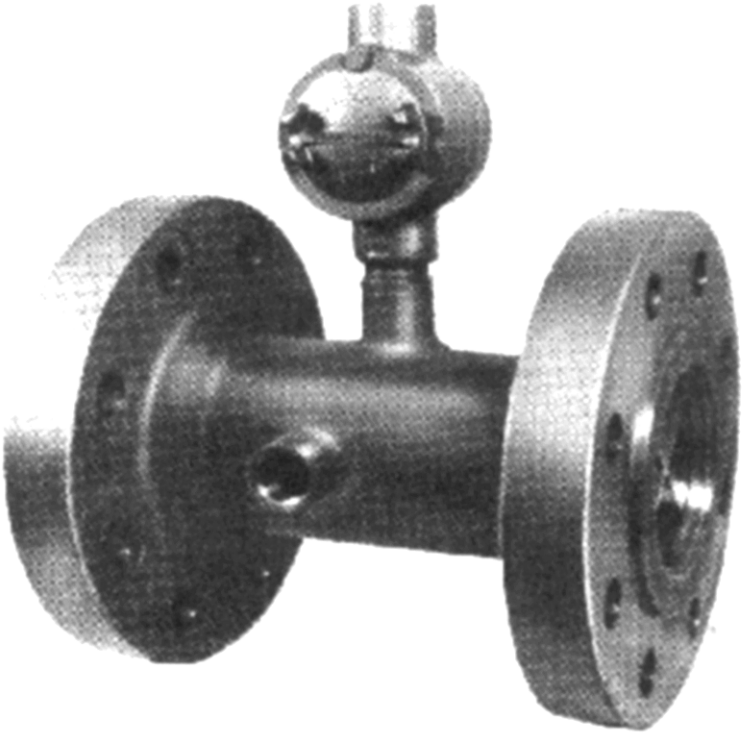
Operating and Maintenance Instructions
P/N 3-9008-505, Rev D
February 2013

Daniel ™ parity turbine meter and preamplifier assembly



DANIEL™

EMERSON™
Process Management

Daniel customer service

Location	Telephone number	Fax number
North America/Latin America	+1.713.467.6000	+1.713.827.4805
Daniel Customer Service	+1.713.827.6413	+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		

Email

- Customer Service: tech.service@emersonprocess.com
- Customer Support: daniel.cst.support@emerson.com
- Asia-Pacific: danielap.support@emerson.com
- Europe: DanielEMA.CST@EmersonProcess.com

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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!

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

⚠ WARNING!

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

⚠ CAUTION!

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

NOTICE

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

Important
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.**

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- 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.
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- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from: *http://www.daniel.com*.
- Read and understand all instructions and operating procedures for this product.
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- 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.
- Ensure that all connections to pressure and electrical sources are secure prior to and during equipment operation.
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1.0 INTRODUCTION

1.1 Meter Description

The Daniel Parity Turbine Meter is a volumetric flow measuring device that produces high resolution signals directly proportional to the rate of liquid flow through the meter. These signals are amplified and shaped by an internal preamplifier mounted directly on the meter. The meter can accommodate up to two signals that can be transmitted to accessories such as totalizing counters, digital readout devices, or control equipment for interpreting data.

The Daniel Parity Turbine Meter is available in sizes from ½ inch to 16-inch with bidirectional components available for some models. The meter is designed for use within the guidelines and test procedures of API Standard Chapter 5.3.

1.2 Specifications

Please see the specifications on page 2-9 through 2-11.

⚠WARNING

SERIOUS PERSONAL INJURY OR DEATH POSSIBLE

Do not operate this equipment in excess of the specifications listed.

Failure to heed this warning could also result in damage to equipment.

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2.0 INSTALLATION

Although your meter may be mounted in either a horizontal line or vertical line flowing upwards, the recommended installation is horizontal with the pickoff on the side in an outward facing position rather than on top. This is the standard factory calibration position. Side mounting the pickoff will prevent condensation from settling in the pickoff well. Review the information below prior to installing your meter.

2.1 Flow Considerations

A properly designed flow system will do two basic things toward maintaining the linearity of the turbine meter. It will properly condition the incoming flow so that it is homogenous 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 parity turbine, is a straight line denoting a constant meter factor.

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

CAUTION

MECHANICAL EQUIPMENT DAMAGE

Provide unobstructed upstream piping.

Flowing liquid encountering a restriction or change of direction may result in damage to adjacent surfaces in meters, valves, pumps and pipes.

Parity turbine meter performance depends, to a great extent, 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 for the dissipation of any flow disturbance before it reaches the meter. Use of flow straighteners or a flow conditioning plate greatly influences meter performance.

2.1.1 Specific Gravity

The parity turbine meter is affected by specific gravity and may influence performance. The effect of specific gravity on the meter may be evidenced when specific gravity drops below 0.66. As specific gravity decreases, the lift force on the turbine blade decreases. Likewise, as velocity decreases, lift force on the turbine blade decreases. 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.

To compensate for separate meter factors at low rates, electronic monitoring equipment is used. This has been proven to enhance the overall measuring accuracy at the load rack and other like applications. As low flow startup and shutoff flow rate is encountered, an established meter factor for that flow rate is applied. During the time that the high flow rate is used to load the bulk of the measured volume, a meter factor established for high flow rate is applied.

2.1.2 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.

In order to maintain turbine meter linearity on viscous fluids a high ratio of inertial to viscous forces, known as Reynolds number, must be obtained. It should be noted that the turbine meter typically performs best in turbulent flow conditions as opposed to laminar flow. A high Reynolds number is one of the factors needed to maintain turbulent conditions.

The Reynolds number is a dimensionless number defined as:

$Re=DuP \div \mu$

where D = inside diameter of the pipe
u = mean flow velocity
P=density of the fluid
μ =dynamic viscosity,

all in consistent units.

2.1.3 Seasonal Changes

For optimal performance, where hydrocarbons are metered and where there is a large temperature swing from summer to winter, it is recommended that a new meter factor be established as seasons change. This is recommended since temperature affects viscosity and viscosity affects meter performance.

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 parity turbine meter to the required application.

2.1.4 Back Pressure and Cavitation

It is preferable that the turbine meter be used with a centrifugal pump and that it work against a constant back pressure. The back pressure must equal:

- the pressure drop through the meter, *plus*
- the vapor pressure of the flowing fluid at the operating temperature and pressure, *plus*
- a minimum of 15 psi (103 kPa).

This will ensure there is no cavitation in the meter that could result in rotor over-speeding. Rotor over-speeding will accelerate wear and damage the rotor. Frequency output from the meter during cavitation is not a valid measure of the flow rate since flow meters are designed to measure liquids.

The minimum pressure at the outlet of the meter may be calculated using the following expression.

$$P_b \approx 2\triangle p + 1.25\, p_e$$

Where:

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

$\triangle p$ = 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 atmosphere).

2.2 General Considerations

Before installing a new meter, pipelines should be flushed thoroughly to rid them of welding bead, pipe scale, and other debris. This can be done using a spool piece in place of the meter. Note the direction liquid should flow through the meter indicated by the plate on the inlet flange, and install the meter downstream from pumps.

CAUTION

Always use a flushing medium compatible with the metallurgy of the meter and its internal parts, and similar to the product the meter is intended to measure.

2.3 Valves

The metering system should have a flow 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.

When a meter is being calibrated with a displacer type prover (one using a piston or sphere) a back pressure valve should also be used downstream of the proving device. This valve can be a simple manual valve that is partially closed. A minimum pressure of 12 to 15 psi (83 to 103 kPa) should be maintained downstream of the prover.

Valves should be capable of rapid, smooth opening and closing with positive shutoff.

- When used for intermittent flow, valves should be fast acting and shock-free.
- Spring loaded or self-closing valves should be of the type that will open to admit air when hydraulic hammering or vacuum conditions occur.
- Bypass lines should be equipped with blind or positive shutoff devices.
- Shutoff or control valves should be located downstream of the meter.

2.4 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 and should contain no flow restricting devices which could cause reversal of the flow straightening effect.

2.5 Flow Conditioning Plate

The flow conditioning plate is available for all new or retrofitted 2", 3", 4", 6", 8" and 10" Daniel Parity Turbine Meters. It 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. It is installed directly into the inlet of the meter and because of its flow conditioning influence on the incoming product, reduces requirements for upstream flow straightening pipe. It is recommended that a minimum of 5 pipe diameters be maintained upstream of the meter and two pipe diameters downstream of the meter, in addition to the Flow Conditioning Plate, to assure proper operation.

2.6 Strainers

A strainer of proper size should be installed upstream of the meter to protect it from the introduction of foreign material which could damage the meter. Recommended sizes include: 40 mesh for refined products, and 10 to 20 mesh sizes for crude products -depending on the product being measured. Recommended strainer mesh sizes based on meter size can be found in Table 2-1.

2.6.1 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 the basket or occlusion of foreign material can cause strainer basket rupture resulting in possible meter damage.

Table 2-1. Recommended Strainer Mesh Sizes

Meter Size (Inches)	Diameter Standard Sieve Size	Microns
1 /2"	100	3.94
3/4"	80	3.15
1" through 4"	60	2.36
6" through 16"	40	0.078

Table 2-2. Quick Reference Setup

Before You Install Your Meter

Before installing a new meter, some general considerations must be made.

1. The meter should be located away from electromagnetic fields that may interfere with proper flow measurement.

2. Pipelines should be flushed thoroughly to rid them of welding bead, pipe scale, and other debris. This can be done using a spool piece in place of the meter.

3. Note the direction liquid should flow through the meter, indicated by the plate on the inlet flange, and install the meter downstream from centrifugal pumps.

4. Calculate the proper back pressure required for safe and accurate installation.

   Refer to Section 2.1.4.

   *Back Pressure **equals** pressure drop through the meter, **plus** the vapor pressure of the flowing fluid at operating temperature and pressure, **plus** a minimum of 15 psi (103 kPa).*

5. Recommended installation is horizontal with the pickoff on the side and facing out; however, the meter may be mounted vertically as the application demands.

6. Install a strainer, or proper mesh size, upstream of the meter.

7. Shut-off or control valves should be positioned downstream of the meter.

8. Isolation valves should be installed to facilitate meter maintenance.

9. Applications using turbine meters with flow conditioning plates require a minimum of two pipe diameters downstream straightening. Conventional meters using flow straightening pipe require 5 pipe diameters downstream.

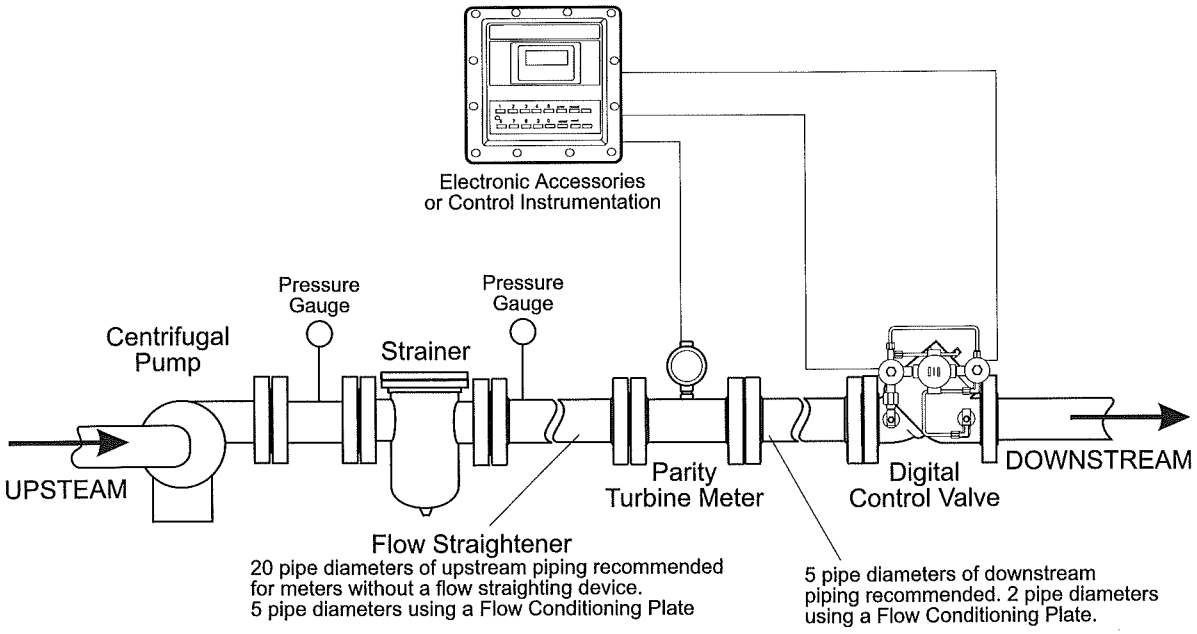

Figure 2-1. Quick Reference Setup

Table 2-3. Specifications

½" through 2-1/2" Parity Turbine Meter

Materials of Construction

Body:	304 Stainless steel
Rotor Support:	316 Stainless steel
Rotor:	1/2" : nickel
	3/4" through 2-1/2": 17-4PH Stainless steel
Bearings	Tungsten carbide
Shaft:	Tungsten carbide
Thrust Washer:	Tungsten carbide

Meter Connections

½" to 2-1/2" meters are available with mechanical ANSI B16.5 R.F. flanges with 150 lb., 300 lb., and 600 lb. pressure ratings and DIN flanges with PN16, PN40, PN64, and PN100 pressure ratings.

Meter Performance

Accuracy:	½" meter: ±0.5%
	3/4" to 2-1/2" meters: ±0.25%
Repeatability:	½" meter: ±0.4%
	3/4" to 2-1/2" meters: ±0.02%
Pickoff Output:1/2" meter:	Contains integral preamplifier/pickoff assembly.
	3/4" to 2-1/2" meters: 15 mV (RMS) at minimum flow
Flow Range:	10 to 1
Linearity:	½" meter: ±0.5% of flow rate on viscosity between 0.3 and 3.0 cS
	3/4" to 2-1/2": ±0.25% of flow rate on viscosity between 0.3 and 3.0 cS.

RF Sensor Performance - ½" Meter

Power Required:	10 to 18 Vdc at 15 mA maximum
Input Sensitivity:	15 mV (RMS) minimum
Output Signal:	Open drain with 3.3 kOhm internal pullup to Vs - 1.0 Vdc
	V_{ol}: 0.4 Vdc max. at I_{ol} = 20 mA
	V_{oh}: 0.9 (Vs - 5Vdc)
Frequency Range:	4 Hz to 3 kHz
Temperature:	-13°F to 257°F (-25°C to 125°C)

Preamplifier Performance
3/4" through 2-1/2"Meters

Power Required:	6 to 28 Vdc at 20 mA maximum
Input Sensitivity:	15 mV (RMS) minimum
Output Signal:	0 to 5V pulsating dc, TTL. compatible or pulse amplitude = Vs -1.5 Vdc
Frequency Range:	4 to 10,000 Hz
Temperature:	-30°F to 165°F (-34°C to 74°C)

Pickoff Temperature

Standard:	-30°F to 400°F (-34°C to 204°C)
Low Temperature:	-450°F to 450°F (-268°C to 232°C)
High Temperature:	-30°F to 400°F (-34°C to 204°C), and -450°F to 850°F (-268°C to 454°C)
All ½" Meters:	-13°F to 257°F (-25°C to 125°C)

Pressure Drop: See Table 2-4

3" through 16" Parity Turbine Meter
Materials of Construction

Body:	Steel with stainless steel option
Internals:	3" and 4": Stainless steel 6" through 16": Stainless steel and aluminum. All stainless steel option
Bearings:	Tungsten carbide

Meter Connections

Mechanical:	150 lb., 300 lb., and 600 lb. ANSI flanges and DIN flanges with PN16, PN25, PN40, PN64 and PN100 pressure ratings
Electrical:	Class I, Division 1, Groups C and D (National Electrical Code), explosion-proof condulet with terminal strip connections.
Recommended Connecting Cable:	Belden 8770, 3-conductor shield 18 gauge strand.
Max. Recommended Cable Length:	3,000 ft (914 m) Frequency dependent

Meter Performance

Accuracy:	±0.15%
Repeatability:	0.04% total ±0.02%
Pickoff Output:	15 mV (RMS) at minimum flow, 2 to 3 Vac at maximum flow

Preamplifier Performance

Power Required:	6 to 28 Vdc at 20 mA maximum
Input Sensitivity:	15 mV (RMS) minimum
Output Signal:	0 to 5V pulsating dc, TTL. compatible or pulse amplitude = Vs - 1.5 Vdc Range up to 3,000 ft. (914 m) with Belden 8770 type cable terminated into 4.7 kW load. (Frequency dependent)
Frequency Range:	4 to 10,000 Hz
Temperature:	-30°F to 165°F (-34°C to 74°C)

Pickoff Temperature

Standard:	-30°F to 400°F (-34°C to 204°C)
Low Temperature:	-450°F to 450°F (-268°C to 232°C)
High Temperature:	-30°F to 400°F (-34°C to 204°C), and -450°F to 850°F (-268°C to 454°C)

Pressure Drop

Less than 5 psi (34.5 kPa) at maximum flow rate (based on gasoline, meter only; see Figure 2.2). Refer to Figure 2.3 for the pressure drop of the flow straightener. To calculate the total pressure drop of the turbine meter system, combine the pressure drop of the meter and the flow straightener.

Other Features

Rotor Shroud: Standard on all meters 6" and larger. Optional for 3" and 4" meters. Recommended for applications with viscosities greater than 4.16 cS.

Flow Conditioning Plate: Available in 2", 3", 4", 6, 8, and 10" sizes. May be retrofitted in existing Parity Turbine Meters. Standard material of construction is stainless steel.

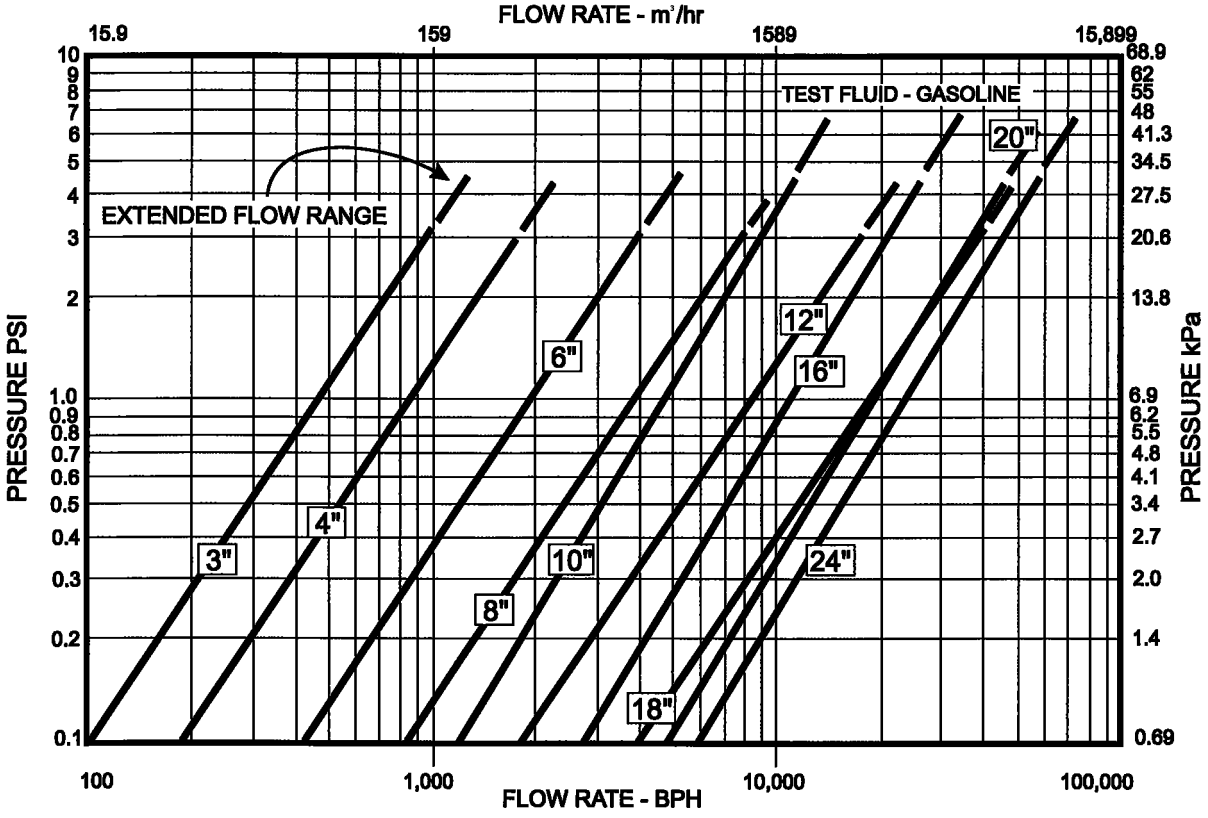

Figure 2-2. Pressure Drop - Meter Only - Sizes 3" - 24"

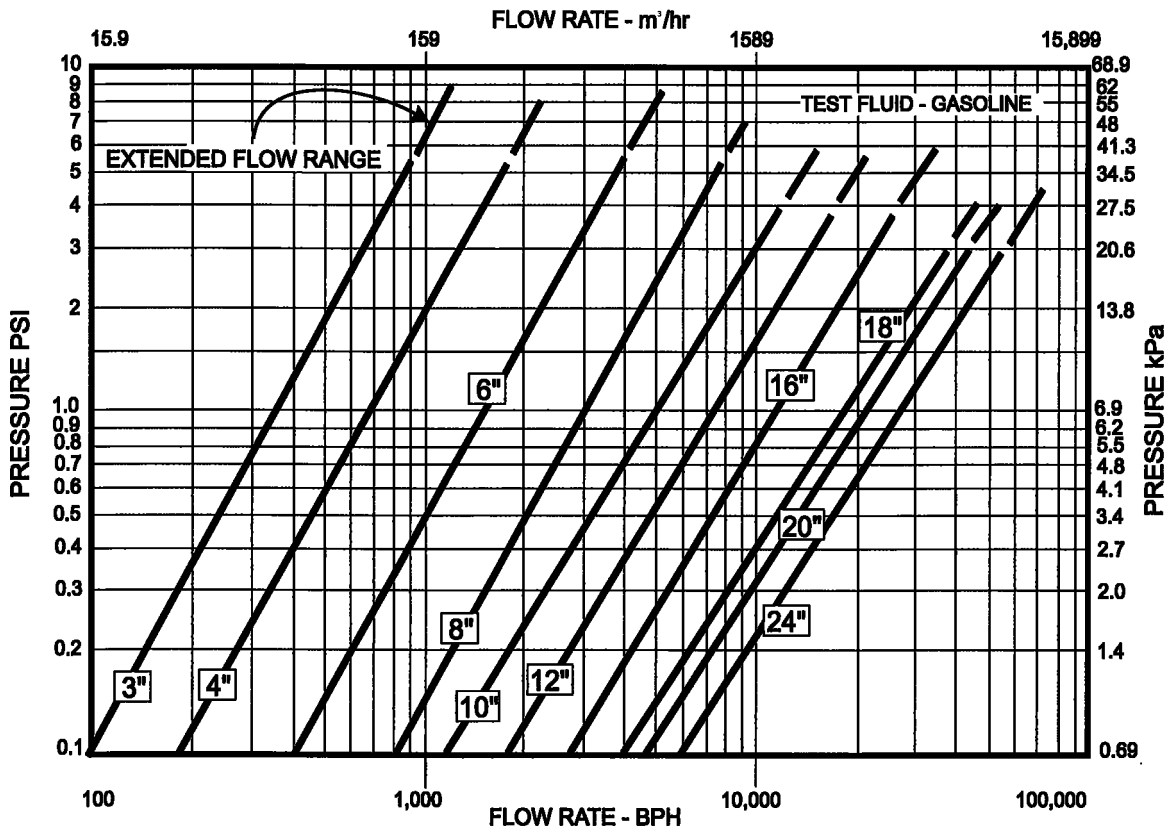

Figure 2-3. Pressure Drop - Flow Straightener Only

Table 2-4. Pressure Drop: Sizes ½" through 2-1/2"

Meter Size	Maximum Flow		Pressure Drop	
	gpm	lpm	psi	kPa
1 /2"	7.0	26.5	15	103
3/4"	20	75.7	9	62
1 "	70	265	14	97
1-1 /2"	150	568	9	62
2"	300	1136	7	48
2-1/2"	500	1893	10	69

3.0 RF SENSOR

The ½-inch Parity Turbine Meter is equipped with an RF sensor with an integral preamplifier. The output is a square wave with a frequency proportional to the flow rate. See Table 2-3 for specifications and Figure 3-1 for electrical connections.

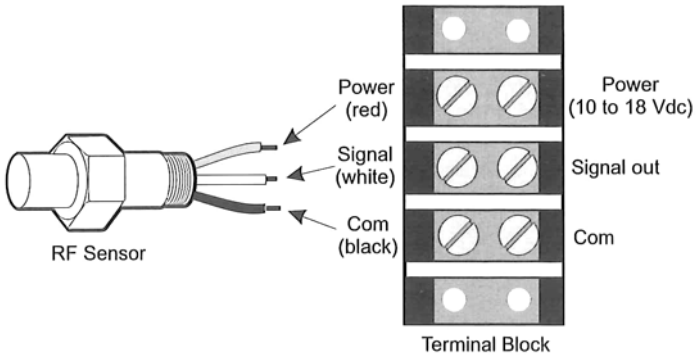

Figure 3-1. RF Sensor Electrical Connections

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4.0 PREAMPLIFIER

The Integral Turbine Mounted Preamplifier (ITMP) is a solid state amplifier used with all Daniel parity turbine flow meters with the exception of the ½-inch Parity Turbine Meter.

The turbine meter pickoff coil produces a low-level sine wave signal that varies in amplitude (mV) and frequency (Hz) in proportion to the velocity of the turbine's rotor blades. This signal is coupled to the input terminals of the preamplifier (preamp) terminal strip, and the preamp converts the signal from the pickoff to a square wave, 0 to 5 Volt TTL output, (Vs - 1.5 Vdc optional) capable of triggering standard computer logic, auxiliary batch totalizers, and readout instrumentation to measure liquid flow through the meter. See Table 2-3 for specifications.

4.1 Preamplifier Installation

Mount the preamp circuit board inside the condulet using the screws included with the preamp board, positioning the board to allow easy access for wiring the preamp to the meter.

Make the input signal connections in the preamp terminal strip at positions 1 and 2 (see Figure 4-1); make the power supply connections at positions 3 and 4; and make the output connections at positions 5 and 6. See Table 2-3, Specifications, for output cable type.

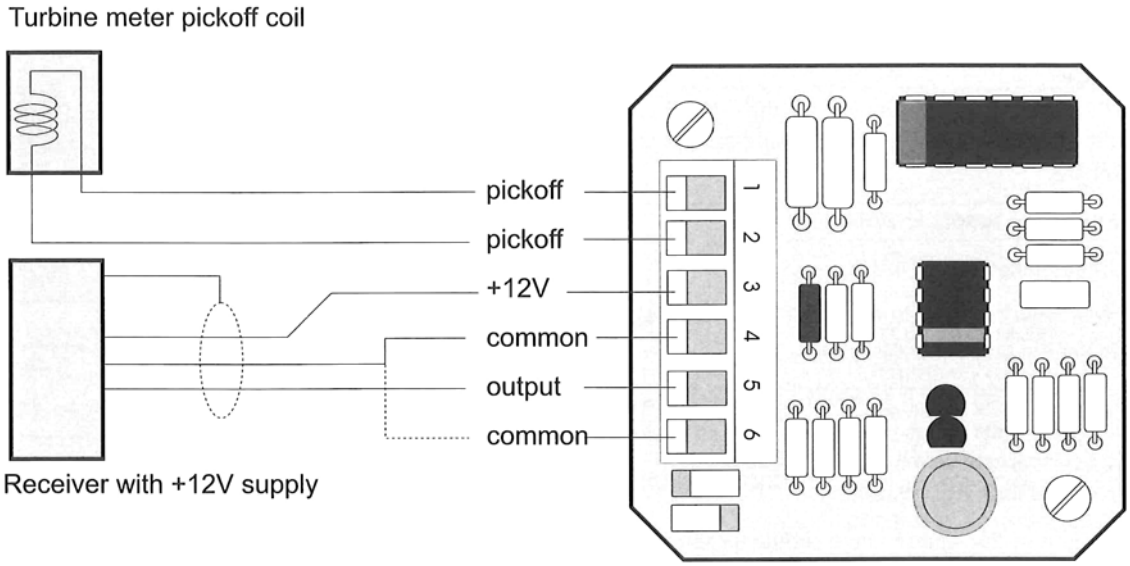

Figure 4-1. Preamplifier Electrical Connections

CAUTION

The intrinsically safe preamplifier must be connected to an approved intrinsically safe power supply unit or protected by suitable intrinsically safe barriers.

4.2 Induced Interference

Your turbine meter should not be located close to electromagnetic fields produced by electric motors, transformers, sparking devices, solenoids, relays, high voltage lines, and other equipment that could induce an interference signal into the turbine meter pickoff coil and interfere with flow measurement.

When installing your preamp, perform the following check to determine if there is interference.

1. Connect a suitable readout device such as a totalizer to the preamplifier output terminal (5) on the terminal strip.

2. Apply 6-28Vdc of power to the preamp.

3. If the device displays a reading at a no-flow condition, induced interference is present, and *it must be corrected prior to operating the meter*.

If an interference-inducing device is located nearby, the ideal configuration is to have the pickoff coil positioned perpendicular to and centered on the interfering inducing coil.

4.3 Maintenance and Testing

Regular maintenance and adjustment is not necessary for your meters' preamplifier. However, should it be necessary to verify the signal, or if a problem is suspected, the preamp should be tested. The following test equipment is required:

- 0 to 30 V DC power supply
- 10 to 3,500 Hz sine wave signal generator
- Oscilloscope

1. Connect the test equipment to the preamp board as shown in Figure 4-2.

2. Set the DC power supply to 12 Vdc.

3. Set the signal generator to 50 Hz.

4. Set the sine wave amplitude to 40 mV peak to peak (15mV RMS) at the preamp board input.

5. The output should be a 5 V (±10%) square wave signal. With jumper Jl connected in position BC, the output should equal the approximate supply voltage. (See Section 5.4 for jumper plug position information.)

6. The frequency of the square wave should be the same as the input frequency.

7. Vary the DC supply from 7 to 28 V DC. The output should not change with jumper J1 in position AC.

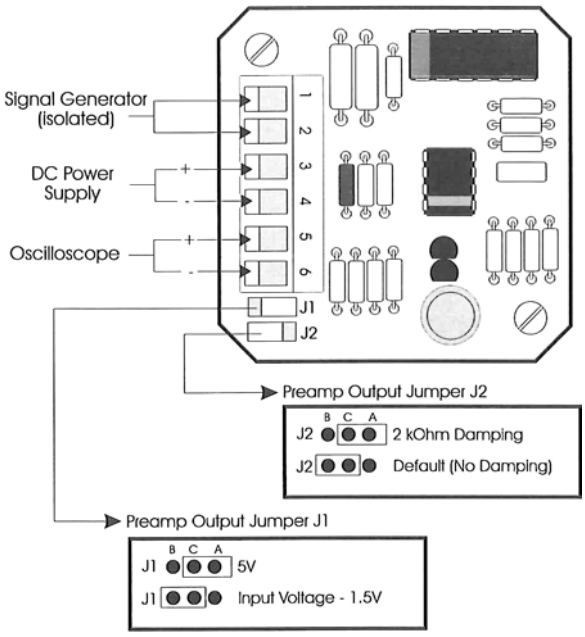

Figure 4-2. Connections for Preamplifier Testing

4.4 Jumper Plug Positions

There are two positions for jumper plug Jl: position AC and position BC. In position AC, any power supply between 6 and 28 V DC will produce a 0 to 5 V square wave signal. With jumper J1 in position BC any power supply between 6 and 28 V DC will provide a signal approximately 1.5 V less than the supplied voltage.

For example, a 24 V DC power supply will provide an output of approximately 22.5V with jumper J1 in position BC. Jumper J2 provides a 2 kOhm damping with the jumper in the AC position. Damping will help eliminate extraneous signals created due to normal load rack vibrations. No damping is provided in the BC position.

4.5 Replacement Parts

Replacement of individual preamplifier components is not recommended. See Section 8 for information about ordering replacement parts.

5.0 OPERATION

Prior to operating your meter, you should:

1. Securely fasten and align all meter components.
2. Inspect all electrical connections to ensure firm contacts.
3. Inspect all bolts to ensure the meter is secure.
1. Review the system setup to ensure all components are in the proper sequence: isolation valve, strainer, flow straightener, meter, downstream section, and control valve.
2. Open valves slowly to prevent system shock.
3. Purge all air from the system.

Your meter should never be subjected to flow and pressure ranges above those specified in Section 2.1.4 or those stamped on the tag on the outside of the meter. Back pressure at the outlet of the meter must be sufficient for proper operation. Minimum back pressure is calculated as follows:

minimum back pressure = pressure drop + vapor pressure + 15psi (03 kPa).

Care should be used in handling the pickoff. Do not drop or otherwise physically impact the meter housing or internal components. Exposure to excessive heat may hinder effectiveness.

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6.0 MAINTENANCE

All meters are calibrated at the factory and should not require adjustment during field set up.

Your meter is designed to operate for an extended period of time without wear or precision loss. However, the meter should be inspected periodically for fouling or corrosion. If maintenance on your meter is needed, please read and make sure you understand the following procedures prior to performing maintenance.

- Label all parts or place parts in labeled containers.
- Do not use metal clamping devices in direct contact with any meter part.
- Handle rotor blades with extreme care. Bending or altering the blades in any way can affect meter accuracy.
- Do not over-tighten screws or nuts.
- If the rotor assembly shows signs of damage, it should be returned to the factory for repair or exchange.

The meter and internal assembly may be cleaned using a cleaning solvent or alcohol. If the meter will be out of service and stored for an extended period of time, it should be dipped in light machine oil and wrapped in glassine paper.

6.1 Disassembly Precautions

Before removing your meter from the system, you must take the following precautions.

1. Disconnect all power to the unit.
2. Remove all leads from electrical instrumentation to the meter.
3. Relieve all line pressure.
4. Disconnect pickoff leads from the preamplifier terminal strip (see Figure 4-1).
5. Remove the pickoff from the meter using a thinwall socket wrench (11/16 inch or 3/4 inch depending on the meter).

⚠WARNING

SERIOUS PERSONAL INJURY OR DEATH POSSIBLE

Disconnect power from the unit and relieve line pressure prior to disassembly.

Failure to heed this warning could also result in damage to the equipment.

6.2 Instructions for Disassembly and Reassembly of Internal Components

6.2.1 ½-through 1-Inch Sizes (See Figure 8-1)

Disassembly

1. Place the meter in a vertical position with the inlet facing upward.
2. Remove the internal retaining ring (5).
3. Place the meter in a horizontal position resting on its flanges.
4. Insert a pencil through the outlet end of the meter and gently nudge the internal assembly (B) out of the meter body into your free hand.
5. Remove the inlet diffuser assembly (2).
6. Remove the rotor (3).
7. Remove the rotor shaft (4).
8. Inspect the bearings for wear, and replace if necessary.

Reassembly

1. Replace the rotor shaft (4) into the outlet diffuser assembly (10).
2. Replace the rotor (3) with the notched side facing upward.
3. Place the inlet diffuser assembly (2) on the rotor shaft (4).
4. Keeping the meter body horizontal and resting on its flanges, insert a pencil through the outlet end of the meter, and gently insert the internal assembly (B) into the meter body, using the pencil to keep the internal assembly components together.
5. Insert the internal retaining ring (5).

6.2.2 1 ½ Inch and 2 Inch Sizes (See Figure 8-1)

Disassembly

1. Place the meter in a vertical position with the inlet facing upward.
2. Remove the internal retaining ring (5).
3. Place the meter in a horizontal position resting on its flanges.
4. Insert a pencil through the outlet end of the meter and gently nudge the internal assembly (B) out of the meter body into your free hand.
5. Remove the cotter pin (22).
6. Remove the diffuser washer (20).
7. Remove the thrust washer (7).
8. Remove the rotor (3).
9. Remove the other thrust washer (7).
10. Remove the shaft sleeve (8).
11. Inspect the thrust bearings in the diffuser assemblies for wear, and replace if necessary.

Reassembly

1. Replace the shaft sleeve (8) onto the shaft in the inlet diffuser assembly (2).
2. Replace the thrust washer (7).
3. Replace the rotor (3) with the notched side facing upward.
4. Replace the other thrust washer (7).
5. Place the diffuser washer (20) on the shaft.
6. Insert the cotter pin (22). (The cotter pin may have to be replaced after being removed.)
7. Insert the internal assembly (B) into the meter body.
8. Insert the internal retaining ring (5).

6.2.3 2 ½ Inch Size (See Figure 8-1)

Disassembly

1. Place the meter in a vertical position with the inlet facing upward.
2. Remove the internal retaining ring (5).
3. Place the meter in a horizontal position resting on its flanges.
4. Insert a pencil through the outlet end of the meter and gently nudge the internal assembly (B) out of the meter body into your free hand.
5. Remove the cotter pin (22).
6. Remove the hex nut (21).
7. Remove the diffuser washer (20).
8. Remove the thrust washer (7).
9. Remove the rotor (3).
10. Remove the other thrust washer (7).
11. Remove the shaft sleeve (8).
12. Inspect the thrust bearings in the diffuser assemblies for wear, and replace if necessary.

Reassembly

1. Replace the shaft sleeve (8) onto the shaft in the inlet diffuser assembly (2).
2. Replace the thrust washer (7).
3. Replace the rotor (3) with the notched side facing upward.
4. Replace the other thrust washer (7).
5. Place the diffuser washer (20) on the shaft.
6. Replace the hex nut (2l).
7. Insert the cotter pin. (The cotter pin may have to be replaced after being removed.)
8. Insert the internal assembly (B) into the meter body.
9. Insert the internal retaining ring (5).

6.2.4 3-Inch and 4-Inch Sizes (See Figure 8-2)

Disassembly

1. Place the meter in a vertical position with the inlet diffuser (2) facing up.
2. Remove the internal retaining ring (5).
3. Remove the flow conditioning plate (28), if your meter is equipped with one.
4. Grasp the fins of the inlet diffuser assembly (2) and carefully lift the internal assembly until it is free of the body assembly.
5. Remove the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
6. Remove the castellated hex nut (21), the diffuser washer (20), and the thrust washer (7) from the inlet diffuser assembly shaft.
7. Carefully remove the rotor assembly (3).
8. Remove the shaft sleeve (8) and the thrust waver (7).

Reassembly

1. Place the inlet diffuser assembly (2) on its fins is a vertical position.
2. With the groove facing up, place the thrust washer (7) on the inlet diffuser assembly shaft.
3. Place the shaft sleeve (8) on the inlet diffuser assembly shaft.
4. Carefully place the rotor assembly (3) on the inlet diffuser assembly shaft with the boss facing up (or facing downstream).
5. With the flat side down, place the diffuser washer (20) on the inlet diffuser assembly shaft. With the groove facing up, place the thrust washer (7) on the diffuser washer (20) assembly shaft.
6. Place the two Belville washers (25) in parallel on the inlet diffuser assembly shaft.
7. With the flat side down, screw the castellated hex nut (22) onto the inlet diffuser assembly shaft. Securely tighten the castellated nut until a slot in the nut aligns with the hole in the shaft. *Torque to 25 inch/pounds then turn to the next available slot. Do not loosen the nut in order to align it with the hole in the shaft.*
8. Replace the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
9. Holding the internal assembly by the fins of the inlet diffuser assembly (2), carefully insert the internal assembly into the body assembly with the rotor assembly facing downstream. Place the ear of the fin that has been milled between the two pins in the body assembly.
10. Insert the flow conditioning plate (28), if your meter is equipped with one.
11. Insert the retaining ring (5) into the groove in the body assembly.

6.2.5 6-Inch and 8-Inch Sizes (See Figure 8-3)

Disassembly

1. Place the meter in a vertical position with the inlet diffuser assembly (10) facing up.
2. Remove the socket head screws (33) and clamps (32) from the body assembly.
3. Remove the flow conditioning plate (28), if your meter is equipped with one.
4. Grasp the fins of the inlet diffuser (10) and carefully lift the assembly until it is free of the meter body.
5. Remove the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
6. Remove the castellated nut (2l).
7. Remove the diffuser washer (20), the lock washer (25), and the thrust washer (31). The lock washer will come out with the diffuser washer, and the thrust washer may come out with the diffuser washer. If not, it may be removed by itself or with the rotor assembly.
8. Carefully remove the rotor assembly (3), rotor bushing (29), and bushing retainer (31) as a single component. If the rotor bushing (29) shows signs of wear and needs to be replaced, remove the socket head screws (33) in the bushing retainer (31), remove the bushing, replace it with the new bushing, and replace the socket head screws.
9. Remove the shaft sleeve (8).
10. Remove the thrust washer (7). This may be difficult. One method is to take two small flat-head screwdrivers and insert them on either side of the thrust washer in the space between the edge of the thrust washer and the recessed area of the inlet diffuser. Then, carefully lift the thrust washer. This may require assistance.

Reassembly

1. Place the inlet diffuser assembly (10) on its fins in a vertical position.
2. With the grooves facing up, place the thrust washer (7) on the inlet diffuser assembly shaft.
3. Place the shaft sleeve (8) on the inlet diffuser assembly shaft.
4. Carefully place the rotor assembly (3), rotor bushing (29), and the bushing retainer (31) -- as one component -- on the inlet diffuser assembly shaft with the bushing retainer facing up (or facing downstream).
5. With the grooves facing down, place the other thrust washer (7) on the inlet diffuser assembly shaft.
6. With the hollow side down, place the diffuser washer (20) on the inlet diffuser assembly shaft.
7. Place the two Belville washers (25) in parallel on the inlet diffuser assembly shaft.
8. With the flat side down, screw the castellated hex nut (21) onto the inlet diffuser assembly shaft. *Torque to 10 foot/pounds then turn to the next available slot. Do not loosen the nut in order to align it with the hole in the shaft.*
9. Replace the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
10. Holding the internal assembly by the fins of the inlet diffuser assembly carefully insert the internal assembly into the body assembly with the rotor.

6.2.6 10-Inch through 16-Inch Sizes (See Figure 8-4)

Disassembly

1. Grasp the fins of the inlet diffuser assembly (2) and carefully lift the internal assembly until it is free of the body assembly. *A sling or other mechanical lifting device is recommended for removing the internal assembly from the body assembly.*
2. Place the meter in a vertical position with the diffuser assembly facing up.
3. Remove the socket head screws (33) from the diffuser support (39).
4. Remove the top diffuser cap (37).
5. Remove the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
6. Remove the castellated hex nut (21), the lock washer (25), the diffuser support (39), and the thrust washer (7).
7. Remove the shaft sleeve (8). The shaft sleeve may come out with the rotor assembly (see step 8).
8. Carefully remove the rotor assembly (3), rotor bushing (29), and bushing retainer (3l) as a single component. If the rotor bushing shows signs of wear and needs to be replaced, remove the socket head screws (33) in the bushing retainer (31), remove the bushing, replace it with the new bushing, and replace the socket head screws.
9. Remove the thrust washer (7). This may require assistance.

It is not necessary to remove the bottom diffuser cap (37). It should not be necessary to disassemble the shaft assembly (38) from the diffuser assembly (2). However, the shaft assembly may be replaced if it shows signs of damage.

Reassembly

1. Place the diffuser assembly (2) on its fins in a vertical position.
2. With the grooves facing up, place the thrust washer (7) on the shaft assembly.
3. Place the shaft sleeve (8) on the shaft assembly (38).
4. Carefully place the rotor assembly (3), rotor bushing (29), and bushing retainer (31) -- as one component -- on the shaft assembly with the bushing retainer (31) facing up (or facing downstream).
5. With the grooves facing down, place the other thrust washer (7) on the inlet diffuser assembly shaft.
6. Place the diffuser support (39) on the shaft assembly (38).
7. Place the two Belville washers (25) in parallel on the shaft assembly.
8. With the flat side down, screw the castellated hex nut (21) onto the shaft assembly. *Torque to 20 foot/pounds then turn to the next available slot. Do not loosen the nut in order to align it with the hole in the shaft.*
9. Replace the cotter pin (22). Removing the cotter pin usually makes it necessary to replace it with a new one.
10. Holding the internal assembly by the fins of the diffuser assembly, carefully insert the internal assembly into the body assembly with the rotor assembly facing downstream.
11. Holes in the fins of the diffuser assembly (2) are numbered to correspond with holes in the body assembly.

6.3 Instructions for Flow Conditioning Plate - Retrofit - Sizes 2", 3", 4", 6", and 8"

The flow conditioning plate may be retrofitted to any existing parity turbine meter sizes 2" through 8". It is installed directly into the inlet of the meter.

1. From the meter inlet -- remove the retaining ring, screws, and clamps that hold the internal assembly in place.
2. Place the flow conditioning plate into the throat of the meter inlet.
3. Reinstall the retaining ring, screws or clamps.
4. Prove the meter.

7.0 TROUBLESHOOTING

Table 7-1 provides information for identifying and correcting operational problems you may experience with your Parity Turbine Meter. Please keep in mind this information is not exhaustive and that system abnormalities may result from causes other than meter error. This information is provided to assist in general field repairs.

Table 7-1. Troubleshooting Information

Symptom	Possible Causes	Test / Check	Corrective Action
No output	No flow	Pump running? Valves open?	Start pump. Open Valves.
	No power at readout device	Readout device turned on?	Apply power to readout device.
	No DC voltage	Power supply at readout device? Power supply at turbine meter?	Troubleshoot readout device. Check input power. Check fuses. Troubleshoot power wiring.
	Loose wiring	Are all connections secure?	Tighten all connections.
	Defective Pickoff coil	Sine wave present at pickoff?	Replace pickoff coil if necessary
	Defective Preamplifier	Sine wave present at preamp?	Replace preamplifier.
	Obstructive flow	Visual inspection	Remove obstruction.
	Damaged internals	Visual inspection	Replace internals.
Under registers - Missing counts or counts are slow. Non-repeatability	Flow rate below meter operating range	Partially closed valve(s)?	Verify that flow rate and range is correct. Open appropriate valves.
	Loose wiring	Are all connections secure?	Tighten all connections.
	Loose pickoff coil	Check pickoff coil tightness.	Tighten as required.
	Missing or bent rotor blades	Observe output signal with oscilloscope.	Remove meter and check rotor.
	Incorrect K-factor programmed into the readout device	Is meter K-factor programmed correctly?	Adjust K-factor in readout device as required.
	Obstructed flow	Visual Inspection	Remove obstruction.
	Magnetized rotor	Check rotor shroud with compass	Demagnetize rotor shroud.
	Damaged internals	Visual inspection	Replace internals.
Over registers - too many counts or counts too fast. Non-repeatability	Leakage through meter.	Leaking valve	Position valves as necessary.
	Electrical noise or ground loop	Observe output signal with oscilloscope.	Check signal cable routing.
		Signal cable shield grounded at meter.	Make sure shield / signal ground is connected at readout device ONLY.
	Magnetic field	Signal wire too close to AC motors?	Reroute signal wiring.
		Signal wiring in the same cable tray as AC wiring?	Reroute signal wiring.
	Foreign material in rotor	Inspect rotor for foreign material.	Remove foreign material.
	Cavitation	Does the meter have proper back pressure?	Apply proper back pressure (valves/orifice)

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8.0 REPLACEMENT PARTS

Tables 8-1 through 8-4 list and show the components of 1/2-inch and larger Daniel Parity Turbine Meters. When ordering replacement parts you must furnish the following information:

- meter serial number
- part number, if available
- part description
- quantity required

To order replacement parts, contact the Daniel Measurement and Control office nearest you. See the back cover of this manual for a list of Daniel Measurement and Control locations.

Tables 8-1. ½" through 2 ½" Sizes Replacement Parts

Seq	Description	Qty.	½ Inch	3/4 Inch	1 Inch	1 ½ Inch	2 Inch	2 ½ Inch
2	inlet diffuser assembly	1	894-05-390-01	894-07-390-00	894-10-390-00	894-14-390-00	894-16-390-00	894-17-390-00
3	rotor assembly	1	894-05-319-00	894-07-319-00	894-10-319-00	894-14-319-00	894-16-319-00	894-17-319-00
4	rotor shaft	1	894-07-073-00	894-07-073-00	894-10-073-00	...	...	...
5	internal retaining ring	1	CF-724B-105-BQA	156538	156539	156537	156535	156532
7	thrust washer	2	...	...	...	894-16-062-00	894-16-062-00	894-22-062-00
8	shaft sleeve	1	...	...	...	894-16-073-00	894-16-073-00	894-22-073-00
9	hex screw socket set	1	...	...	...	1500187	1500187	...
10	outlet diffuser assembly, bidirectional meter	1	894-05-390-01	894-07-391-00	894-10-391-00	894-14-013-00	894-16-013-00	...
11	pickoff assembly	1	894-00-373-10	...	...	...	...	...
12	preamp assembly							
	standard	*	...	894-00-373-12	894-00-373-12	894-00-373-12	894-00-373-12	894-00-373-12
	CENELEC EEx d IIC T6	*	...	894-00-301-00	894-00-301-00	894-00-301-00	894-00-301-00	894-00-301-00
	CENELEC EEx ib IIC T6	*	...	894-00-373-15	894-00-373-15	894-00-373-15	894-00-373-15	894-00-373-15
13	pickoff							
	standard	*	...	ES-595D-017-AAA	ES-595D-017-AAA	ES-595D-017-AAA	ES-595D-017-AAA	ES-595D-017-AAA
	high temp: 400°F (204°C)	*	...	ES-595D-045-AAA	ES-595D-045-AAA	ES-595D-045-AAA	ES-595D-045-AAA	ES-595D-045-AAA
	high temp: 850°F (454°C)	*	...	EW-595H-004-AAA	EW-595H-004-AAA	EW-595H-004-AAA	EW-595H-004-AAA	EW-595H-004-AAA
	low temp -450°F (-268°C)	*	...	ES-595K-001-AAA	ES-595K-001-AAA	ES-595K-001-AAA	ES-595K-001-AAA	ES-595K-001-AAA
	CENELEC Eex ib IIC T6	*	...	ES-595D-049-AAA	ES-595D-049-AAA	ES-595D-049-AAA	ES-595D-049-AAA	ES-595D-049-AAA
14	high temperature extension	*	...	CA-296Z-049-ACA	CA-296Z-049-ACA	CA-296Z-049-ACA	CA-296Z-049-ACA	CA-296Z-049-ACA
15	coupling assemmbly	*	...	157780	157780	157780	157780	157780
20	diffuser washer	1	...	...	...	...	...	894-17-013-00
21	castellated hex nut	1	...	...	...	...	...	151650
22	cotter pin	1	...	...	...	...	...	153930
28	flow conditioning plate	1	...	...	...	...	893-16-301-01	...
A	rf sensor	*	1500286	...	...	...	...	...
B	complete internal assembly		894-05-300-60	894-07-300-60	894-10-300-60	894-14-300-60	894-16-300-60	894-17-300-60
**	Repair Kit (not shown)	1	...	...	...	...	W894-16-400-00	W894-22-400-00

* Quantity determined by number of pickoffs

** Repair Kit includes thrust washers, shaft sleeve, castellated nut, cotter pin, and Belville washers.

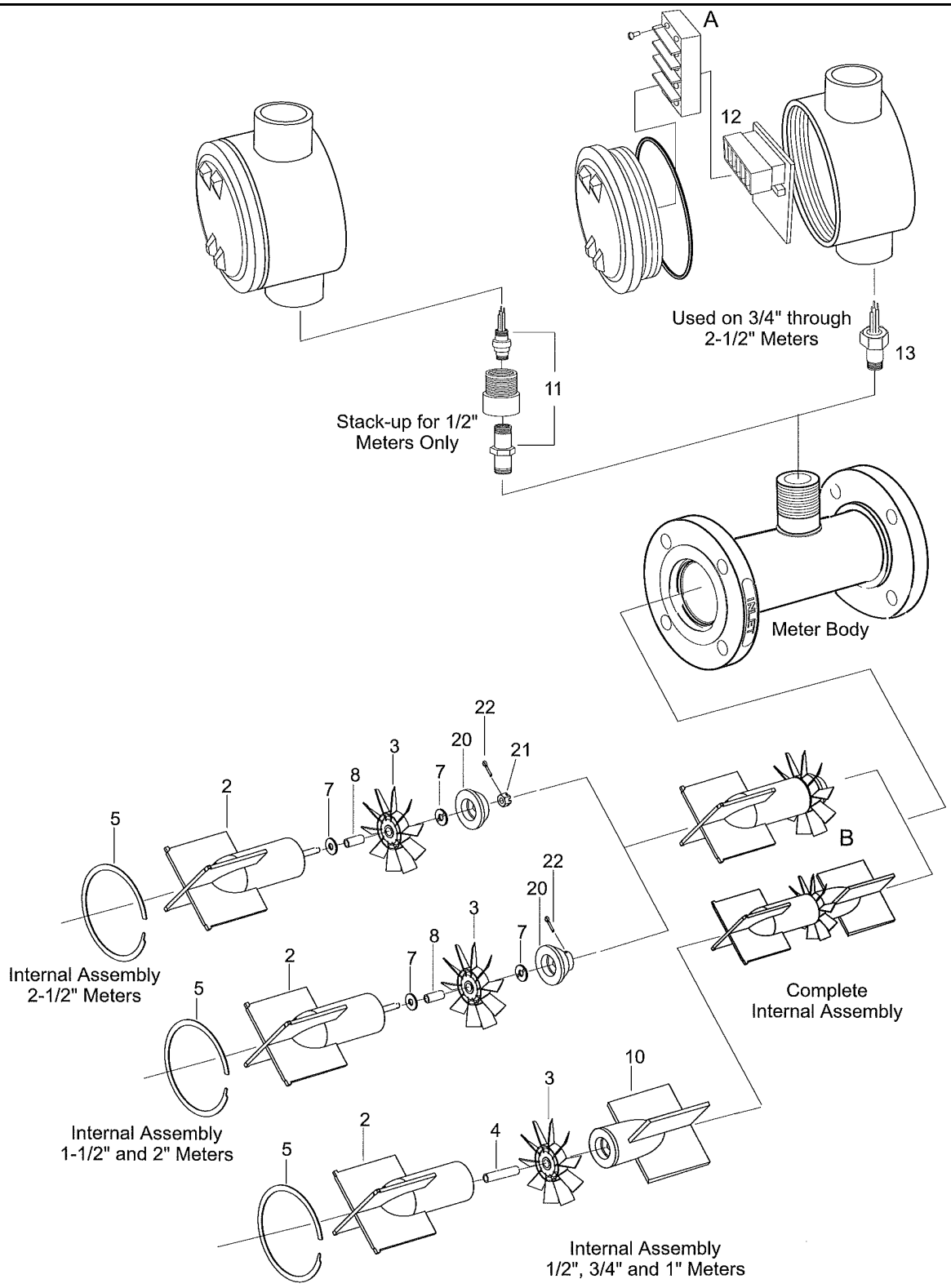

Figure 8-1. ½" through 2-1/2" Sizes Assembly Illustration

Table 8-2. 3" and 4" Sizes Replacement Parts

Seq.	Description	Qty.	3 inch	4 inch
2	inlet diffuser assembly	1	894-20-390-00	894-22-390-00
	bidirectional meter	1	894-20-390-02	894-22-390-02
3	rotor assembly	1	894-20-319-00	894-22-319-00
	rotor assembly, shrouded rotor	1	894-20-319-11	894-22-319-11
	rotor assembly, bidirectional meter	1	894-20-319-02	894-22-319-04
4	spirol pin	2	153548	153548
5	internal retaining ring	1	156505	156504
7	thrust washer	2	894-22-062-00	894-22-062-00
8	shaft sleeve	1	894-22-073-00	894-22-073-00
10	outlet diffuser assembly			
	bidirectional meter	1	894-20-008-01	894-22-008-03
11	NPT cap	*	154781-419M	154781-419M
12	preamp assembly			
	standard	*	894-00-373-12	894-00-373-12
	CENELEC EEx d IIC T6	*	894-00-301-00	894-00-301-00
	CENELEC EEx ib IIC T6	*	894-00-373-15	894-00-373-15
13	pickoff			
	standard -30°F to 400°F (204°C)	*	ES-595D-017-AAA	ES-595D-017-AAA
	high temp: -30°F to 400°F (204°C)	*	ES-595D-045-AAA	ES-595D-045-AAA
	high temp: -450°F to 850°F (454°C)	*	EW-595H-004-AAA	EW-595H-004-AAA
	low temp: -450°F (-268°C) to 450°F	*	ES-595K-001-AAA	ES-595K-001-AAA
	CENELEC EEx ib IIC T6 -40°F to 250°F (121°C)	*	ES-595D-049-AAA	ES-595D-049-AAA
14	high temperature extension coupling assembly	*	CA-296Z-049-ACA	CA-296Z-049-ACA
15	high temperature, CENELEC EExd	*	894-10-309-00	894-10-309-00
	coupling assembly, high temperature	*	157780	157780
17	backup washer, bi-directional meter	1	894-20-001-00	894-20-001-00
20	diffuser washer	1	894-20-013-00	894-20-013-00
21	castellated hex nut	1	151650	151650
22	cotter pin	1	153930	153930
23	flat washer, bidirectional meter	1	151891	151891
24	groove pin, 150 lb. body	2	153688	153688
	groove pin, 300 lb. body	2	153689	153689
	groove pin, 600 lb. body	2	153689	153689
25	Belville washer	2	1500442	1500442
26	outlet diffuser support,			
	bidirectional meter	3	895-20-070-00	895-22-070-00
27	hex nut, bidirectional meter	3	151533-419	151533-419
28	flow conditioning plate	1	893-20-301-01	893-22-301-01
41	lock washer, bidirectional meter	3	152126	152126
A	preamplifier circuit board	*	ES-097Y-167-AAA	ES-097Y-167-AAA
	explosion proof	*	ES-097Y-167-AAA	ES-097Y-167-AAA
	intrinsically safe	*	894-00-373-20	894-00-373-20
B	internal assembly	1	894-20-300-00	894-22-300-00
	internal assembly, bidirectional meter	1	894-20-300-61	894-22-300-01
**	repair kit (not shown)	1	W894-22-400-00	W894-22-400-00

* quantity determined by number of pickoffs

**Repair Kit includes thrust washers, shaft sleeve, castellated nut, cotter pin, and Belville washers

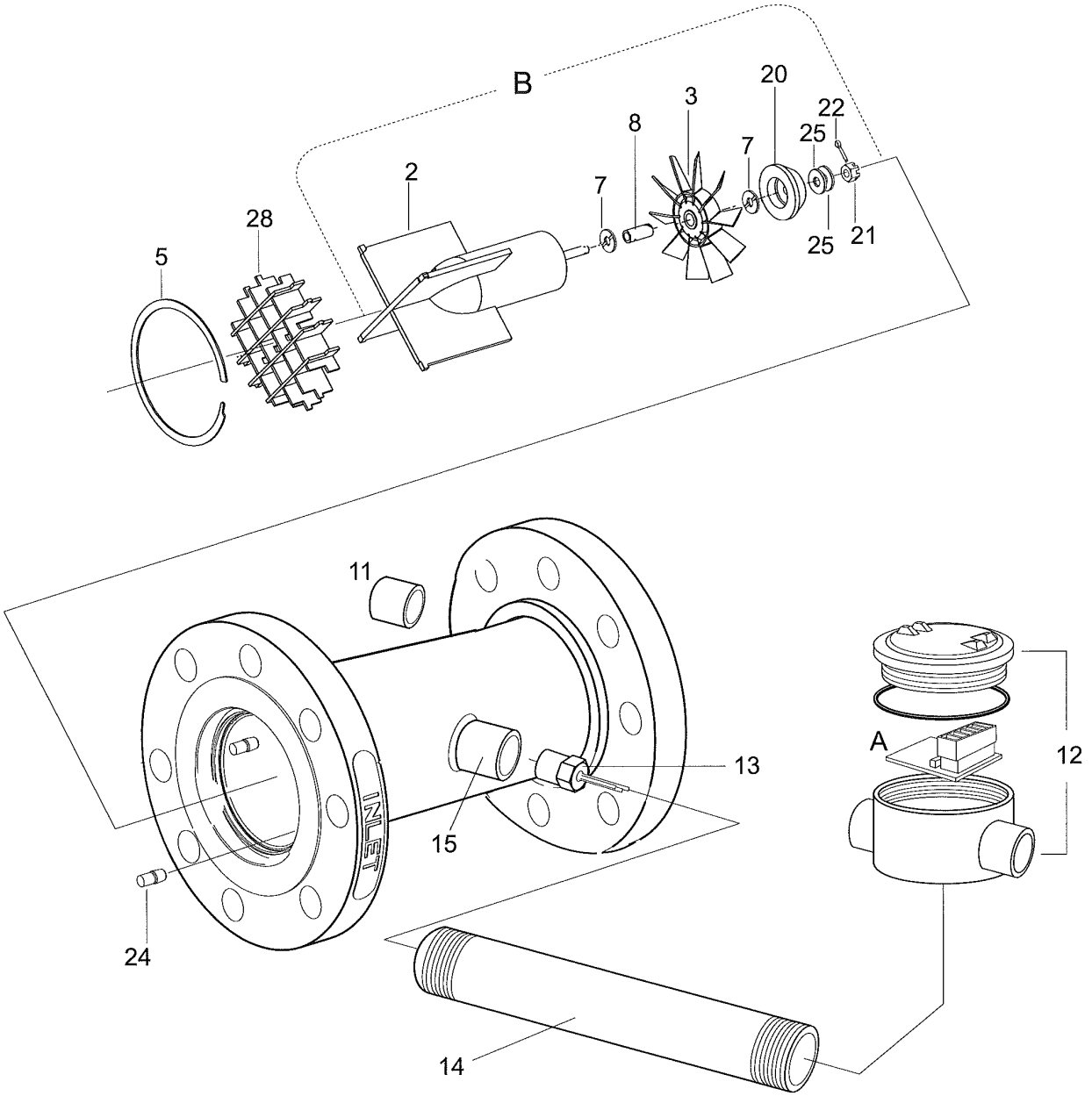

Figure 8-2. 3" and 4" Sizes Assembly Illustration

Table 8-3. 6" and 8" Sizes Replacement Parts

Seq.	Description	Qty.	6 inch	8 inch
2	inlet diffuser assembly, stainless steel	1	894-24-390-02	894-26-390-01
	inlet diffuser assembly, bidirectional meter	1	894-24-390-01	895-26-390-02
	inlet diffuser assembly	1	894-24-390-00	894-26-390-00
	inlet diffuser assembly, stainless steel, bidirectional meter	1	894-24-390-61	895-26-390-0I
3	rotor assembly, stainless steel hub, bidirectional meter	1	894-24-319-04	...
	rotor assembly, stainless steel hub	1	894-24-319-02	894-26-319-0I
	rotor assembly, aluminum hub	1	894-24-319-00	894-26-319-00
	rotor assembly, aluminum hub, bidirectional meter	1	894-24-319-0I	894-26-319-03
7	thrust washer	2	894-26-062-00	894-26-062-00
8	shaft sleeve	1	894-26-073-00	894-26-073-00
9	drive screw	4	153991	153991
10	outlet diffuser assembly, stainless steel, bidirectional meter	1	894-24-008-61	...
10	outlet diffuser assembly, aluminum, bidirectional meter	1	894-24-008-0I	894-26-008-03
12	preamp assembly			
	standard	*	894-00-373-12	894-00-373-12
	CENELEC EEx d IIC T6	*	894-00-301-00	894-00-301-00
	CENELEC EEx ib IIC T6	*	894-00-373-15	894-00-373-15
13	pickoff			
	standard	*	ES-595D-017-AAA	ES-595D-017-AAA
	high temp: 400°F (204°C)	*	ES-595D-045-AAA	ES-595D-045-AAA
	high temp: 850°F (454°C)	*	EW-595H-004-AAA	EW-595H-004-AAA
	low temp: -450°F (-268°C)	*	ES-595K-001-AAA	ES-595K-001-AAA
	CENELEC EEx ib IIC T6	*	ES-595D-049-AAA	ES-595D-049-AAA
14	high temperature extension	*	CA-296Z-049-ACA	CA-296Z-049-ACA
15	coupling assembly, high temperature, Europe	*	894-10-309-00	894-10-309-00
	coupling assembly, high temperature	*	157780	157780
17	backup washer, aluminum, bidirectional meter	1	894-24-001-00	894-24-001-00
	backup washer, stainless steel. bidirectional meter	1	894-24-001-60	...
20	diffuser washer, aluminum	1	894-24-013-00	894-26-013-00
	diffuser washer, stainless steel	1	894-24-013-01	894-26-013-01
21	castellated hex nut	1	151657	151657
22	cotter pin	1	153931	15393 I
23	flat washer, bidirectional meter	1	151883	151883
24	groove pin, 150 lb. body	2	153688	153688
	groove pin, 300 lb. body	2	153688	153689
	groove pin, 600 lb. body	2	153689	153689
25	Belville washer	2	1500443	1500443
26	outlet diffuser support, bidirectional meter	3	895-24-070-00	895-26-070-00
27	hex nut, bidirectional meter	3	151638	151638
28	flow conditioning plate	1	893-24-301-02	893-26-301-03
29	rotor bushing	1	894-26-127-00	894-26-127-00
30	hexagonal socket head screw	4	151086	151086
31	bushing retainer	1	894-24-065-00	894-24-065-00
32	clamp	4	894-26-006-00	894-26-006-00
33	socket head hex screw, no flow conditioning plate	4	151086	151086
	socket head hex screw, with flow conditioning plate	4	151486	151486
	binding head screw	4	...	150629-419
35	retaining ring	1	893-24-302-00	893-26-302-01
36	spacer, no flow conditioning plate	4	893-24-303-00	...
A**	preamplifier circuit board	*	ES-097Y-167-AAA	ES-097Y-167-AAA
	preamplifier circuit board, explosion proof	*	ES-097Y-167-AAA	ES-097Y-167-AAA
	preamplifier circuit board, intrinsically safe	*	894-00-373-20	894-00-373-20
***	repair kit (not shown)	1	W894-26-400-00	W894-26-400-00

* quantity determined by number of pickoffs
** not shown
*** Repair Kit includes thrust washers, shaft sleeve, castellated nut, cotter pin, and Belville washers

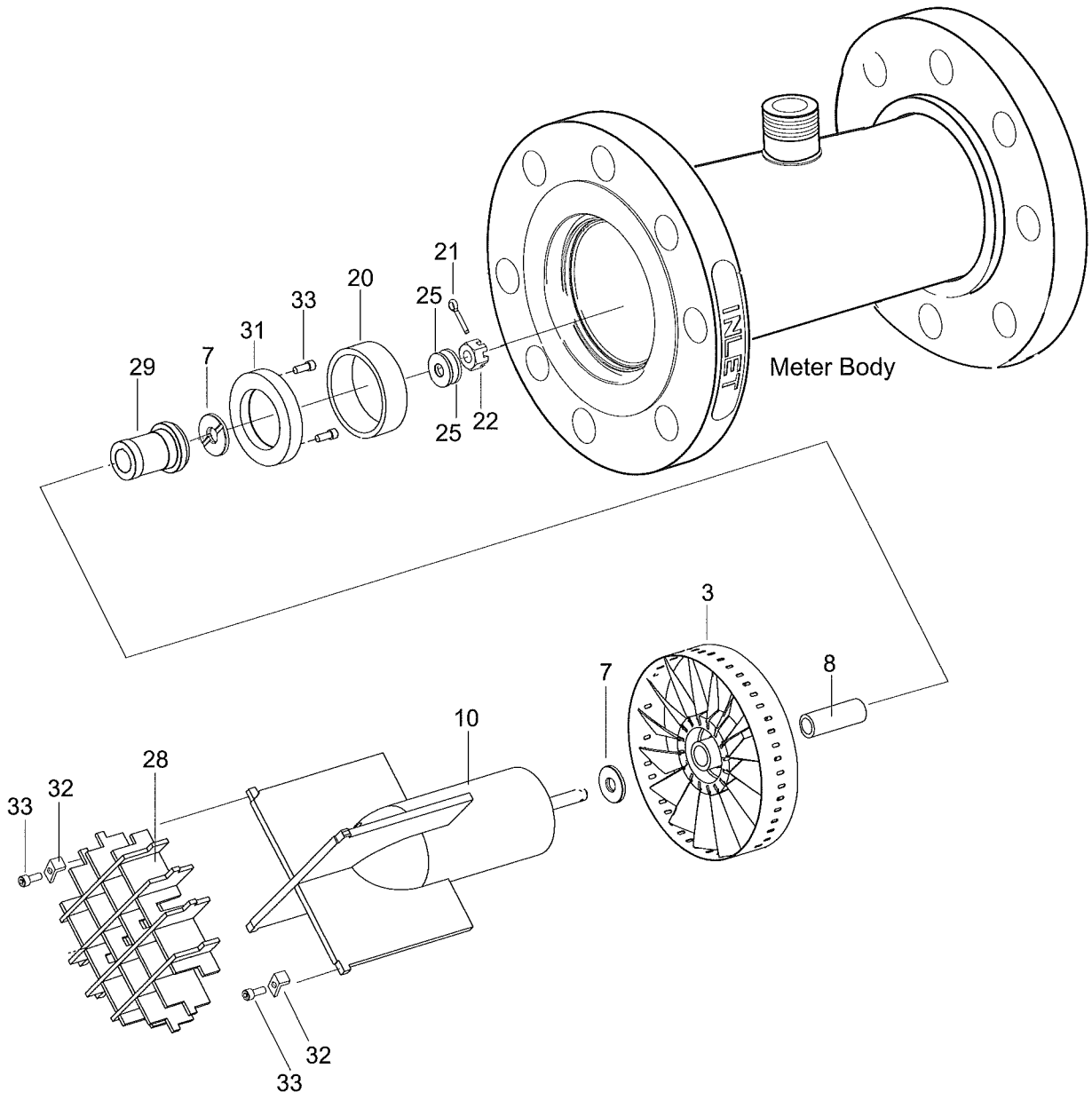

Figure 8-3. 6" and 8" Sizes Assembly Illustration

Table 8-4. 10" through 16" Sizes Replacement Parts

Seq.	Description	Qty	10 inch	12 inch	16 inch
2	inlet diffuser assembly, aluminum	1	894-29-390-00	894-31-390-00	894-33-390-00
	inlet diffuser assembly, stainless steel	1	894-29-390-01	894-31-390-01	894-33-390-60
3	rotor assembly, aluminum hub	1	894-29-319-00	894-31-319-00	894-33-319-00
	rotor assembly, stainless steel hub	1	894-29-319-01	894-31-319-01	894-33-319-60
7	thrust washer	2	894-29-062-00	894-29-062-00	894-33-062-00
8	shaft sleeve	1	894-29-073-00	894-29-073-00	894-33-073-00
9	drive screw	4	153991	153991	153991
12	preamp assembly				
	standard		894-00-373-12	894-00-373-12	894-00-373-12
	CENELEC EEx d IIC T6	*	894-00-301-00	894-00-301-00	894-00-301-00
	CENELEC EEx ib IIC T6	*	894-00-373-15	894-00-373-15	894-00-373-15
13	pickoff	*			
	standard		ES-595D-017-AAA	ES-595D-017-AAA	ES-595D-017-AAA
	high temp: 400°F (204°C)	*	ES-595D-045-AAA	ES-595D-045-AAA	ES-595D-045-AAA
	high temp: 850°F (454°C)	*	EW-595H-004-AAA	EW-595H-004-AAA	EW-595H-004-AAA
	low temp: -450°F (-268°C)	*	ES-595K-001-AAA	ES-595K-001-AAA	ES-595K-001-AAA
	CENELEC EEx ib IIC T6	*	ES-595D-049-AAA	ES-595D-049-AAA	ES-595D-049-AAA
14	high temperature extension	*	CA-296Z-049-ACA	CA-296Z-049-ACA	CA-296Z-049-ACA
15	coupling assembly, high temperature,	*			
	Europe		894-10-309-00	894-10-309-00	894-10-309-00
	coupling assembly, high temperature	*	157780	157780	157780
21	castellated hex nut	*	151656	151656	151653
22	cotter pin	1	153918	153918	153918
24	groove pin, 150 lb. body	1	153688	153688	153688
	groove pin, 300 16. body	2	153688	153688	153688
	groove pin, 600 lb. body	2	153689	153689	153689
25	Belville washer	2	1500444	1500444	...
28	flow conditioning plate	2	893-29-301-01	...	...
29	rotor bushing	1	894-29-127-00	894-29-127-00	894-33-127-00
30	socket head hex screw	1	151089-419	151089-419	151001-019
31	bushing retainer	4	894-29-065-00	894-29-065-00	894-33-065-00
33	socket head hex screw	1	151087	151087	151001-019
37	diffuser cap, aluminum	14	894-29-018-00	894-29-018-00	894-33-018-00
	diffuser cap, stainless steel	2	894-29-018-01	894-29-018-01	894-33-018-60
38	shaft assembly, aluminum support plate	2	894-29-309-00	894-31-309-00	894-33-309-00
	shaft assembly, stainless steel	1			
	support plate		894-29-309-01	894-31-309-01	894-33-309-60
39	outlet diffuser support, aluminum	1	894-29-029-00	894-29-029-00	894-33-029-00
	outlet diffuser support, stainless steel	1	894-29-029-01	894-29-029-01	894-33-029-60
40	socket head screw,	1			
	no flow conditioning plate		151087	151087	151001-019
	socket head screw,	4			
	with flow conditioning plate		151485	151485	151485
A	preamplifier assembly	4	ES-097Y-167-AAA	ES-097Y-167-AAA	ES-097Y-167-AAA
	preamplifier assembly, explosion proof	*	ES-097Y-167-AAA	ES-097Y-167-AAA	ES-097Y-167-AAA
	preamplifier assembly, intrinsically safe	*	894-00-373-20	894-00-373-20	894-00-373-20
		*			

* quantity determined by number of pickoffs

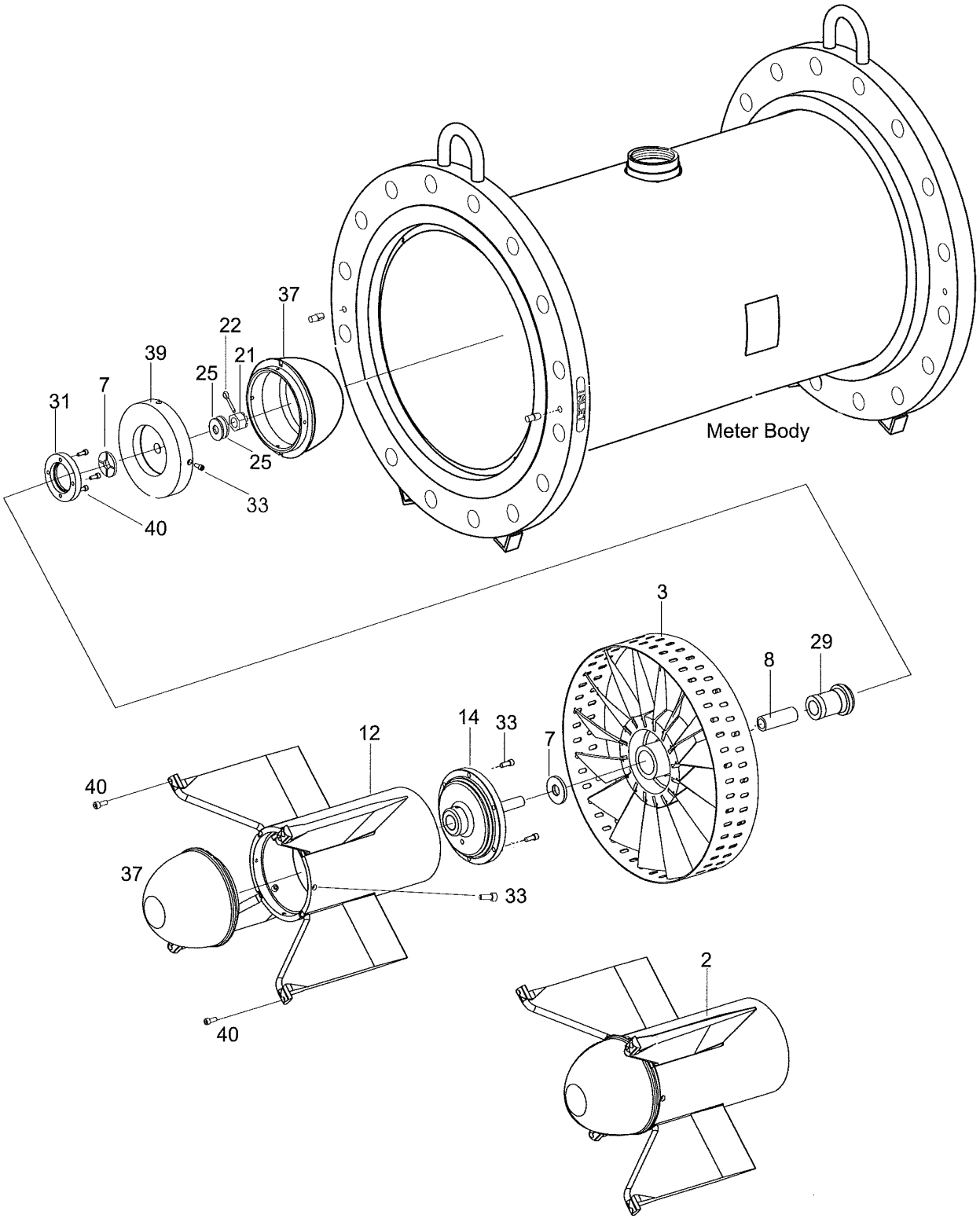

Figure 8-4. 10" through 16" Sizes Assembly Illustration

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9.0 Abbreviations Used in this Manual

Table 9-1. Abbreviations

AC	Alternating current
ANSI	American National Standards Institute
API	American Petroleum Institute
bph	Barrels per hour
C	Celsius
cS	Centistoke(s)
DIN	Deutsche Industrie Norm
DC	Direct current
F	Fahrenheit
ft.	Foot, feet
Hz	Hertz
In.	Inch(s)
kOhm	Kilo Ohm(s)
Kg	Kilograms
kHz	Kilo Hertz
kPa	Kilo Pascal
1	Liters
lb.	Pound(s)
lol	Length of lead
M	Meters
m	Millimeters
m^3	Cubic meters
mA	Milli Amp(s)
mV	Milli Volt(s)
psi	Pounds per square inch
R.F.	Raised Face
RMS	Square root of mean Square
TTL.	Transistor transistor logic
V	Volt(s)
V_{oh}	Volts output high
V_{ol}	Volts output low
V_s	Supply voltage

Table 9-2. Approvals

UL	Underwriters Laboratories, U.S.A.
cUL	Certified to CSA (Canadian Standards Association)
CENELEC	Certified to European standards

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Daniel Measurement and Control, Inc.
11100 Brittmoore Park Drive
Houston, TX 77041 USA
T +1 713-467-6000
F +1 713-827-4805
USA Toll Free 1 888-356-9001
Daniel Measurement Services, Inc.
T +1 713-827-6413
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 +65-677-8211

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