

# DANIEL SERIES 1500 TURBINE METER

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**1" THROUGH 2 1/2" SIZES**

**INSTALLATION AND OPERATIONS  
MANUAL**

**DANIEL MEASUREMENT AND CONTROL, INC.  
AN EMERSON PROCESS MANAGEMENT COMPANY  
HOUSTON, TEXAS**

**Part Number 3-9008-503  
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## IMPORTANT INSTRUCTIONS

Daniel Measurement and Control, Inc. (Daniel) designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Daniel products.

- **Read all instructions prior to installing, operating and servicing the product.** If this instruction manual is not the correct manual, call 1-713-827-6314 (24-hour response number for both Service and Sales Support) and the requested manual will be provided. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Daniel representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by the manufacturer. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent personal injury.
- **ALWAYS READ AND FOLLOW THE DANIEL® SERIES 1500 TURBINE METER MANUAL AND ALL PRODUCT WARNINGS AND INSTRUCTIONS.**
- Use of this equipment for any purpose other than its intended purpose may result in property damage and/or serious personal injury or death.
- Before opening the flameproof enclosure in a flammable atmosphere, the electrical circuits must be interrupted.
- The ATEX approval applies to equipment without cable glands or conduit seals. When mounting the flameproof enclosure in a hazardous area, only flameproof cable glands and conduit seals certified to EN 60079-1 must be used.

## CAUTION

### DAMAGE TO ELECTRONIC COMPONENTS

**Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.**

Failure to properly handle the instrument can damage electronic components that are susceptible to static electricity.

#### Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

## CAUTION

### DAMAGE TO ELECTRONIC COMPONENTS

**This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, CMOS, etc.).**

Failure to properly handle the instrument can damage or destroy electronic components that are susceptible to even small amounts of static electricity. The components will exhibit early failure even though they appear to function properly

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DANIEL SERIES 1500 TURBINE  
INSTALLATION AND OPERATIONS MANUAL**

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## **1.0 INTRODUCTION**



### **1.1 General**

This manual is designed to assist in the installation and operation of the Series 1500 Turbine Flowmeter. To assure proper installation and startup it is important to read this manual in its entirety.

### **1.2 Description**

The Series 1500 Turbine Flowmeter is a volumetric flow metering and transmitting device used extensively in the petroleum industry for the accurate measurement of hydrocarbon and other related process fluids. The meter's clean lines and simple configuration assures higher flow rates, extended flow range and sustained performance capability.

It is designed for use within the guidelines of API Standards, Chapter 5.3, formerly Standard 2534 (The Measurement of Liquid Hydrocarbons by Turbine Meter Systems) and the test procedures of API Standards, Chapter 4 (Prover Systems).

The UMB (Universal Mounting Box) provides explosion proof, weather resistant housing for both single or dual pickoffs as well as the preamplifier board. It serves as the mechanical mounting connection necessary for local and remote accessories.

The Series 1500 Turbine is ideal for applications requiring high frequency resolution. Applications may include Electronic Registers, Batchers, Electronic Presets or Flow Computers.

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## 2.0 SPECIFICATIONS



### **PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Do not exceed specifications listed below.**

Failure to heed this warning could result in serious injury and/or damage to the equipment.

### **Performance - Meter**

#### Linearity:

1", 1 1/2", 2" and 2 1/2".

± 0.25% over normal flow range

± 0.15% premium linearity over reduced flow ranges. Consult Daniel Measurement engineers.

#### 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 #

#### Viscosity and Specific Gravity:

Low specific gravities or high viscosities will reduce the flow range of the meter. Consult Daniel Measurement engineers.

**Preamplifier Performance****Inputs**

Supply voltage: 10-30 Vdc  
Sensor Type: Reluctance  
Signal: Sine Wave  
Preamp Sensitivity: 40 mV peak to peak minimum

**Outputs**

## Powered Pulse Output

Type: Square Wave  
Frequency Range: 0 to 5 kHz  
Amplitude: 0 to 5 V  
1000 Ohm internal pull-ups, 20 mA, max.

## Variable Voltage Output

Type: Square Wave  
Frequency Range: 0 to 5 kHz  
Amplitude: 0 to Supply Voltage  
1000 Ohm internal pull-ups, 70 mA, max.

## Open Collector Output (per Channel)

Type: Square Wave  
Frequency Range: 0 to 5 kHz  
Max. Voltage: 30 Vdc  
Max. Current: 125 mA  
Max. Power: 0.5 Watts

**Transmission Distance**

Without Preamp: 20 ft. (6.1 meters)  
With Preamp: 3,000 ft. (914 meters)  
Belden 88442 or equivalent up to 20 ft.

**Materials of Construction**

Meter Body (All sizes): St. Steel  
Internal Components: St. Steel  
Bearings: Tungsten Carbide  
UMB Housing: Aluminum

**Ratings**

Pressure	ANSI pressure/temperature rating corresponding to flanges used
Ambient Temperature	-40 to 140°F (-40 to 60°C) ( $T_{amb}$ is an electrical specification)
Process Temperature	-20° to 180° F (-29° to 82° C)
Optional Process Temperature	-20° to 400° F (-29° to 204° C), ATEX -29° to 200° C

**NOTICE**

At temperatures above 180° F the preamplifier must be remote mounted.

The maximum working pressure for the Series 1500 Turbine Meter is based on the temperature/pressure rating of the ANSI B16.5 flanges. The following chart lists the maximum working pressure of 304 stainless steel flanges at 100°, 180°, and 400°F. For maximum working pressures at intermediate temperatures refer to ANSI B 16.5.

Pressure/Temperature	Stainless Steel
150# ANSI / -20 to 100°F	275 psig WP
150#ANSI / 180°F	239 psig WP
150#ANSI / 400°F	190 psig WP
300# ANSI / -20 to 100°F	720 psig WP
300# ANSI / 180°F	624 psig WP
300# ANSI / 400°F	495 psig WP
600 ANSI / -20 to 100°F	1440 psig WP
600# ANSI / 180°F	1248 psig WP
600# ANSI / 400°F	995 psig WP
900# ANSI / -20 to 100°F	2160 psig WP
900# ANSI / 180°F	1872 psig WP
900# ANSI / 400°F	1490 psig WP

**Mechanical Connections:**

Standard: 150, 300, 600 and 900 lb. ANSI R.F. flanges

For other ANSI ratings consult the factory.

**Approvals:**

Electrical: Class I, Division 1, Groups C & D, UL, and CUL

Environmental: NEMA 4

Standard Temperature:

**CE 0539 Ex II 2G**  
**DEMKO 03 ATEX 130946X**  
**Ex d IIB T6**

Optional Temperature:

**CE 0539 Ex II 2G**  
**DEMKO 03 ATEX 130946X**  
**Ex d IIB 210°C**

### **3.0 INSTALLATION**

#### **3.1 General**

This section contains specific instructions for installation of the meter.

#### **3.2 Flow Considerations**

A properly designed flow system will do two basic things towards maintaining the linearity of the turbine meter. It will properly condition the incoming flow such that it is homogeneous throughout its cross section and it will provide proper back pressure so that cavitation will not originate inside the meter.

Linearity can be defined as the total range of deviation of accuracy, expressed as a curve, between minimum and maximum flow rates. The ideal accuracy curve of a volumetric meter, such as the turbine, is a straight line denoting a constant meter factor.

Cavitation is the formation and collapse of vapor-filled cavities that result from a sudden decrease and increase in pressure.

Turbine meter performance depends on the incoming fluid being devoid of swirls and excessive turbulence. These conditions can be avoided by providing unobstructed piping upstream of the meter. Pipe fittings such as elbows and tees, and piping components such as valves and strainers should be located far enough upstream as to allow as to dissipate any flow disturbance before it reaches the meter. Use of flow straighteners or a flow conditioning plate greatly influences meter performance.

##### **A. Specific Gravity**

The turbine meter is affected by specific gravity and may influence performance. The effect of specific gravity on the turbine meter may be evidenced when specific gravity drops below 0.7. As specific gravity decreases, the lift forces on the turbine blade decreases. Likewise as velocity decreases, lift forces decrease. These reduced lift forces are overtaken by bearing friction as low rates are approached. Subsequently, linearity deteriorates at low flow rates while measuring light fluids.

##### **B. Viscosity**

Turbine meters are viscosity sensitive in that as the metered fluid increases in viscosity, meter linearity begins to suffer. This effect on linearity is primarily due to a change in the fluid's velocity profile and skin friction between the fluid and the rotor blades.

Generally speaking, viscosities of 3 centipoise or less give no cause for concern. Above this viscosity, all influential factors should be considered. By properly anticipating the flow system's viscosity, maximum flow rate, flow range and desired linearity, the user can properly apply the turbine meter to the required application.

### 3.3 Installation and Equipment

Figure 3-1, Typical Installation, has been provided as a guide in establishing optimum performance of the meter. Prior to installation, consider the general information listed below.

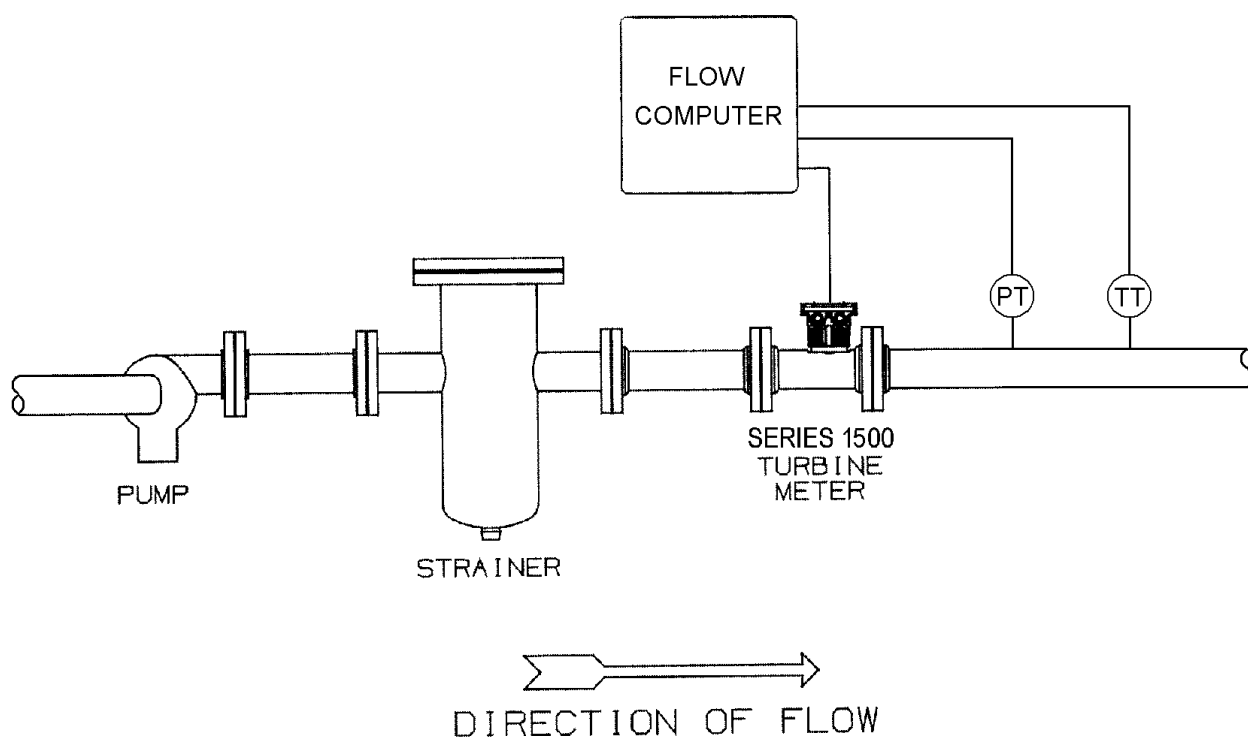


Figure 3-1. Typical Installation

1. Note the direction of flow indicated on the plate near the inlet flange and install accordingly.
2. New Installations - Lines should be flushed thoroughly to rid piping of potentially damaging foreign material such as welding bead, pipe scale, etc. before the meter is placed into service.



**NOTICE**

A spool piece installed in place of the meter is recommended for this procedure.

When installing this equipment, bolting must conform to the requirements of ASME B16.5 paragraph 5.3 and to the material requirements of ASME B16.5 Table 1B. Gaskets must conform to the requirements of ASME B16.20.

It is the customer's responsibility to ensure that piping or other attachments connected to the Product do not place adverse stresses on the Product.

The design of the Product has not been assessed for the effects of traffic, wind or earthquake loading.

It is the customer's responsibility to provide fire prevention measures and equipment per local regulations.

**⚠ WARNING****PERSONAL INJURY AND/OR DEATH**

**Never use equipment for unintended purposes.**

Use of this equipment for any purpose other than its intended purpose may result in property damage and/or serious personal injury or death.

The Product has been designed with a minimum of 1.5mm (.059 inches) corrosion allowance. The customer should implement a periodic inspection and maintenance program to ensure that no part of the Product's pressure-retaining components has corrosion or erosion exceeding this amount. (The design engineer may choose to select a different corrosion allowance, but it should be identified and published.)

### 3. Products to be measured -

## CAUTION

### MECHANICAL EQUIPMENT DAMAGE

**Always use a flushing medium that is compatible with the metallurgy of the meter and its internal components and similar to the product for which the meter is intended.**

Using water as a flushing medium may result in damage to the internal components of the turbine meter.

### A. Valves

The metering system should have a flow rate control valve located at a convenient distance downstream of all measurement equipment. The function of the control valve is to limit and maintain system pressure on the meter. This avoids cavitation.

1. Valves should be capable of rapid, smooth opening and closing with positive shut-off.
2. When used for intermittent flow, valves should be fast acting and shock-free.
3. Bypass lines should be equipped with blind or positive shutoff devices.
4. Shut-off or control valves should be located downstream of the meter.

**B. Flow Straightening**

For proper operation of the meter, a flow conditioning plate, flow straightener (designed for the meter), or a straight run of pipe (20 pipe diameters long) is required. All piping must be the same diameter as the meter. Flow straightening devices must be installed directly upstream of the meter and should contain no flow restricting devices which could cause reversal of the flow straightening effect.

**C. Flow Conditioning Plate**

The flow conditioning plate is available for all standard Series 1500 Turbine meters, size 2", and is designed to eliminate product flow characteristics such as liquid swirl and non-uniform velocity profiles (induced by piping configurations and other elements of the system) that may impede proper measurement within the turbine meter run. The plate is installed directly into the inlet of the meter. Due to the flow conditioning influence on the incoming product, this reduces the requirement for upstream flow straightening piping. It is recommended that a minimum of five pipe diameters be maintained upstream of the meter and five pipe diameters downstream of the meter to assure proper operation. Actual length will be determined by piping requirements specific to the application.

**D. Strainers**

A strainer of proper size should be installed upstream of the meter to protect it from the introduction of foreign material which might damage the meter. Recommended mesh sizes include: 80 mesh for refined products, and 20 to 40 mesh for crude products (depending on the product being measured).

**Strainer Monitoring:**

1. Recommended procedures dictate that regular, scheduled cleaning of the strainer basket be conducted to prevent filling and rupturing of the screen.
2. Pressure gauges installed on both sides of the strainer will indicate differential pressure across the strainer. High pressure differential caused by filling of the basket or occlusion of foreign material can cause strainer basket rupture resulting in possible meter damage.

### **3.4 Pickoff Coils and Electrical Connections**

#### **A. Pickoff Coils**

The Series 1500 Turbine has the capacity for single or dual pickoff coils mounted 90° electrically out of phase. Each pickoff produces a low level sine wave signal which varies in amplitude (mV) and frequency (Hz), proportional to the velocity of the turbine blades. This signal information is coupled to the input terminals of the preamplifier.

The optional dual UMB Turbine Meter can be configured with up to four pickoff coils, each pair mounted 90° electrically out of phase.

#### **B. Electrical Connections**

Pickoff input signal connections are made at terminal strip connection TB2 for Channel A, and TB3 for Channel B. Power supply and output signal connections are made at terminal strip TB1. Reference Figure 3-2. For single channel wiring use Belden 8770, or equivalent. Earth ground shield at one end only. Terminate shield and insulate it at the other end. For dual channel wiring use Belden 8770, or equivalent for power and channel A signal. Use Belden 8219, or equivalent for channel B. Connect both shields to earth ground at one end of cables and terminate and insulate shields at the other end. UMB housing should be at earth ground.

#### **C. Induced Interference**

The Turbine meter should be located as far as possible from any electrical equipment such as motors, solenoids or relays which could induce an interference signal into the turbine meter pickoff coil. High amplitude interference introduced into the preamplifier can result in interference with the flow signal.

Proper shielding and an earth grounded UMB housing will greatly reduce the possibility of induced interference. See B, Electrical Connections.

#### **D. Accessory Hookup**

General considerations: It is important that the appropriate service manual be referenced before attempting to use accessories or instrumentation with the Series 1500 Turbine. If service manuals for instrumentation were not received at the time of purchase or delivery, please contact the factory or nearest Daniel Measurement and Control sales and service office.

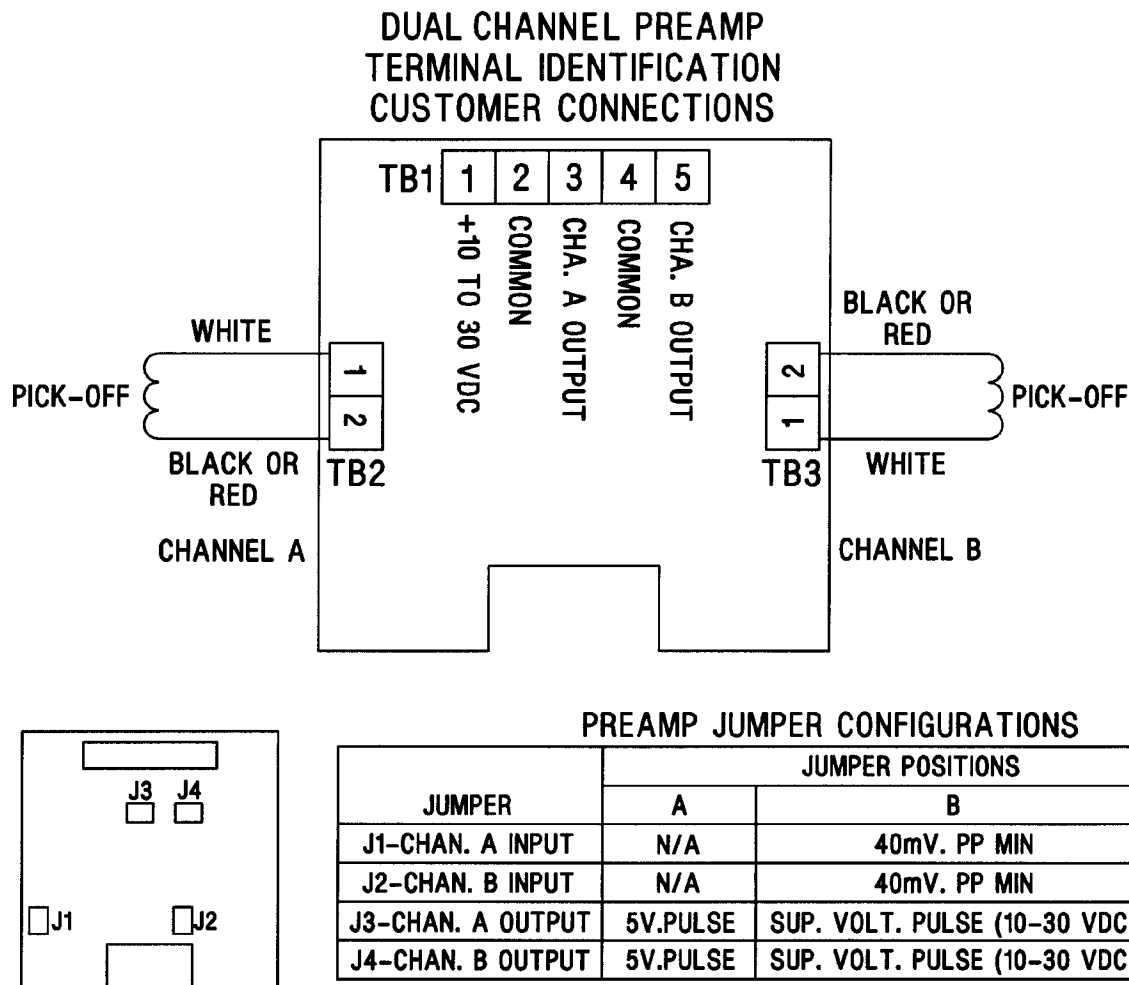


Figure 3-2. UMB Wiring

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## **4.0 OPERATION**

### **4.1 General**

This section contains the operating procedures for the Series 1500 Turbine Flowmeter. Reference Section 3-4 for general flow considerations that may effect meter performance. The Series 1500 Turbine Meter is a volumetric flow measuring and transmitting device that produces an output signal proportional to the rate-of-flow of the liquid being measured. The primary output is a single or dual high resolution signal that is amplified and shaped by an integral amplifier mounted within an explosion proof housing. This wave pulse can be fed directly to remote totalizing counters, digital readout devices or control instrumentation, or an integrally mounted Tri-10 Electronic Register.

### **4.2 Pre-start Checks**

1. Inspect all electrical connections to assure compliance to electrical codes and safety regulations.
2. All bolts used to secure the meter in line should be inspected to assure that proper mounting procedures have been followed and that flange connections are leak free.
3. Evaluate the system setup to assure that all components are in the proper sequence for accurate product measurement: isolation valve, strainer, flow straightener, meter, downstream section, control valve, etc.
4. Ensure that the supply voltage to the preamp is within the range of 10-30 VDC.

### 4.3 Operation

Flow and pressure information is stamped on the nameplate located on the outside of the meter.



#### **PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Never subject the meter to flow or pressure ranges above those specified in Section 2 Specifications, or those stamped on the meter.**

Exceeding the meter specifications could result in serious injury and/or damage to the equipment.

1. Back pressure at the outlet of the meter must be sufficient for proper operation. Consider the following equation when determining back pressure for the meter.

2.  $P_b = 2 \Delta p + 1.25 p_e$

Where

$P_b$  = minimum back pressure, pounds per square inch gauge (psig)

$\Delta p$  = pressure drop through the meter at the maximum operating flow rate for the liquid being measured, pounds per square inch (psi)

$p_e$  = equilibrium vapor pressure of the liquid at the operating temperature, pounds per square inch absolute (psia), gauge pressure plus atmospheric pressure

3. Valves should be opened slowly in such a way as to prevent system shock.
4. Care should be taken to protect the Series 1500 housing and components from external impact of any kind. Note temperature limitations, Section 1 when selecting meter location.



## **5.0 MAINTENANCE**

Reference Figures 7-1 through 7-4 Exploded Parts Drawing.

### **NOTICE**

Item numbers reference actual engineering drawings and are not meant to be consecutively numbered.

### **5.1 General**

The Series 1500 Turbine is designed to operate for extended periods of time without evidence of wear or loss of precision. All meter adjustments were completed at the factory during liquid calibration and should not require field setup. However, should inspection of internal components be required or should field requirements change, information contained in this document must be read and understood before attempting any maintenance procedure.

If the Series 1500 Turbine is found to be in need of repair, it is recommended the user contact the nearest Daniel Measurement and Control Sales or Service Office. It is important that servicing be performed by trained and qualified service personnel.

### **5.2 Maintenance Considerations**

1. Label all parts or place parts in labeled containers during disassembly.
2. Use no metal clamping devices in direct contact with any meter part or surface.
3. Rotor blades determine proper flow measurement and should be handled with extreme care. Bending or altering the blades in any way can effect meter accuracy.

### 5.3 Disassembly of Internal Components - 1 1/2", 2" and 2 1/2"

1. Before removing the meter from the system the following precautions must be taken:
  - a. Disconnect all power to the meter.



#### **PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Disconnect power to the meter.**

Failure to disconnect power to the meter could result in serious personal injury and/or damage to the equipment.

- b. Relieve all line pressure.

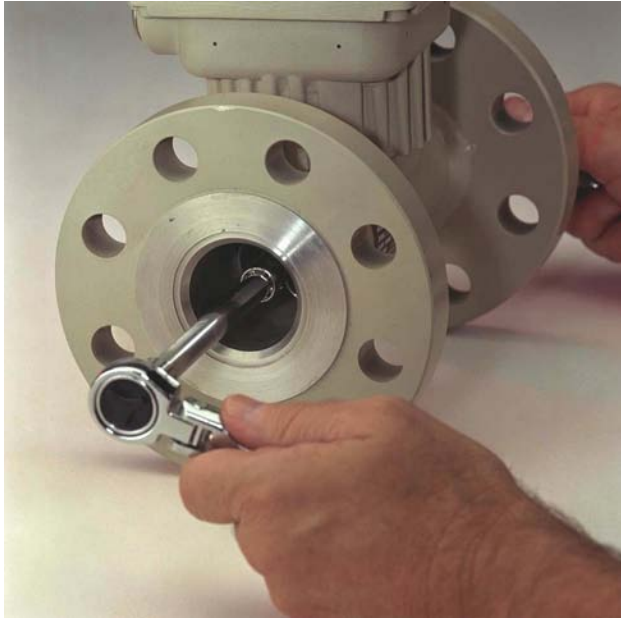


#### **PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Relieve pressure at this time.**

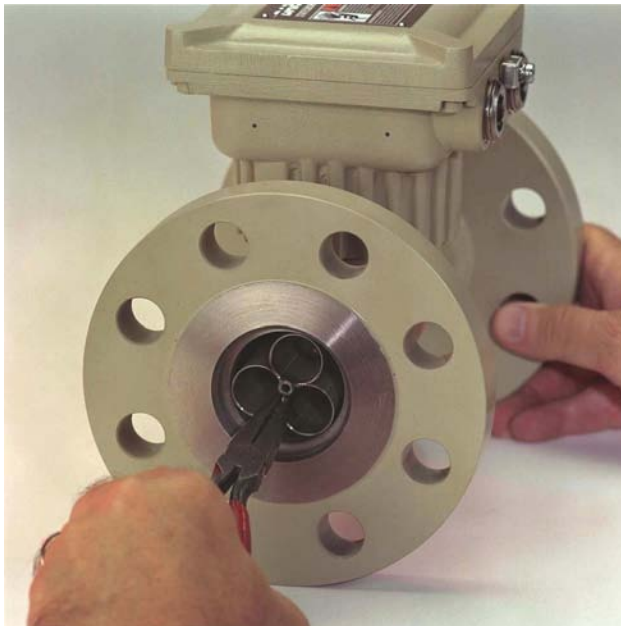
Failure to relieve line pressure at this time could result in serious personal injury and/or damage to the equipment.

2. Disconnect conduit connections to the Series 1500 Turbine. (Reference Figure 7-1)
    - a. Remove screws (item 52) and top cover (item 16) of the UMB.
    - b. Disconnect conduit connections from terminal board TB1 (assembly item 56).
  3. Remove meter from line.



**Disassembly Step 1**

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

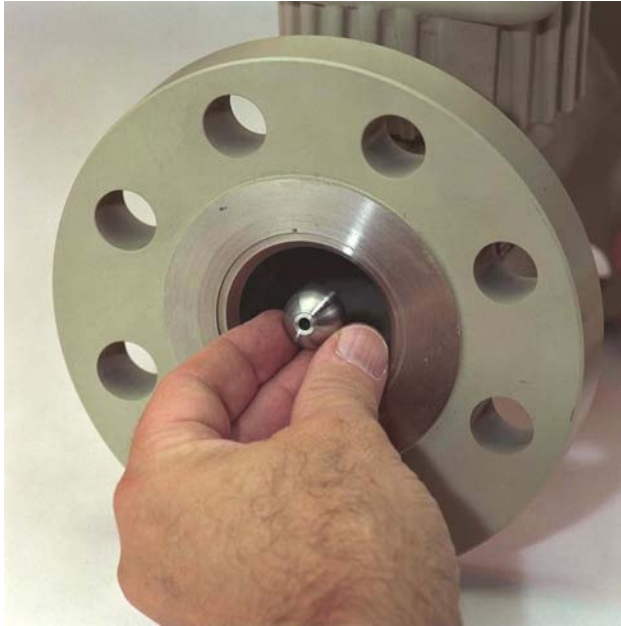


**Disassembly Step 2**

Using a pair of needle nose pliers, remove downstream spring clip assembly by pulling straight out downstream end of meter.

**NOTE:**

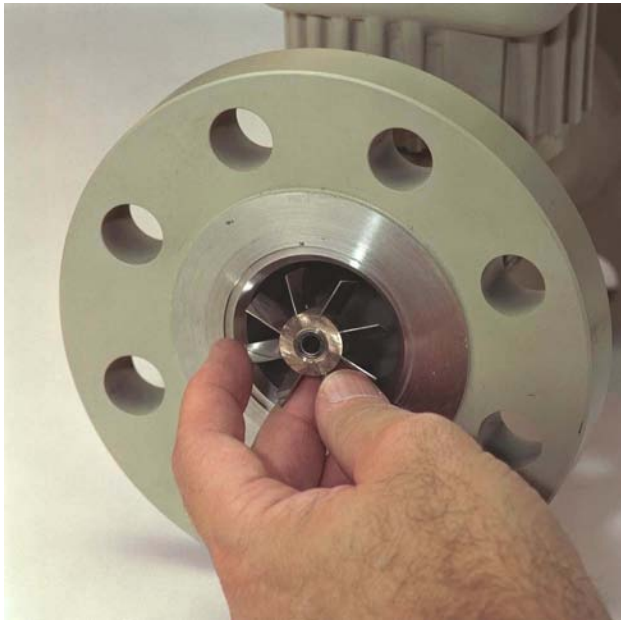
*1 1/2" Sizes - Thrust washer may remain in cone but may be loose. Take care not to drop.*

**Disassembly Step 3**

1 1/2" Size - Downstream cone is welded to spring clip assembly. Proceed to Step 4.

2" & 2 1/2" Size - Remove downstream cone from shaft.

**NOTE:** *Thrust washer may remain in cone but may be loose. Take care not to drop.*

**Disassembly Step 4**

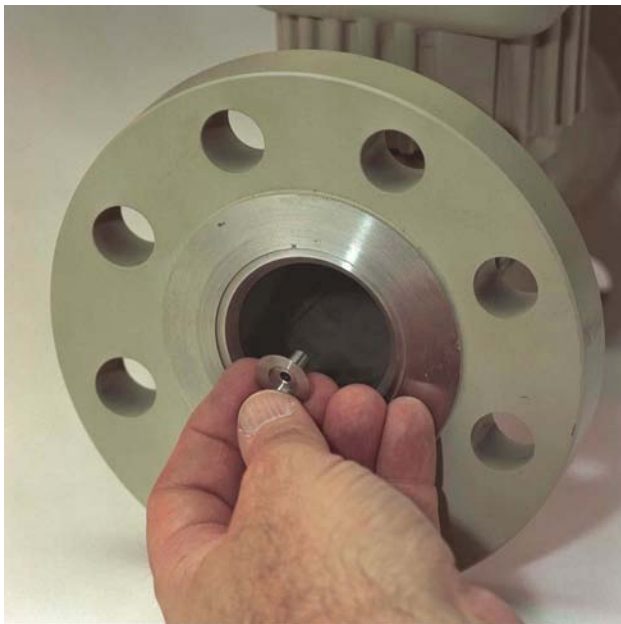
Remove rotor from shaft. Journal may come out with rotor or remain on shaft. Take care not to drop journal or thrust washer.

**NOTE:** *"A" is etched on one side of rotor hub. "B" on the other side. Notice which direction rotor was assembled.*



**Disassembly Step 5**

Remove journal from shaft.



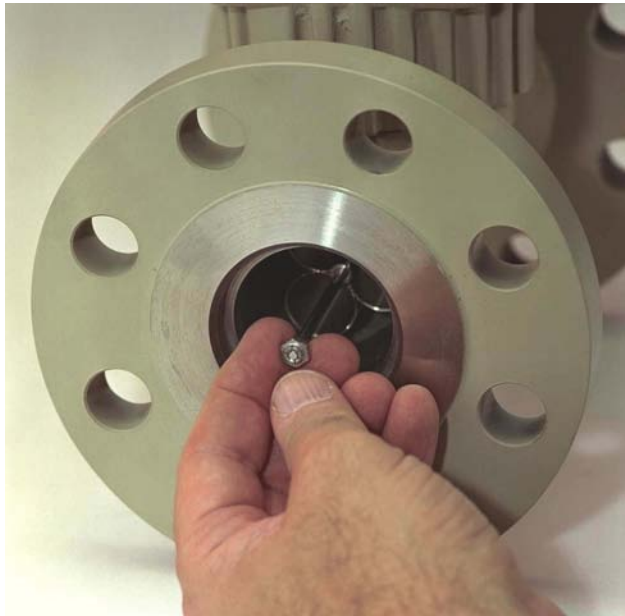
**Disassembly Step 6**

1 1/2" Size - Upstream cone is welded to spring clip assembly, proceed to Step 7.

2" & 2 1/2" Size - Reach through meter and remove upstream cone and thrust washer from shaft.

**NOTE:**

*Thrust washer may remain in cone but may be loose. Take care not to drop.*



**Disassembly Step 7**

Remove shaft from upstream end of meter.



**Disassembly Step 8**

Using a pair of needle nose pliers, remove spring clip assembly by pulling straight out.

**NOTE:**      *1 1/2" Size - Thrust washer may remain in cone but may be loose. Take care not to drop thrust washer.*

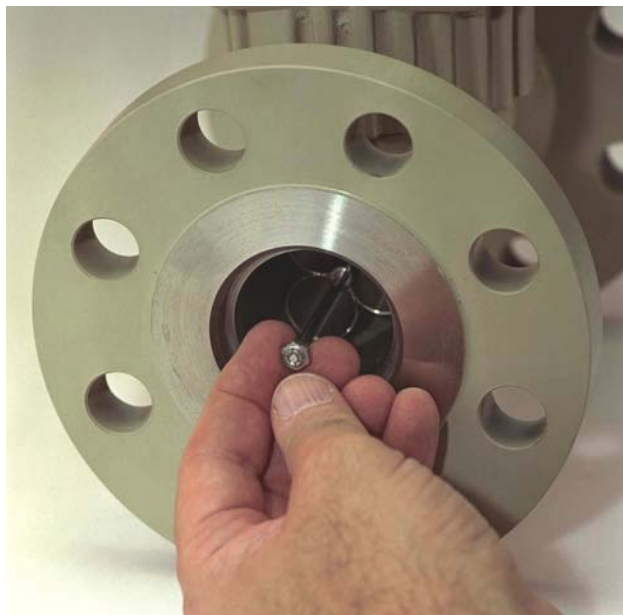
All parts should be cleaned, inspected, and any part found to be worn should be replaced.



**5.4 Assembly of Internal Components - 1 1/2", 2" and 2 1/2"****Assembly Step 1**

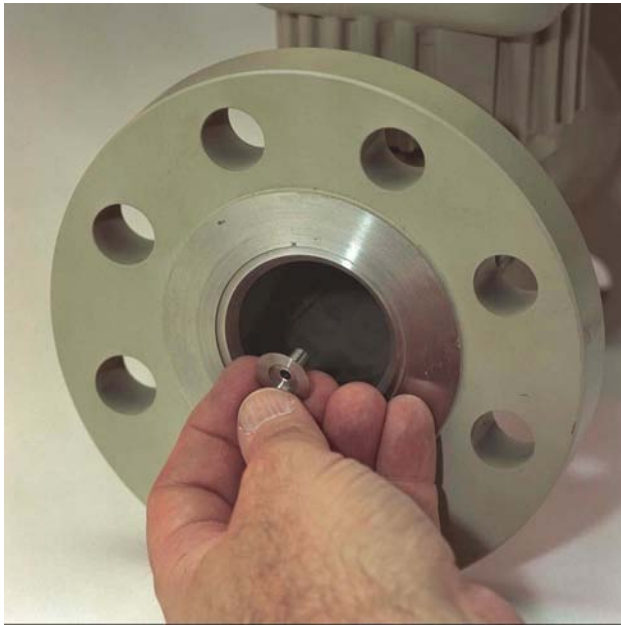
2" & 2 1/2" Size - Place upstream spring clip assembly, small washer end first, into upstream end of housing. Push spring clip assembly into bore to shoulder.

1 1/2" Size - Place thrust washer in counterbore of upstream cone face, polished side out. Place upstream spring clip assembly cone end first into upstream end of housing. Push assembly into bore to shoulder.

**Assembly Step 2**

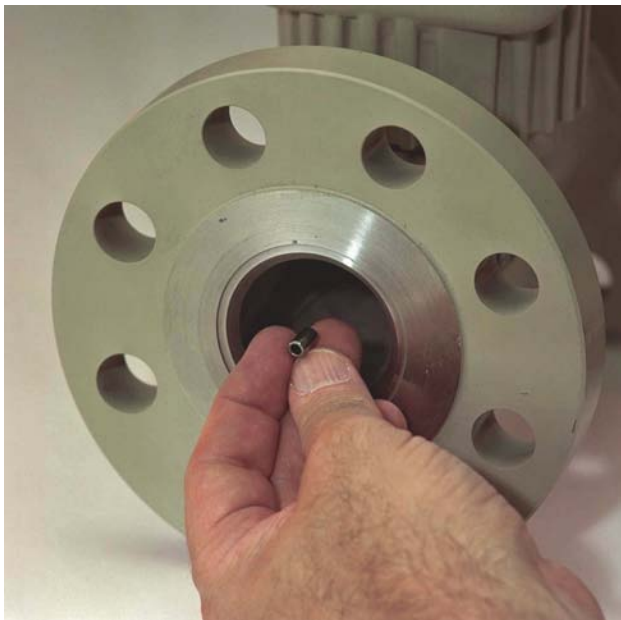
Insert end of shaft into center hole of upstream end of upstream spring clip assembly.

1 1/2" Size - Take care not to knock thrust washer out of cone counterbore.

**Assembly Step 3**

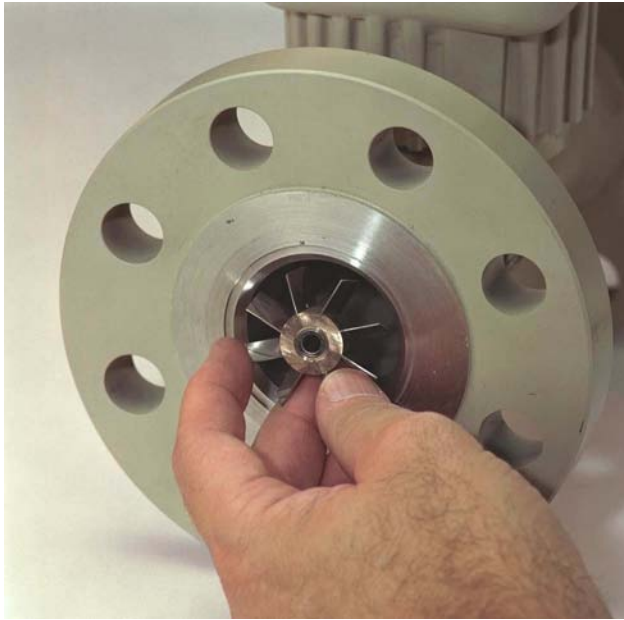
1 1/2" Size - Upstream cone is welded to upstream clip assembly. Proceed to Step 4.

2" & 2 1/2" Size - Place thrust washer in counterbore of upstream cone face, polished side out. Place upstream cone, small diameter end first, on the downstream end of the shaft, slide into meter, contacting the downstream end of the upstream spring clip assembly.

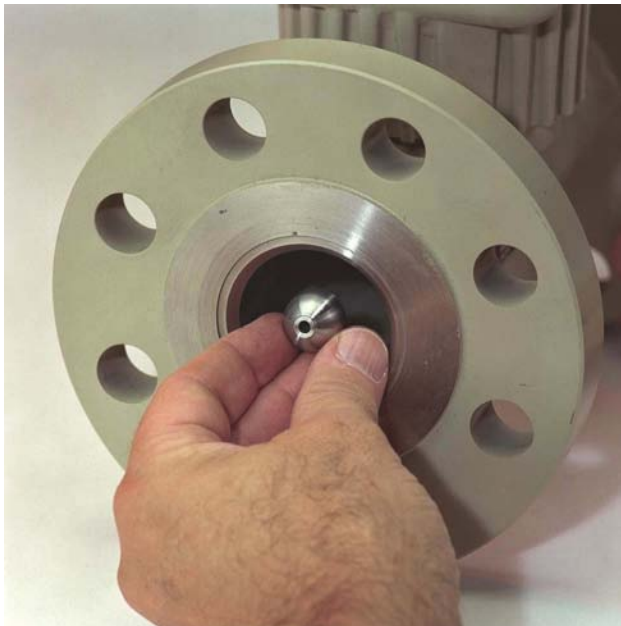
**Assembly Step 4**

Place journal on shaft. Wipe outside surface with a clean cloth.



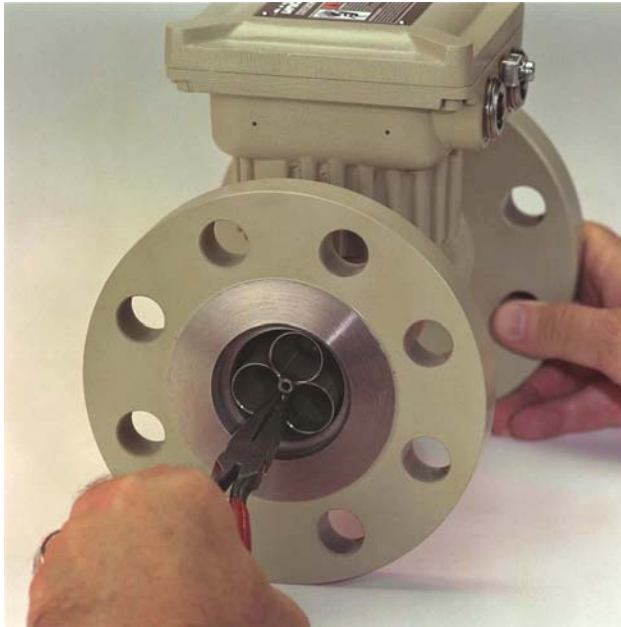
**Assembly Step 5**

Clean bearing inside surface and install rotor in same direction as disassembled. Slide rotor onto shaft and journal. Simultaneously slide journal and rotor along shaft to upstream cone.

**Assembly Step 6**

1 1/2" Size - Downstream cone is welded to downstream spring clip assembly, proceed to Step 7.

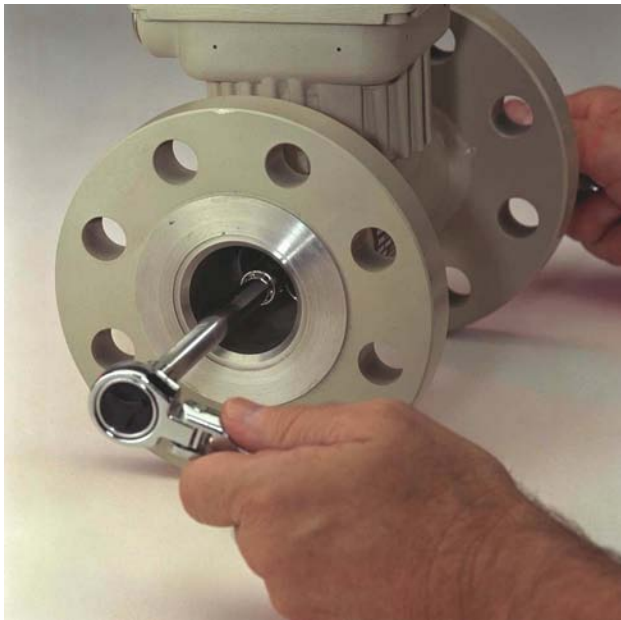
2" & 2 1/2" Size - Place thrust washer in the counterbore on the downstream cone face, polished side out. Install downstream cone, large diameter end first, onto shaft and slide along shaft to rotor.

**Assembly Step 7**

1 1/2" Size - Place thrust washer in counterbore of downstream cone face, polished side out. Place downstream spring clip, cone end first, into downstream end of housing, push spring clip assembly into bore contacting journal.

2" & 2 1/2" Size - Place downstream spring clip, small washer end first, into downstream end of housing, push spring clip assembly into bore contacting downstream cone.

*NOTE: Rotate downstream spring clip assembly to align the three tubes with the tubes of the upstream spring clip assembly.*

**Assembly Step 8**

Tighten downstream nut, simultaneously holding upstream nut to prevent shaft from turning.

**NOTICE**

**IMPORTANT** - Torque the retaining nut to 25 in. lbs. for the 1 1/2" meter, 30 in. lbs. for the 2" meter, and 40 in. lbs. for the 2 1/2" meter.

**5.5 Disassembly of Internal Components - 1"**

1. Before removing the meter from the system the following precautions must be taken:
  - a. Disconnect all power to the meter.

**⚠ WARNING****PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Disconnect power to the meter.**

Failure to disconnect power to the meter could result in serious personal injury and/or damage to the equipment.

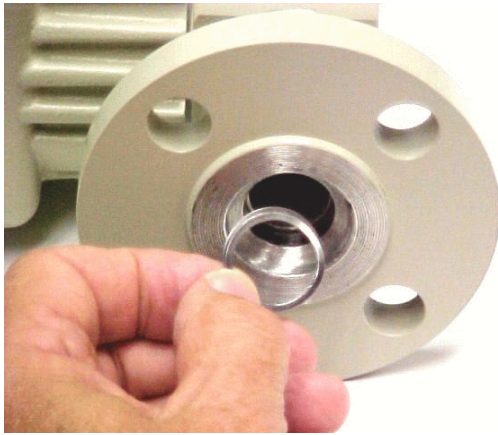
- b. Relieve all line pressure.

**⚠ WARNING****PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

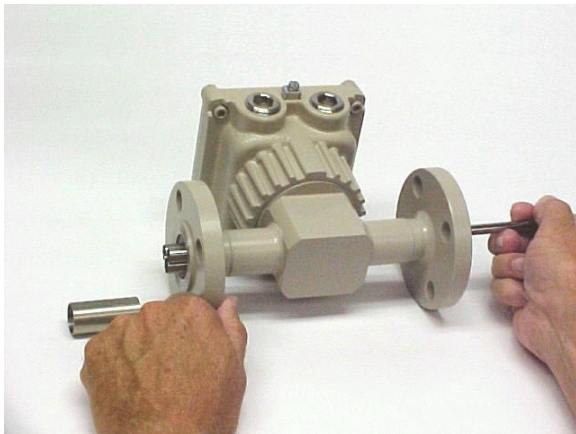
**Relieve pressure at this time.**

Failure to relieve line pressure at this time could result in serious personal injury and/or damage to the equipment.

2. Disconnect conduit connections to the Series 1500 Turbine. (Reference Figure 7-1)
  - a. Remove screws (item 52) and top cover (item 16) of the UMB.
  - b. Disconnect conduit connections from terminal board TB1 (assembly item 56).
3. Remove meter from line.

**Disassembly Step 1**

Remove retainer ring from upstream end of meter.

**Disassembly Step 2**

Using a long dowel or rod push downstream end of downstream spring clip assembly towards the upstream end of the housing sliding the internal assembly and sleeve out of the meter housing.

**Disassembly Step 3**

Pull the upstream spring clip assembly away from the downstream spring clip assembly. The shaft with the rotor and journal will stay with either the upstream or downstream spring clip assembly. Remove the downstream spring clip assembly from the upstream end of the housing.

**NOTE:**

*Thrust washers may remain in the cones but may be loose. Take care not to drop.*

**Disassembly Step 4**

Remove rotor from shaft. Journal may come off with rotor or remain on shaft. Take care not to drop journal.

*NOTE: "A" is etched on one side of rotor hub. "B" on the other side. Notice which direction rotor was assembled.*

**Disassembly Step 5**

Remove journal and thrust washer from shaft.

**Disassembly Step 6**

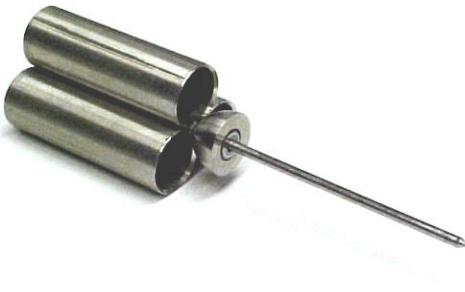
To remove shaft, pull shaft out of cone and spring clip assembly.

## **5.6 Assembly of Internal Components - 1"**



### **Assembly Step 1**

Push one end of shaft into center hole in downstream spring clip assembly cone. Place a thrust washer, unpolished side first, onto shaft and position in counterbore of cone.



### **Assembly Step 2**

Place journal on shaft and slide to contact downstream cone. Wipe journal outside surface with a clean cloth.



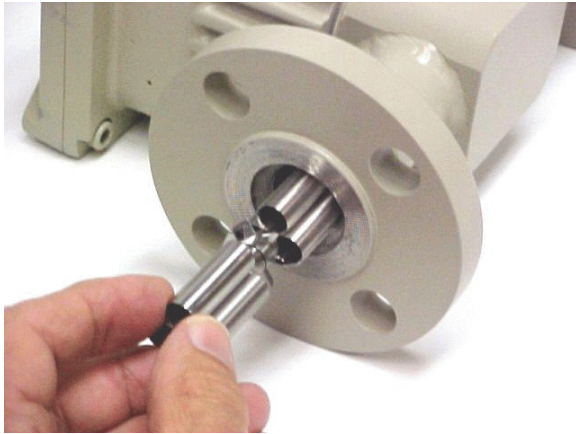
### **Assembly Step 3**

Clean bearing inside surface and install rotor in same direction as disassembled. Slide rotor onto shaft and place on journal.



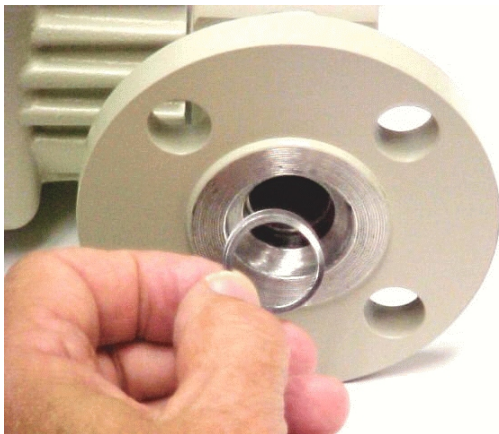
**Assembly Step 4**

Place thrust washer in counterbore of upstream cone face, polished side of thrust washer out. Place end of shaft into center hole in upstream spring clip assembly cone and push the upstream and downstream spring clip assemblies together until the cones/thrust washers contact the journal.

**Assembly Step 5**

Insert internal assembly downstream spring clip, assembly end first, into the upstream end of the meter housing bore. Push internal assembly into the bore contacting the shoulder on the downstream end of the housing bore.

Rotate downstream spring and assembly to align the three tubes with the three tubes of the upstream spring clip assembly.

**Assembly Step 6**

Install sleeve and retainer ring in groove in upstream end of housing bore. Tang side of retainer ring is to be inserted last to provide for future disassembly.

## 5.7 Field Retrofitable Dual Pickoff

In the event that a second pickoff is required for equipment originally supplied with a single pickoff, or should field service or replacement of existing pickoffs be necessary, the following procedure is recommended.

See Figures 7-1 through 7-4.

1. Disconnect all power to the meter.



### **PERSONAL INJURY AND/OR EQUIPMENT DAMAGE**

**Disconnect power to the meter.**

Failure to disconnect power to the meter could result in serious injury and/or damage to the equipment.

2. Remove retaining screws (item 52) and cover (item 16) of the UMB housing assembly.
3. Disconnect terminal connects at TB1, TB2 and TB3.
4. Loosen retaining screws of preamplifier board (item 56) and lift out.
5. Care should be taken not to jar or disrupt terminal board components.
6. Remove retaining plate and screw (item 52).
7. Insert second pickoff into the pickoff cavity of the UMB and secure with retaining plate and screw (item 52).
2. Mount the preamplifier board in its original position and secure using spring loaded retaining screws.
3. Attach electrical output wiring from both pickoffs to terminal connection TB2 and TB3 as shown in Figure 3-2.
4. Attach electrical output wiring from electrical accessories (conduit wiring) to terminal connection TB1, number 3 for channel A, and number 5 for channel B.
5. Secure all electrical wiring.
6. Return UMB cover and secure using original retaining screws.



## 6.0 TROUBLESHOOTING

### 6.1 General

This information has been provided as an aid in basic troubleshooting. Disassembly procedures have been outlined in Section 5 of this manual. If the Series 1500 Turbine is found to be in need of repair, it is recommended the user contact the nearest Daniel Measurement and Control Sales or Service Office. It is important that servicing be performed by trained and qualified service personnel.

Table 6-1. Troubleshooting

Condition	Probable Cause	Correction
No output pulses from amplifier module	Input voltage to amplifier below minimum required for operation	Apply correct voltage (10 - 30 VDC)
	Damaged or shorted pickoff (Resistance across leads should be 600-900 Ohm)	Replace pickoff
	Damaged amplifier module	Replace amplifier module
	Receiver unit not operating	Refer to instruction manual on defective unit
	Meter rotor not turning	Troubleshoot internal assembly
Turbine meter rotor not turning	Defective rotor bearing	Return rotor assembly to factory for replacement or repair
	Rotor damaged by foreign material passing through meter	Return rotor assembly to factory for replacement or repair
Inaccurate readout	Foreign material on rotor blades	Check and clean blades
	Rotor blades are bent	Return to factory for replacement or repair
	Defective accessory equipment	Troubleshoot equipment

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## **7.0 PARTS LIST**

This section contains the necessary parts required to make up any standard unit covered in this manual. Recommended spare or replacement parts have been denoted by an asterisk.

### **NOTICE**

Item numbers reference actual engineering drawings and are not meant to be consecutively numbered.

When ordering, the following information must be supplied:

- Serial number
- Part number
- Part description
- Quantity required

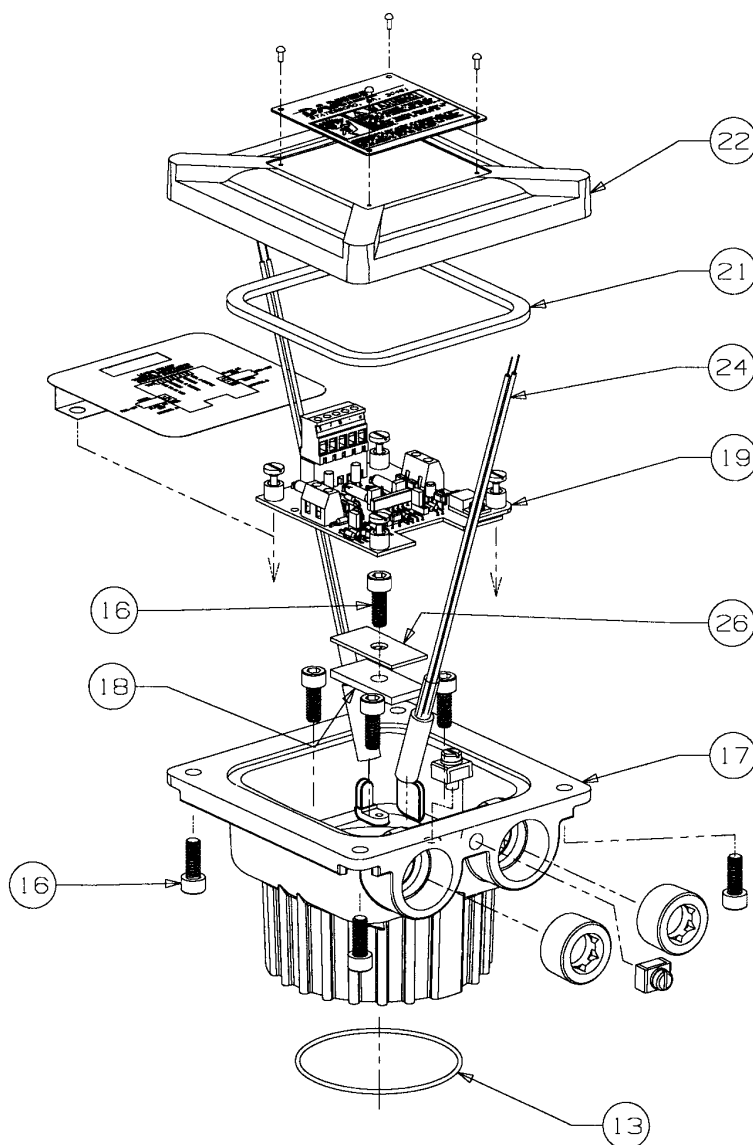


Figure 7-1. UMB Assembly - All Sizes (Reference Table 7-1)  
\* Torque 55 in. lbs.

Table 7-1. UMB Assembly (All Sizes) (Reference Figure 7-1)

Item Number	Description	Part Number	Quantity Required
13*	O-ring (Viton®-A)	1500093-022	1
16**	Screw (Hex Socket Head)	151496	9
17	UMB Housing	899-00-100-00	1
18	Insulator	799-00-424-01	1
19*	Dual Channel Preamp	230-00-300-00	1
21*	Gasket	CA-375Z-259-XXA	1
22	UMB Cover	899-00-101-00	1
24*	Pickoff	899-00-201-00	1 or 2
26	Clamp	799-00-424-00	1

\* Recommended Spare Parts

\*\* All item 16 - Torque 55 in. lbs., min.

Viton® is a registered trademark of E.I. du Pont de Nemours and Company.

#### ATEX REPAIR NOTE:

**Special Conditions for Safe Use:** The joint between the Universal Mounting Box cover and housing is a flat joint and has a flame path of 9.52mm in length and clearance of less than .0381mm. The joint between the Universal Mounting Box housing and Sensor housing is a spigot joint which has a radial length of 3.18mm, a axial length of 13.61mm and a clearance of .059mm.

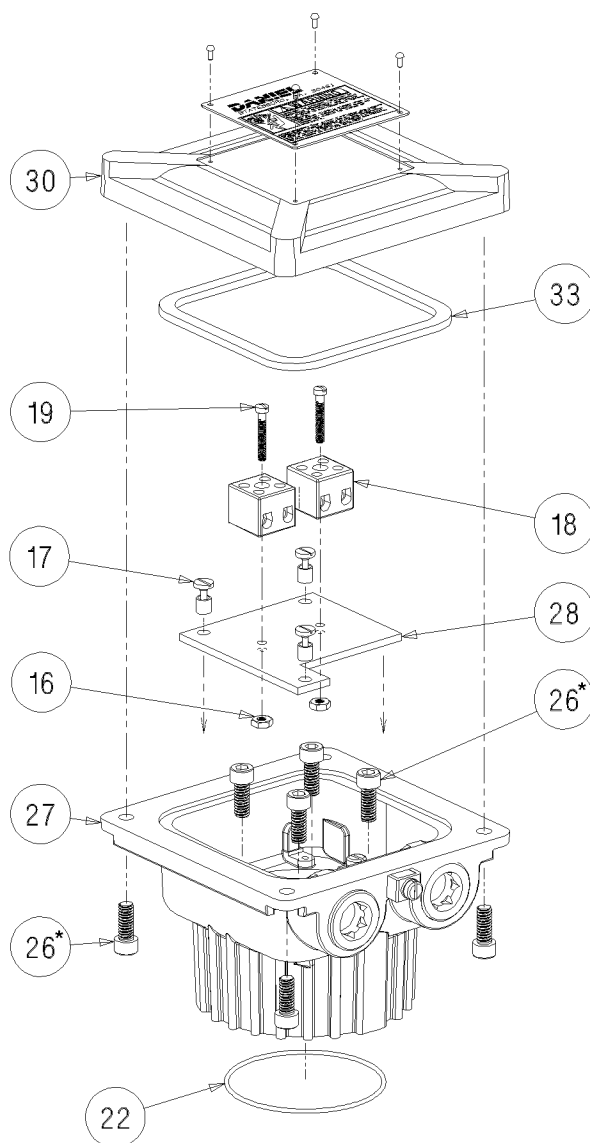


Figure 7-2. High Temperature UMB Assembly (Reference Table 7-2)

\* Torque 55 in. lbs.

Table 7-2. High Temperature UMB Assembly (Reference Figure 7-2)

Item Number	Description	Part Number	Quantity Required
16	Nut	151524	2
17	Mounting screw	1505069	3
18	Terminal block	1505065	2
19	Screw	150511	2
22	O-ring (Viton®-A)	1500093-022	1
26	Screw - hex socket head	151496	8
27	UMB housing	899-00-100-00	1
28	High temp mounting bracket	899-00-600-04	1
30	UMB cover	899-00-101-00	1
33	Gasket	CA-375Z-259-XXA	1

Viton® is a registered trademark of E.I. du Pont de Nemours and Company.

#### ATEX REPAIR NOTE:

**Special Conditions for Safe Use:** The joint between the Universal Mounting Box cover and housing is a flat joint and has a flame path of 9.52mm in length and clearance of less than .0381mm. The joint between the Universal Mounting Box housing and Sensor housing is a spigot joint which has a radial length of 3.18mm, a axial length of 13.61mm and a clearance of .059mm.

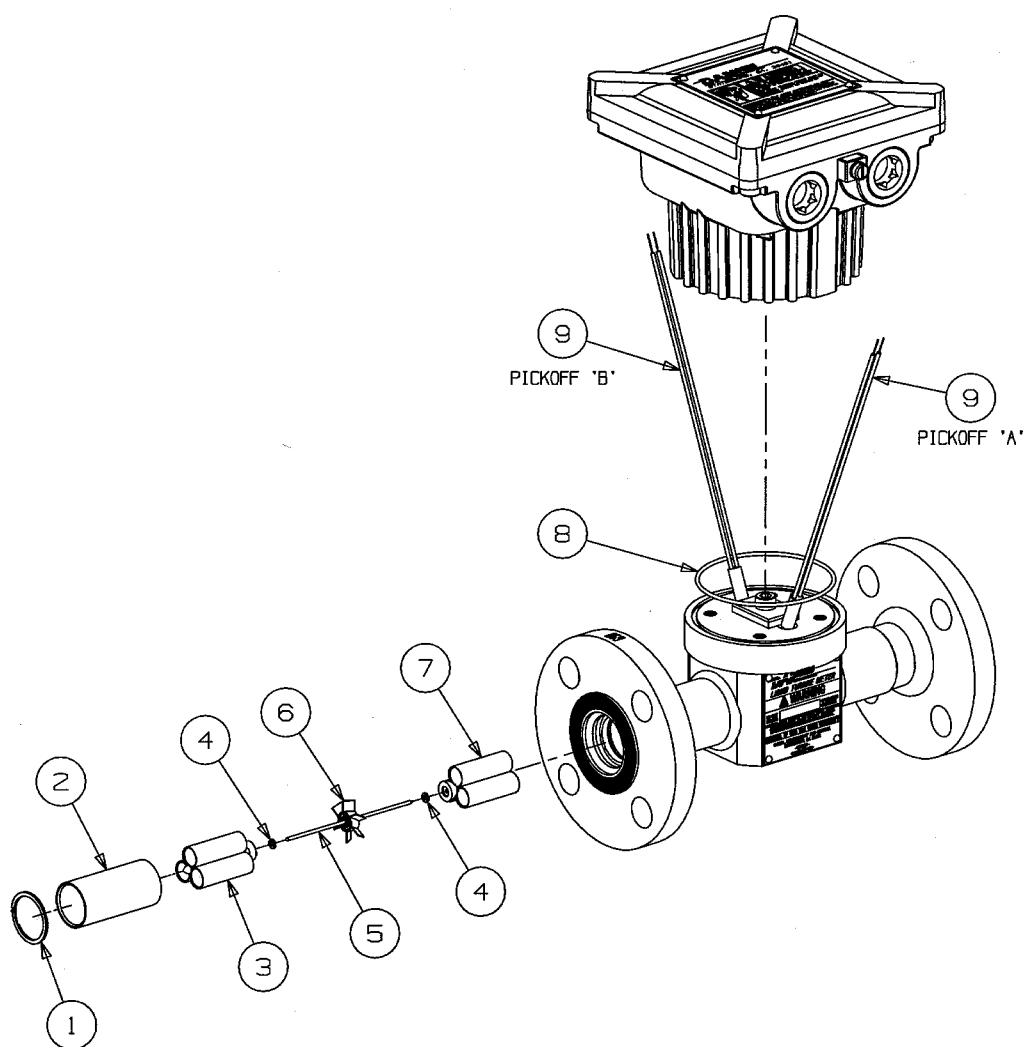


Figure 7-3. Internal Components 1" Series 1500 Turbine Meter  
(Reference Table 7-3)



Table 7-3. 1" Uni-Directional  
Series 1500 Turbine Meter  
(Reference Figure 7-3)

<b>1" UNI-DIRECTIONAL SERIES 1500 TURBINE METER</b>			
<b>Item Number</b>	<b>Description</b>	<b>Part Number</b>	<b>Quantity Required</b>
1	Spring clip	1-504-05-520	1
2	Sleeve	799-10-500-60	1
3	Upstream clip assembly	1-307-09-007	1
4	Thrust washer	1-504-05-109	2
5	Shaft	1-504-05-705	1
6	Rotor assembly	1-307-11-033	1
7	Downstream clip assembly	1-307-09-008	1
8	O-ring	1500093-022	1
9	Pickoff	899-00-201-00	2

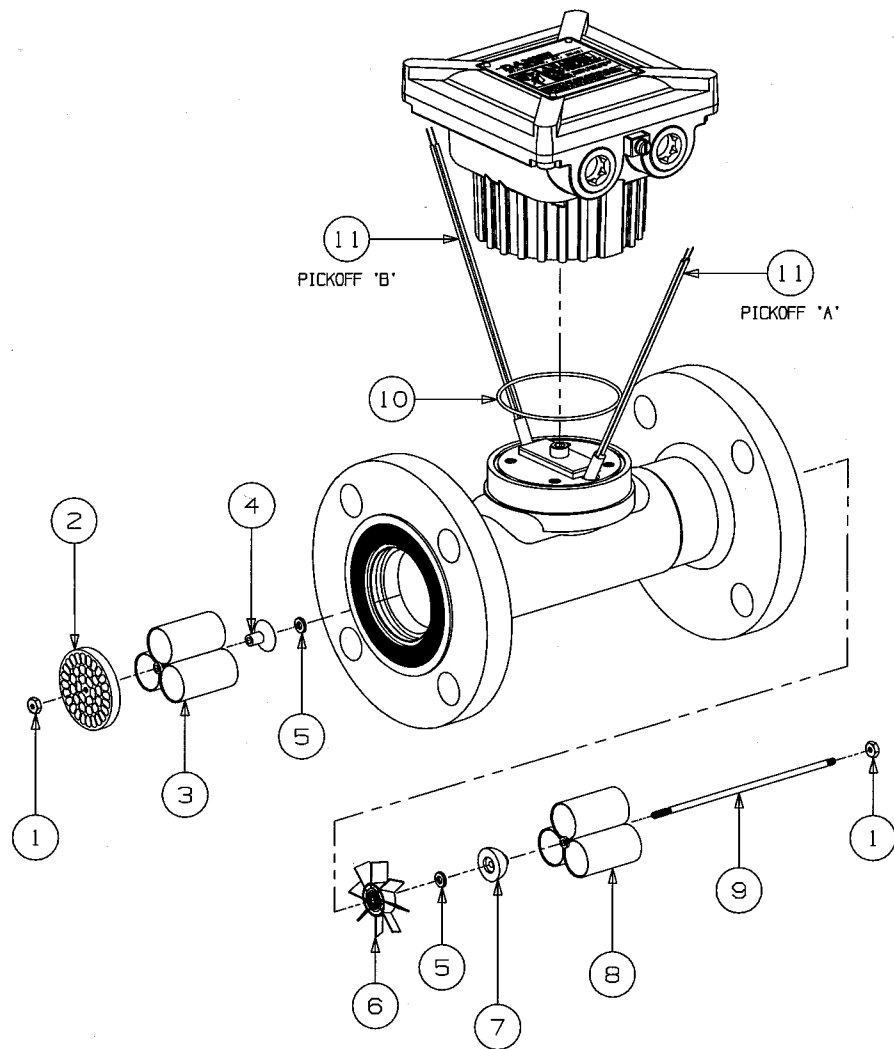


Figure 7-4. Internal Components Sizes 1 1/2", 2" and 2 1/2"  
(Reference Table 7-4)

Table 7-4. 1 1/2" through 2 1/2" Series 1500 Turbine Meter (Reference Figure 7-4)

1-1/2" THROUGH 2-1/2" SERIES 1500 TURBINE METER							
ITEM NO.	DESCRIPTION	1-1/2"		2"		2-1/2"	
		PART NO.	QTY.	PART NO.	QTY.	PART NO.	QTY.
1	Nut	1-561-76-041	2	1-561-76-051	2	1-561-76-052	2
2	Flow conditioning plate	N/A	N/A	1-307-01-090	1	N/A	N/A
3	Spring clip assembly	N/A	N/A	1-307-09-016	2	1-307-09-018	2
	Upstream spring clip assembly	1-307-09-113	1	N/A	N/A	N/A	N/A
4	Upstream cone	N/A	N/A	1-307-10-014	1	1-307-10-018	1
5	Thrust washer	1-504-05-111	2	1-504-05-112	2	1-504-05-113	2
6	Rotor assembly	1-307-11-078	1	1-307-11-107	1	1-307-11-225	1
7	Downstream cone	N/A	N/A	1-307-10-116	1	1-307-10-119	1
8	Downstream spring clip assembly	1-307-09-014	1	N/A	N/A	N/A	N/A
9	Shaft	1-504-05-138	1	1-504-05-706	1	1-504-05-707	1
	Shaft for flow conditioning plate	N/A	N/A	1-504-05-708	1	N/A	N/A
10	O-ring	1500093-022	1	1500093-022	1	1500093-022	1
11	Pickoff	899-00-201-00	2	899-00-201-00	2	899-00-201-00	2

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**DANIEL MEASUREMENT AND CONTROL, INC.**  
**RETURN POLICY FOR WARRANTY**  
**AND NON-WARRANTY MATERIAL**

Use the following procedure for returning equipment to the Daniel factory in the United States.

**Step 1      Obtaining a RMA Number**

*A Return Material Authorization (RMA) number must be obtained prior to returning any equipment for any reason.*

To obtain a RMA number, call the Customer Service Department at 713-827-5033 between 8:00 a.m. and 5:00 p.m. (Central Standard Time), Monday through Friday, except holidays or email [daniel.support@emersonprocess.com](mailto:daniel.support@emersonprocess.com).

**NOTICE**

**No product returns will be accepted without a RMA number and will be returned at the customer's expense.**

For warranty consideration, the product must be returned to Daniel within twelve (12) months of the date of original shipment or within eighteen (18) months of the date of original shipment of the product to destinations outside the United States. The Purchaser must prepay any shipping charges.

In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

- The following information is required at the time the RMA is issued:
  - Customer name
  - Contact name
  - Billing address
  - Contact Phone # and email address
  - Daniel SO #, PO #, or Invoice #
  - Item(s) to be returned
  - Reason for return
  - End user and final destination address
  - Consignee's complete name, address, contact name and phone number
- A RMA number is required for each original order. (Example: Two fittings purchased on two separate orders now being returned require two RMA numbers.)

*For product returns from locations outside the United States, Daniel Customer Service personnel will provide additional shipping requirements.*

## **Step 2      Cleaning and Decontamination**

Prior to shipment, thoroughly clean and decontaminate all equipment removing all foreign substances. This includes all substances used for cleaning the equipment. The cleaning and decontamination requirement applies to any part exposed to process fluids or cleaning substances.

Shipping equipment that has not been decontaminated may be in violation of U.S. Department of Transportation (DOT) regulations. For your reference, the requirements for packaging and labeling hazardous substances are listed in DOT regulations 49 CFR 172, 178, and 179.

If you suspect that a part has been contaminated, the part must be completely drained and flushed to remove contaminants.



**MAY CAUSE DEATH OR SERIOUS INJURY TO PERSONNEL**

**Contents may be under pressure or materials may be hazardous**

Follow appropriate handling instructions for accessing pressurized equipment. Avoid contact with hazardous materials or contaminated units and parts. Failure to do so may result in death or serious injury.

### **Decontamination/Cleaning Statement**

A blank Decontamination/Cleaning Statement is provided on the “Returned Material Authorization Repair Form for Used Equipment”.

- A Decontamination/Cleaning Statement is required for each returned part.
- Fully complete each form and include a signature. If the decontamination statement is incomplete, the customer may be charged for decontamination and cleaning.

If the equipment has been exposed to a known hazardous substance with any characteristic that can be identified in the Code of Federal Regulations, 40 CFR 261.20 through 261.24, the chemical abstracts number and hazardous waste number/hazard code must be stated in the space provided on the form.

Two (2) copies of each Decontamination/Cleaning Statement must be provided:

- One (1) copy must be attached to the outside of the package.
- One (1) copy must be included inside the package.

### **Step 3      Material Safety Data Sheets (MSDS)**

Provide a Material Safety Data Sheet (MSDS) with the returned equipment for each substance that has come in contact with the equipment being returned, including substances used for decontamination and cleaning.

*A MSDS sheet is required by law to be available to people exposed to specific hazardous substances*, with one exception: if the equipment has only been exposed to food-grade substances or potable water, or other substances for which an MSDS is not applicable, the Decontamination/Cleaning Statement form alone is acceptable.

Two (2) copies of each MSDS must be provided:

- One (1) copy must be attached to the outside of the package.
- One (1) copy must be provided inside the package.

### **Step 4      Packaging**

#### **Shipping a Device With Possible Contamination**

To meet DOT requirements for identifying hazardous substances, ship only one device per package.

#### **Shipping a Device Without Any Potential Contamination**

Devices being returned may be shipped together in one package, if there is no potential of foreign substance contamination.

## Step 5      Shipping

### Before returning used equipment:

- Mark each package clearly with a RMA number.
- Include a Decontamination/Cleaning Statement inside the package.
- Attach a duplicate Decontamination/Cleaning statement to the outside of the package.
- Include a MSDS for each substance that has come in contact with the equipment inside the package.
- Attach a duplicate MSDS to the outside of the package.

### NOTICE

**No product returns will be accepted without a RMA number and will be returned at the customer's expense.**

For warranty consideration, the product must be returned to Daniel within twelve (12) months of the date of original shipment or within eighteen (18) months of the date of original shipment of the product to destinations outside the United States. The Purchaser must prepay any shipping charges.

### Ship all \* mechanical equipment to the following address:

Daniel Measurement and Control, Inc.  
Attn: Service Dept.  
5650 Brittmoore Rd.  
Houston, TX 77041  
Ref: RMA# \_\_\_\_\_

\*Mechanical equipment includes: Orifice Fittings, Parts, Plates, Seal Rings, Turbine Meters, Control Valves, Provers, Strainers, Meter Tubes, Ultrasonic Meters, Flow Conditioners, etc.

### Ship all \* electronic equipment to the following address:

Daniel Measurement and Control, Inc.  
Attn: Service Dept.  
11100 Brittmoore Park Drive  
Houston, TX 77041  
Ref: RMA# \_\_\_\_\_

\*Electronic equipment includes: Gas Chromatographs, Petrocount Presets, Danload Preset, Ultrasonic Meter Electronics (CPU boards, transducers, etc.), 2403 Totalizer, MRT 97 Indicator, Preamps, Pick Up Coils, Prover Interface Boards, and the following Flow Computer Models: 2230, 2239, 2270, 2460, 2470, S100, 2100, and 3000.



# Daniel Measurement and Control, Inc.

## Returned Material Authorization

### Repair Form for Used Equipment Including Decontamination/Cleaning Statement

1. Return Material Authorization (RMA) Number \_\_\_\_\_
2. Equipment to be returned:  
Model Number \_\_\_\_\_ Serial Number \_\_\_\_\_
3. Reason for return: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

#### Decontamination/Cleaning Fluids Process

A. List each substance in which the equipment was exposed. Attach additional documents if necessary.

Common Name	CAS# if available	Used for Hazardous Waste (20 CFR 261)	EPA Waste Code if used for hazardous waste
		[ ] Yes [ ] No	
		[ ] Yes [ ] No	
		[ ] Yes [ ] No	
		[ ] Yes [ ] No	
		[ ] Yes [ ] No	
		[ ] Yes [ ] No	

B. Circle any hazards and/or process fluid types that apply:

Infectious	Radioactive	Explosive	Pyrophoric	Poison Gas	
Cyanides	Sulfides	Corrosive	Oxidizer	Flammable	Poison
Carcinogen	Peroxide	Reactive-Air	Reactive-Water	Reactive-Other (list)	
Other hazard category (list):					

C. Describe decontamination/cleaning process. Include MSDS description for substances used in decontamination and cleaning processes. Attach additional documents if necessary.

## Shipping Requirements

**Failure to comply with this procedure will result in the shipment being refused.**

4. Write the RMA number on the shipping package.
5. Inside the package include one copy of this document and all required Material Safety Data Sheets (MSDS)
6. Outside of the package attach one copy of this document and all required Material Safety Data Sheets (MSDS).

**THIS EQUIPMENT, BEING RETURNED “FOR REPAIR,” HAS BEEN COMPLETELY DECONTAMINATED AND CLEANED. ALL FOREIGN SUBSTANCES HAVE BEEN DOCUMENTED ABOVE AND MSDS SHEETS ARE ATTACHED.**

By:

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Print name)

Title:

Date:

Company:

Phone:

Fax:



The sales and service offices of Daniel Measurement and Control are located throughout the United States and in major countries overseas.  
Please contact Daniel Measurement Services at  
11100 Brittmoore Park Drive, Houston, Texas 77041, or phone (713) 827-6314  
for the location of the sales or service office nearest you.  
Daniel Measurement Services offers both on-call and contract  
maintenance service designed to provide single-source  
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