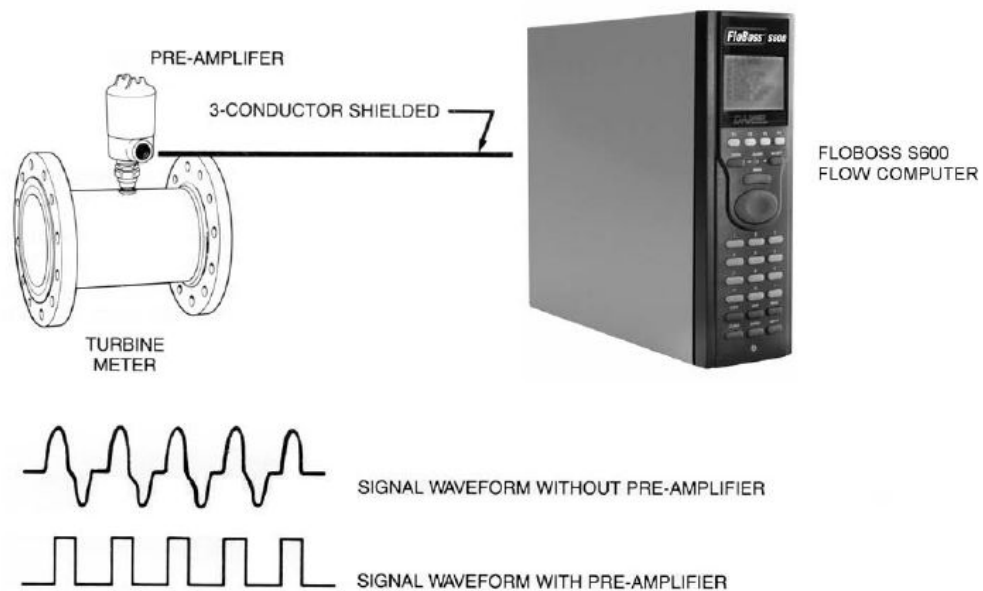
### 4.1 Connection of the Turbine Meter to the Readout

#### 4.1.1 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 to amplify this signal. A two conductor shielded cable is used to connect the pickup coil to the pre-amplifier, with the shield grounded at one end. This shields the signal from electromagnetic 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.

**Figure 4-1: Turbine meter pre-amplifier and signals**



#### 4.1.2 Pre-amplifier

The Universal Preamplifier (Preamp) converts the low level signal from a turbine meter inductive pickup to high level pulses. It is distinguished by the following features:

- **Tailored Frequency Response:**

The sensitivity of the Preamp rolls off as frequency increases, matching the characteristic output of a turbine meter with inductive pickup. High sensitivity at low

frequencies allows the turbine meter to operate at its lowest possible flow rates. Reduced sensitivity at high frequencies prevents spurious counting due to RFI and transients.

- **Common Mode Rejection:**

The Preamplifier employs a differential amplifier which responds only to differences between the COIL+ and COIL- wires.

- **Dual Outputs:**

With its dual outputs, the Preamplifier works with virtually any end device. One output swings from 0V to 5V regardless of the power supply voltage, and is suited for most inputs with thresholds of 4V or less. An open collector output swings from 0V to any available power supply voltage up to 36V, sinking up to 50 mA.

- **Wide Power Supply Range, Low Power Operation:**

The Preamplifier operates with any power supply voltage from 5.4 to 26V and requires less than 1 mA. It can be added to virtually any system without special power conditioning, and typically with no impact on power system requirements.

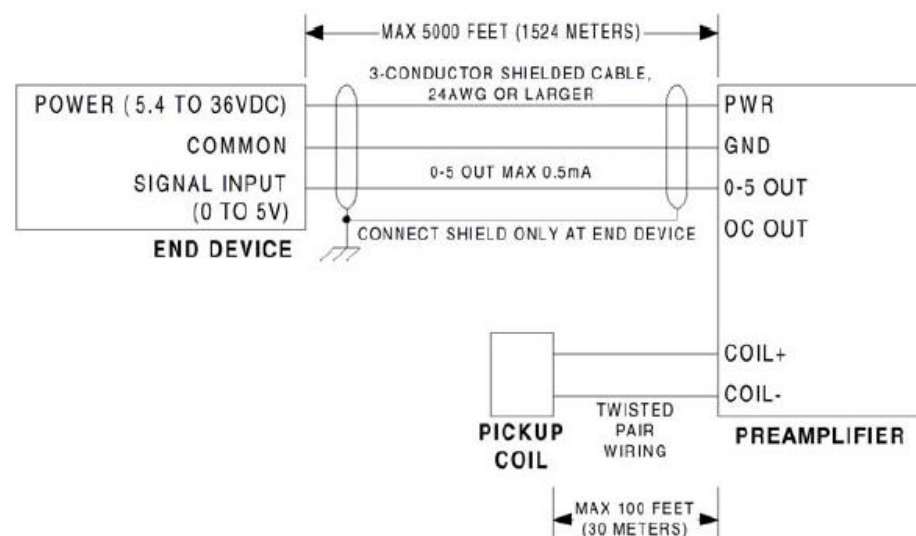
- **Bullet-Proof I/O:**

All field wiring terminals are protected against ESD (electrostatic discharge) and transients.

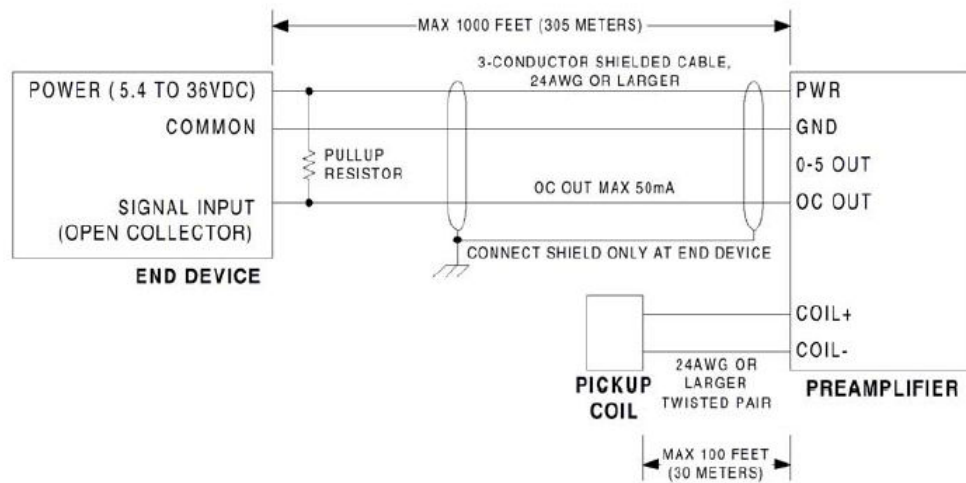
- **Rugged and Convenient Packaging:**

The Preamplifier is fully encapsulated in a compact package suitable for mounting on a panel or in a standard 3" ID explosion-proof housing. Pluggable cage-clamp type connectors allow convenient, reliable connections without the need for lugs. Terminals are labeled with signal names to simplify installation.

**Figure 4-2: Universal Pre-amplifier 0-5V out configuration**



**Figure 4-3: Universal Pre-amplifier OC out configuration**



**Figure 4-4: Model 1818 and 1818AX2 (Low Temp)**

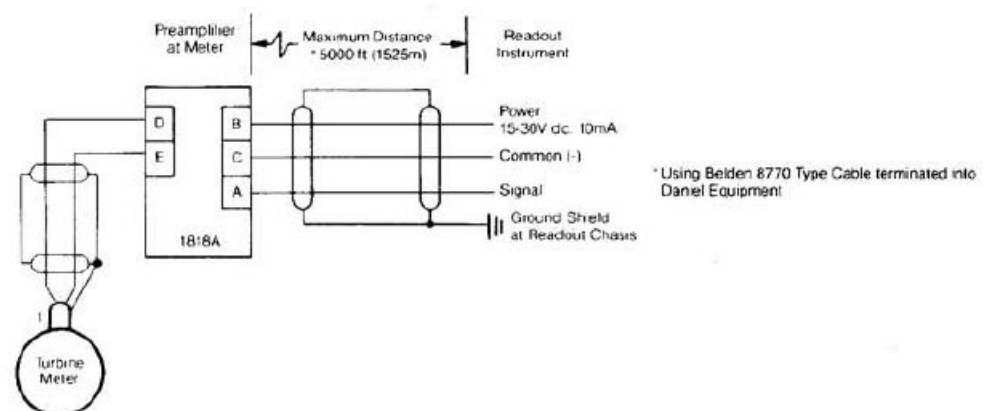


Figure 4-5: Model 1819-4 Hi Resolution

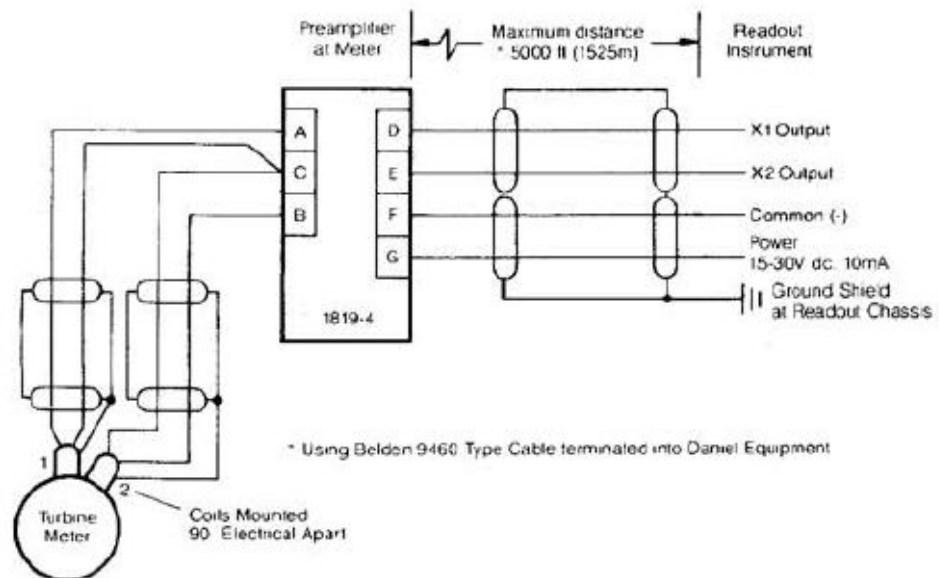
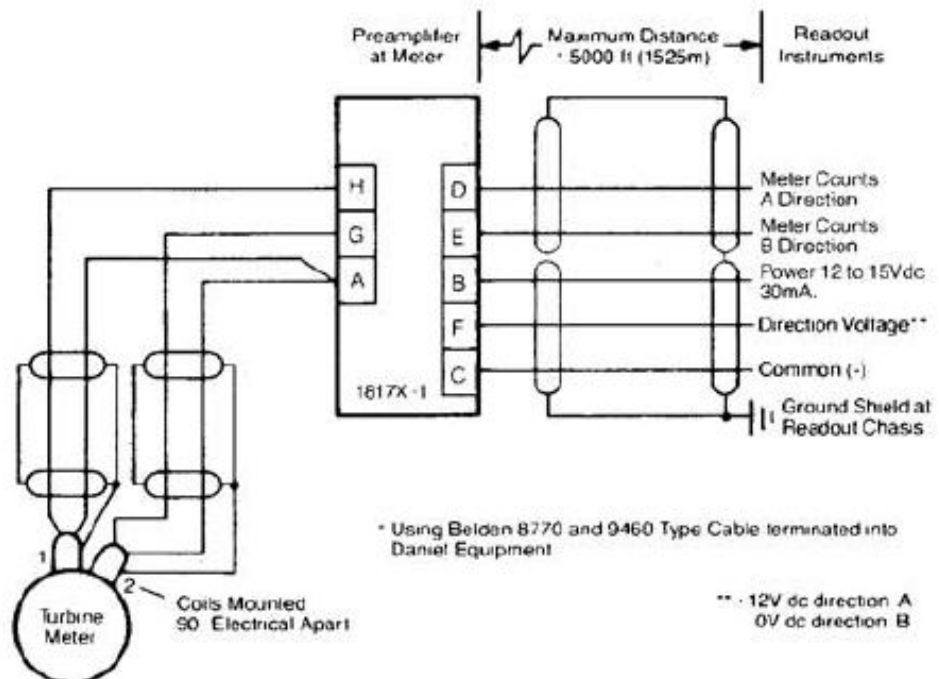


Figure 4-6: Model 1817X1 and 1817X2 (Low Temp)



# Part IV

# Maintain



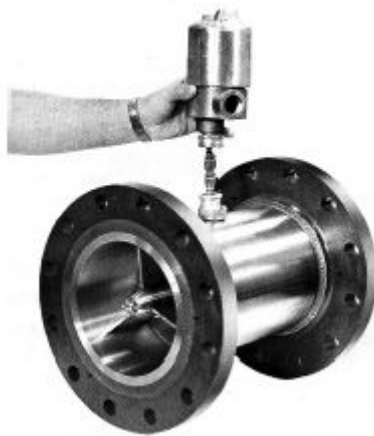
## 5 Disassembly and assembly instructions

### 5.1 3" through 24" PT Meter disassembly

#### Procedure

1. To remove preamplifier housing, unscrew collar nut on the quick connect union, lift preamplifier housing, unscrew and disconnect cable connector from pickup coil.

**Figure 5-1: Step 1**



2. To remove pickup coil, unscrew from coil boss.

#### **Note**

Preamplifier housing and pickup coil need not be removed for internal meter disassembly.

---

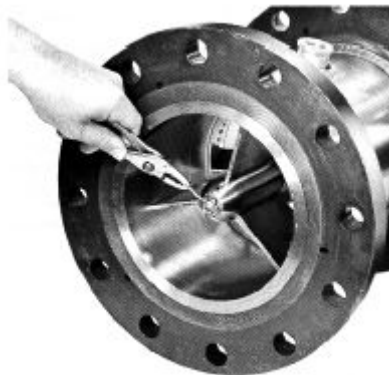
**Figure 5-2: Step 2**



- 
3. Remove cotter pin from downstream end of shaft.

---

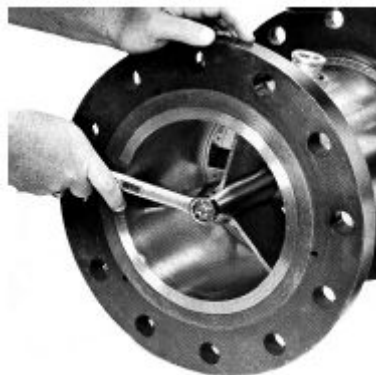
**Figure 5-3: Step 3**



- 
4. Remove downstream shaft nut, simultaneously holding upstream shaft nut to prevent shaft from turning.

---

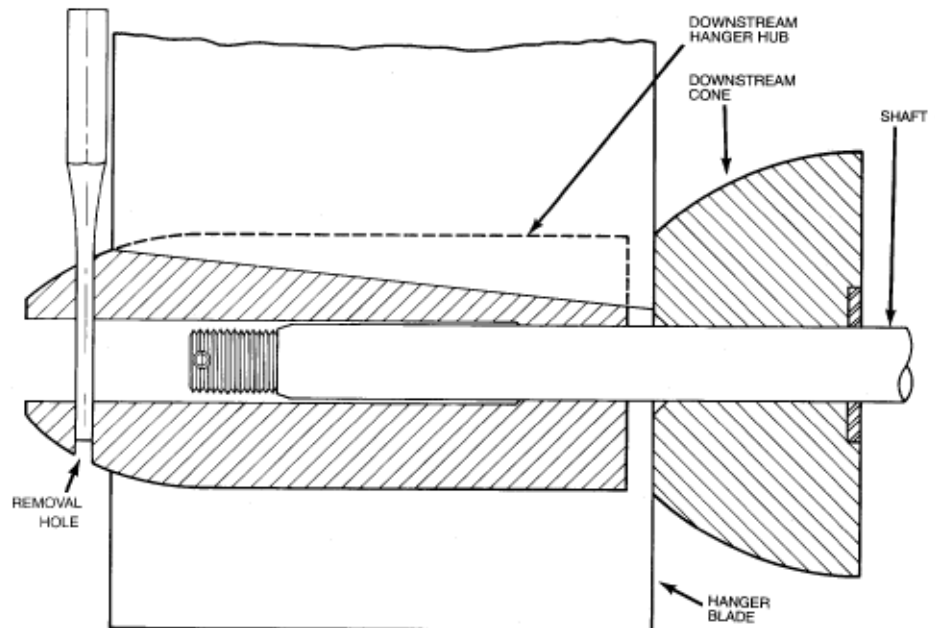
**Figure 5-4: Step 4**





5. Position meter housing horizontally with one hanger blade in the vertical top position. Slowly push (or tap) downstream end of shaft into downstream hanger hub.

Insert a punch or metal rod into the removal hole of the downstream hanger hub.



6. Strike upstream end of shaft with a soft headed hammer, loosening downstream hanger assembly. Remove the metal rod from the downstream hanger assembly.

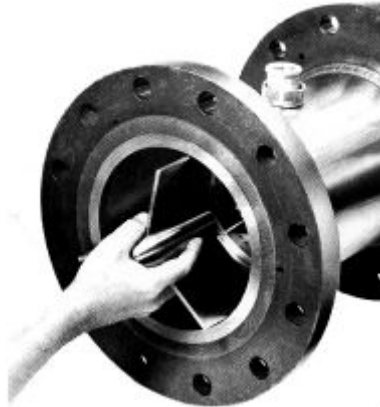
**Figure 5-5: Step 6**



7. Remove downstream hanger assembly from downstream end of meter housing. Care should be taken not to drop hanger blades.

---

**Figure 5-6: Step 7**



- 
8. Remove hanger blades from hanger hub.

---

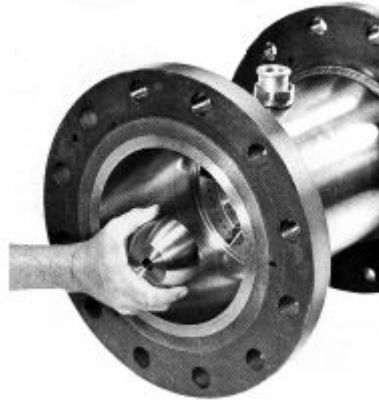
**Figure 5-7: Step 8**



- 
9. Remove downstream cone from shaft. Thrust washer should remain in cone.

---

**Figure 5-8: Step 9**



- 
10. Remove rotor from shaft. Leave journal on shaft.

**Note**

“A” is etched on one side of rotor hub, “B” on the other side. Notice which direction rotor was assembled.

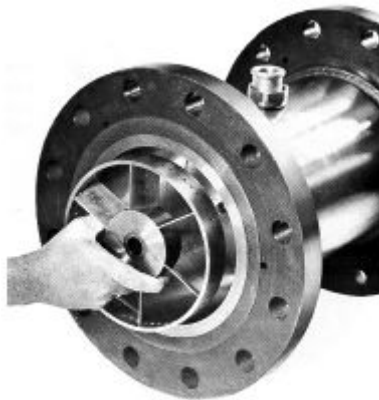
---

**Note**

If bi-directional rimmed rotor meter, remove deflector ring before removing rotor.

---

**Figure 5-9: Step 10**



- 
11. Remove journal from shaft. Take care not to drop.

---

**Figure 5-10: Step 11**



- 
12. Reach through meter and remove upstream cone from shaft. Thrust washer should remain in core.

---

**Note**

For most servicing, disassembly is now completed. However, if necessary for thorough cleaning or inspection, complete the following steps.

---

**Figure 5-11: Step 12**



- 
13. Remove shaft from upstream end of meter.

---

**Figure 5-12: Step 13**



- 
14. Insert shaft (end without nut) into downstream end of meter housing. Place end of shaft against the downstream hanger hub. With a soft headed hammer strike the shaft loosening the upstream hanger assembly.

---

**Figure 5-13: Step 14**



- 
15. Remove upstream hanger assembly from upstream end of meter housing.

---

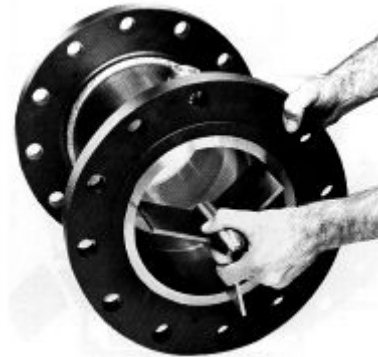
**Note**

Take care not to drop hanger blades.

---

---

**Figure 5-14: Step 15**



- 
16. Remove hanger blades from hanger hub.

---

**Figure 5-15: Step 16**



- 
17. If rimmed rotor meter, remove deflector ring from upstream end of meter housing.

---

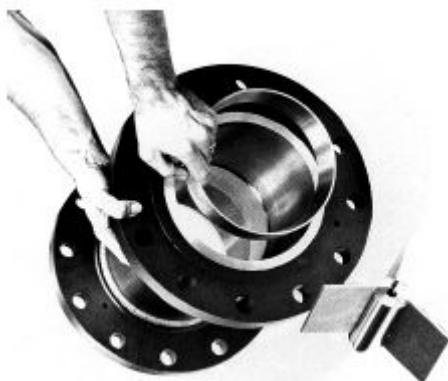
**Note**

Rimless rotor meters do not have a deflector ring.

---

---

**Figure 5-16: Step 17**



## 5.2 3" through 24" PT Meter assembly



### CAUTION

#### MECHANICAL EQUIPMENT DAMAGE

See Section 7 "INSPECTION" prior to assembly.

Failure to properly clean and inspect all parts according to Section 7 "INSPECTION" may result in meter damage and improper operation.

### Procedure

1. If rimmed rotor meter, install deflector ring by sliding it, widest edge first, into upstream end of meter housing until contacting the step in the bore.

---

#### Note

Rimless rotor meters do not have a deflector ring.

---

**Figure 5-17: Step 1**



2. Insert angled end of hanger blades into the three slots in a hanger hub. When correctly installed outside hanger blade edges are parallel to hanger hub. The upstream and downstream edges are perpendicular to hanger hub.

**Figure 5-18: Step 2**



3. Position hanger blades in hanger hub slots to protrude enough from the flat faced end of the hanger hub to allow the outside edges of hanger blades to fit inside meter housing bore.

---

**Figure 5-19: Step 3**



- a) Slide assembly, flat faced end first into upstream bore of meter housing.
  - b) Push hanger blades so downstream edges are touching deflector ring upstream edge on rimmed rotor meters or touching upstream edge of step in bore on rimless rotor meters.
  - c) Push hanger hub forcing hanger blades outward contacting meter housing bore.
  - d) Tap upstream edges of hanger blades with a soft headed hammer making sure they are properly positioned.
  - e) Then strike the upstream end of hanger hub wedging and locking assembly in place.
4. Insert shaft into center hole of upstream end of upstream hanger hub.

---

**Figure 5-20: Step 4**

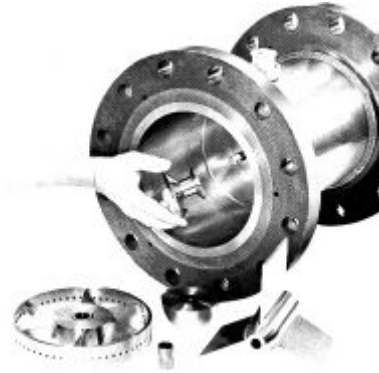


5. Put upstream cone, small diameter end first, on downstream end of shaft, slide into meter, contacting the downstream end of upstream hanger blades.



---

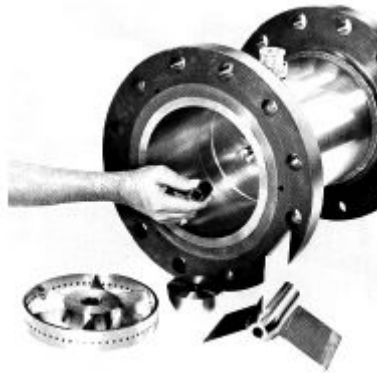
**Figure 5-21: Step 5**



- 
6. Place journal on shaft over threads. Wipe outside surface with a clean cloth.

---

**Figure 5-22: Step 6**



- 
7. Clean bearing inside surface. Slide rotor on to shaft and journal, simultaneously sliding journal and rotor along shaft to upstream cone.

---

**Note**

Install rotor in same direction as disassembled.

---

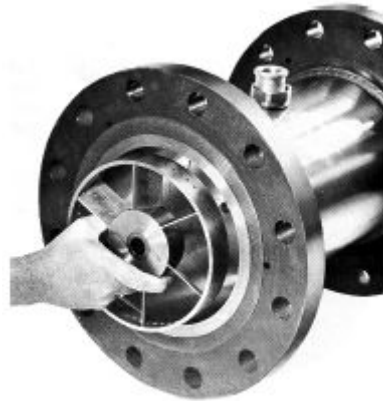
**Note**

If bi-directional rimmed rotor meter install deflector ring after installing rotor.

---

---

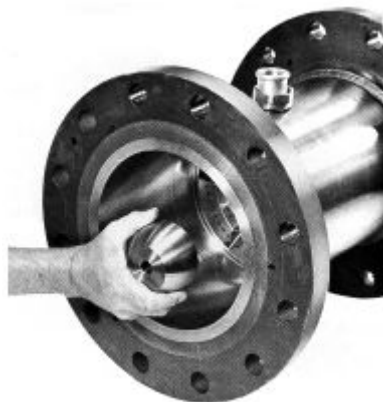
**Figure 5-23: Step 7**



- 
8. Install downstream cone, largest diameter end first, on to shaft and slide along shaft to rotor.

---

**Figure 5-24: Step 8**



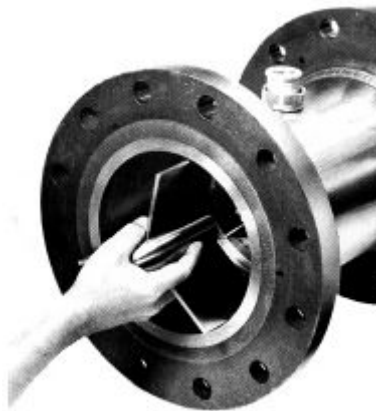
- 
9. Insert angled edge of hanger blades into the three slots in hanger hub.
- a) When correctly installed, outside edges of hanger blades are parallel to hanger hub and upstream and downstream edges are perpendicular to hanger hub.

---

**Figure 5-25: Step 9**

- 
10. Position hanger blades in hanger hub slots to protrude enough from the flat faced end of hanger hub to allow the outside edges of hanger blades to fit inside meter housing bore.

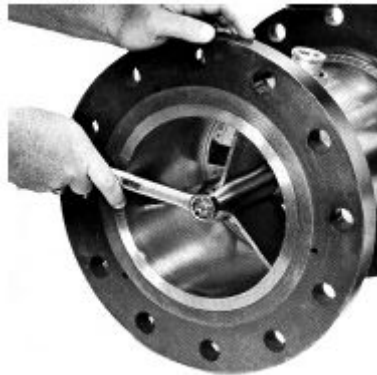
---

**Figure 5-26: Step 10**

- 
- a) Slide assembly, flat faced end first into downstream bore of meter housing and on to shaft.
  - b) Push hanger blades so upstream edges are touching downstream cone.
  - c) Push hub forcing hanger blades outward contacting meter housing bore.
  - d) Rotate downstream hanger assembly lining up upstream and downstream hanger blades.
  - e) Tap downstream edges of downstream hanger blades with a soft headed hammer to insure the blades are against the downstream cone.

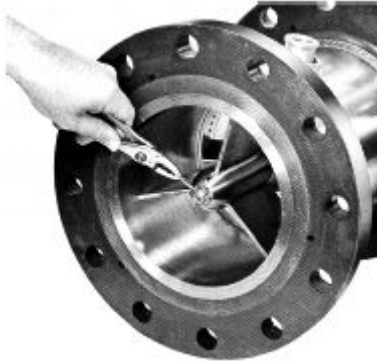
- f) Strike the downstream end hanger hub wedging and locking hanger assembly in place.
11. Tighten downstream nut, simultaneously holding upstream shaft nut to prevent shaft from turning. Line up cotter pin hole.
- 

**Figure 5-27: Step 11**



12. Insert cotter pin and bend ends around and back to nut.
- 

**Figure 5-28: Step 12**



13. To install pickup coil, clean debris from coil boss and coil tip. Screw in pickup coil.
- 

**Note**

Do not exceed 30 in. pounds of torque.

---

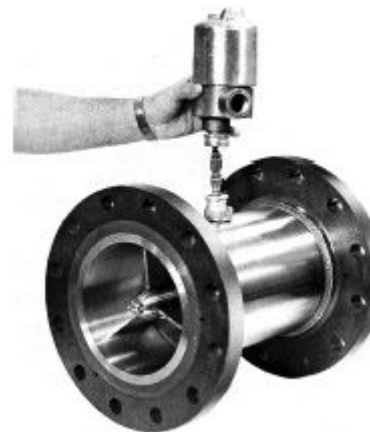
---

**Figure 5-29: Step 13**



- 
14. To install preamplifier housing hold preamplifier housing over pickup coil, connect and hand tighten the cable connector to pickup coil.
    - a) Lower explosion proof housing over pickup coil and tighten collar nut of the quick connect union.
- 

**Figure 5-30: Step 14**



---

**NOTICE**

When an XIHL or GUB2 enclosure is fitted, the coupling flame path must be checked and must not exceed 0.15 mm (0.006").

---

## 5.3 Parts inspection

Clean and inspect all parts for damage and wear. Replace parts as required. Clean bearings, journals and thrust washers with solvents and paper towels. Assemble dry. Do not spray lubricants as either a cleaner or a lubricant.

Upstream and downstream cones should have sharp edges free of nicks. Thrust washers should be seated flat in cone recesses.

Rotor hub and blade edges should be sharp and free of nicks and debris. Rotor blades should not be twisted or bent.

The bearing, which is pressed into the rotor hub, should have an equal amount protruding from both hub faces. The bearing internal surface and journal external surface should be smooth and free of scratches, wear spots, chips, and nicks. The bearing and journal are a matched set. For replacement, return the rotor to Daniel Measurement and Control, Inc. It is not recommended that the bearing be replaced in the field.



**Emerson Automation Solutions**

Daniel Measurement and Control, Inc.

North America / Latin America:

Headquarters

USA - Houston, Texas

T +1.713.467.6000

USA Toll Free 1.888.FLOW.001

[www.daniel.com](http://www.daniel.com)

Europe: Stirling, Scotland, UK

T +44.1786.433400

Middle East, Africa: Dubai, UAE

T +971.4.811.8100

Asia Pacific: Singapore

T +65.6777.8211

©2019 Daniel Measurement and Control, Inc. All rights reserved. Unauthorized duplication in whole or part is prohibited. Printed in the USA.

Daniel Measurement and Control, Inc. ("Daniel") is an Emerson Automation Solutions business unit. The Daniel name and logo are trademarks of Daniel Industries, Inc. The Emerson logo is a trademark and service mark of Emerson Electric Co. All other trademarks are the property of their respective companies.

**DANIEL™**

