Smith Meter® Turbine Meters

Models 4" through 24" Sentry Turbine Meters

Service Manual

Bulletin MN02004 Issue/Rev 0.3 (8/02)

Contents

It is suggested that a detailed record be maintained for each meter. Nameplate data, progressive totalizer readings, meter factor, parts used, and other similar information provide background material for scheduling a preventive maintenance program. An increase in meter factor drift against throughput can be used as the basis for making an inspection.

The time of the first inspection must be based on the operating conditions imposed by the installation. Flow rate, lubrication properties of the fluid, and the possibility of abrasive contaminants are points to consider. Then, at the time of inspection, the condition of the meter should indicate whether the inspection interval could be lengthened or shortened.

All parts, as they are removed, should be thoroughly inspected and, if necessary, cleaned in solvent.

Before any disassembly is performed on the meter, be sure the trouble is in the meter.

1. Check that the meter is being operated within the proper flow rate. Refer to the nameplate on the side of the meter.
2. Check pick-up coil and preamplifier for proper operation. An oscilloscope will be necessary to determine wave form of the pick-up coil. Refer to Bulletin SS02001 for pick-up coil specifications and Page 3 of this document for preamplifier information.
3. Check for electronic totalizer malfunction.
4. Check that the system flow temperature has stabilized, that there are no abnormal pressure fluctuations, and that there is proper system back pressure.
5. Check valve operation in the system.
6. Check for air in the system.

After all other accessories have been checked and found to be operating normally, the turbine meter should be checked.

Before beginning any service procedure, stop product flow, drain the line in the direction of flow (if possible), and relieve the pressure from the system. Remove the Sentry Series Turbine Meter from the line and take it to a clean area for disassembly.

Return Procedures

No material can be returned from either a distributor or customer without receiving a properly executed Return Material Authorization (RMA). Once the RMA is received, the material may be returned in accordance with the instructions contained in the RMA.

Authorization for the return of either new or used material can only be granted by the Customer Service Department of TechnipFMC.

If the material to be returned is new and unused, the customer should supply the invoice number and/or the shipping order number of the original purchase.

For any units that have been installed and could contain a residue of product, it is the responsibility of the customer to properly flush and, if necessary, neutralize the inside of the equipment in question. If not properly accomplished, the customer must assume all responsibility for any injuries, property damages, or violations of state or local statutes.

All items to be returned must be freight prepaid to the TechnipFMC 1602 Wagner Avenue, Erie, Pennsylvania 16514 and shipped in accordance with all rules and regulations of the Department of Transportation and Environmental Protection Agency.

Removal and Replacement of Pick-Up Coil With Meter in Product Line

1. Make certain power has been disconnected to meter.
2. Remove cover from junction box by turning counterclockwise.
3. If a preamplifier is being used, disconnect pick-up coil wires from Terminals 6 and 7 of PA-6 Preamplifier.
4. Remove junction box from meter by turning counterclockwise, Figure 1.

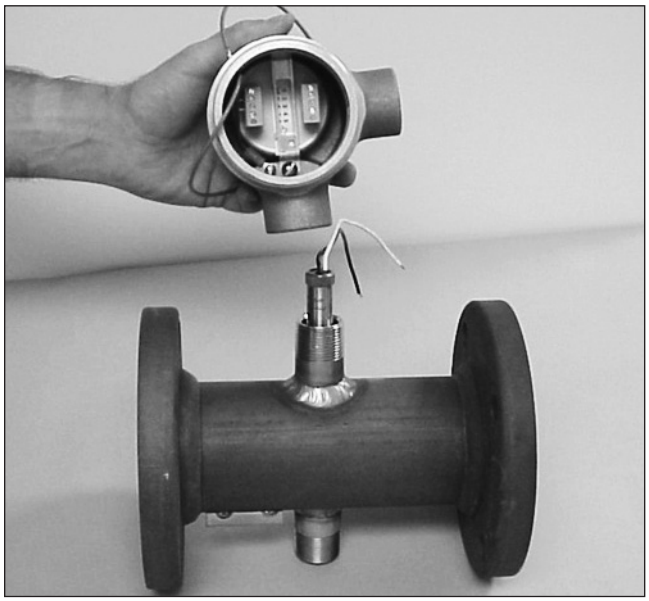

Figure 1

5. Remove pick-up coil from meter by turning counterclockwise, Figure 2.
6. Check resistance of coil (nominal dc coil resistance -1,020 Ω) to determine if coil is faulty.
7. For reassembly, reverse procedure.

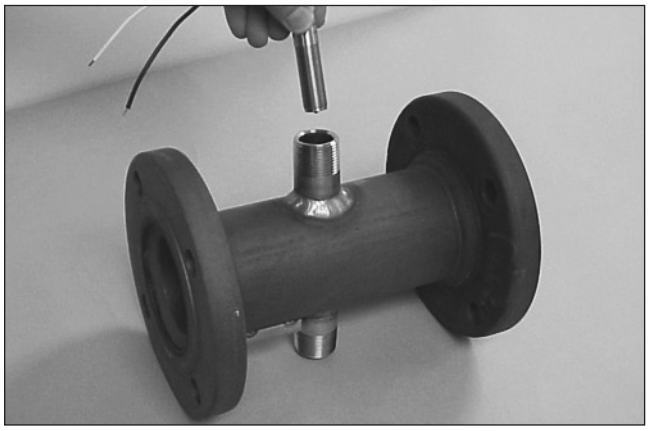

Figure 2

Caution: *Tighten pick-up coil finger tight. Over tightening will result in damage to coil.*

Removal and Replacement of Preamplifier With Meter in Product Line

1. Remove pick-up coil as outlined above, Steps 1 through 5.
2. For PA-6 removal, remove #6-32 round head screw, Figures 3 and 4, to permit removal of metal clip, Figure 5.

Figure 3

Figure 4

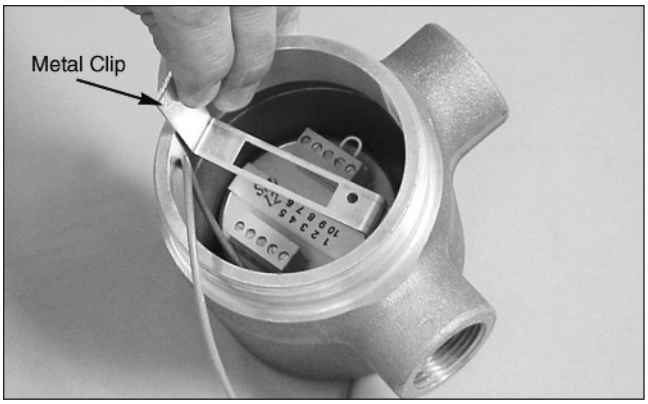

Figure 5

3. Disconnect output wiring and remove preamp from junction box, Figure 6.
4. For reassembly, reverse procedures.

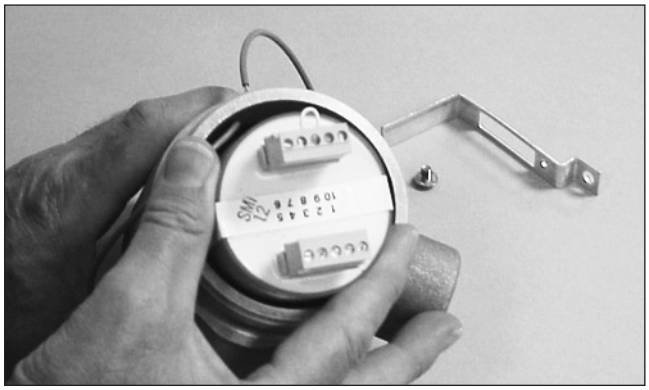

Figure 6

Removal and Servicing of Meter Internals

1. Drain product from line. Drain in direction of flow (if possible).
2. Make certain power has been disconnected to meter.
3. Remove junction box cover, disconnect output wiring and conduit where required.
4. Make certain meter is properly supported before re-moving bolts and nuts.
5. With meter removed, check straightening section to make certain tube bundle is clean and free from damage.
6. If necessary to remove pick-up coil and preamplifier, refer to procedures outlined above.
7. Remove cotter pin and slotted nut from downstream end of meter, Figures 7 and 8.

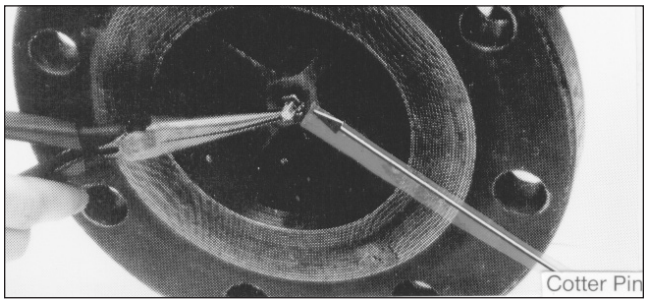

Figure 7

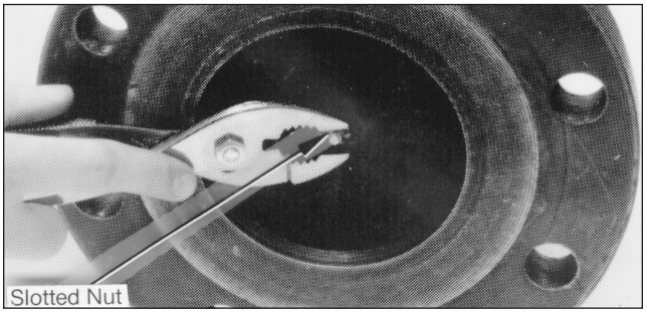

Figure 8

8. Remove downstream stator, Figure 9. In a unidirectional turbine meter, the stator is located by a Woodruff key. Care should be taken that the Woodruff key is not lost. In a bidirectional turbine meter, there is no Woodruff key; the two stators are located by two deflector rings.

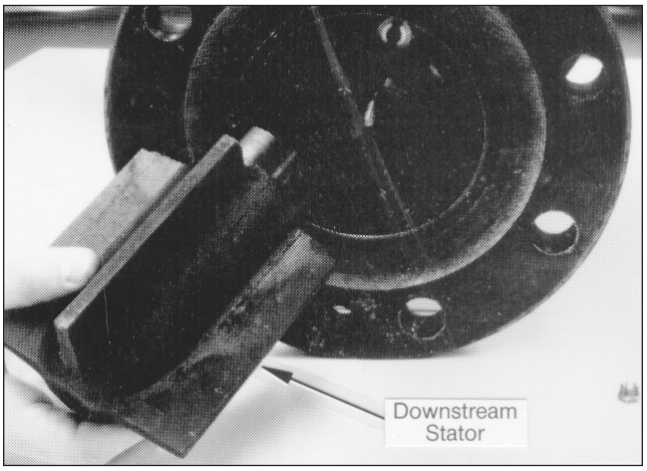

Figure 9

9. Inspect the holes in the downstream stator fins on the thrust bearing end, Figure 10, to make certain they are open and the inside of the stator is clean. Inspect thrust washer for signs of roughness, grooves, or cracks.

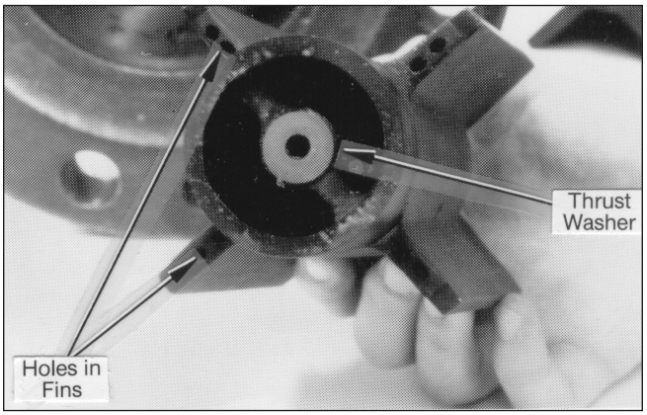

Figure 10

If thrust washer shows signs of wear but is not cracked, turn washer over.

- In some of the older turbine meter designs, it will be necessary to apply a small amount of heat to the stator around the thrust washer area to re move the washer.
- On models after serial number 229T, the thrust washer is secured in place with a small amount of Locktite No. 72-41. This can also be removed by applying a small amount of heat around the washer. The washer can then be turned over for reuse. If the new bearing surface shows evidence of Locktite (yellowish color), it can be removed with acetone.

10. Remove rotor and platform bearings, Figure 11, using extreme care that the platform bearing is not permitted to fall from the rotor since, due to the brittleness of the bearing, a fall could result in severe damage. Inspect outside surface of bearing for grooves, chipping, roughness, and cracks, as well as cracks in end surfaces.

    When removing the rotor from a bidirectional turbine meter, it is necessary to remove the downstream deflector ring. Remove the set screw and slide the ring out. When reinserted, the ring must be relocated exactly in its former position as the ring properly positions the downstream stator in relation to the upstream stator.

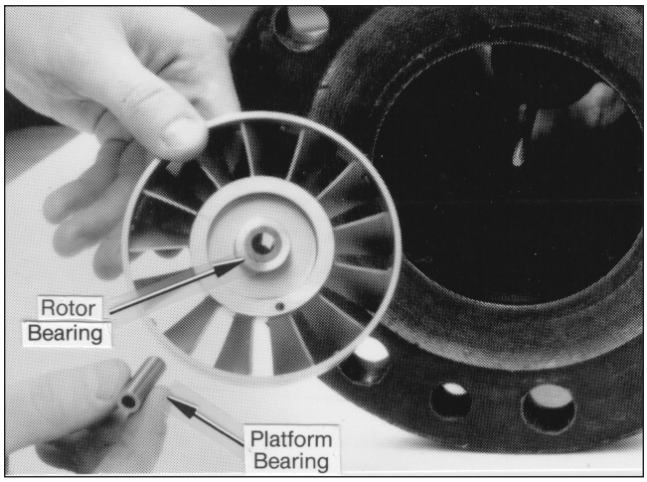

Figure 11

    Inspect inside surface and end surfaces of rotor bearing for same defects as for platform bearing. If bearing surfaces show no defects, the bearing will be suitable for reuse in most cases.

    - Bearing wear is minimal and bearing replacement is usually required only due to damaged surfaces.

11. Should rotor bearing require replacing, it is suggested that rotor assembly be returned to Measurement Solutions for rework. See “Return Procedures,” Page 2.

    Rotor bearing replacement can be done in the field by the following repair procedure.

    a. With proper tool and fixture, Figure 12, the old rotor bearing may be forced out of the rotor hub with an arbor press. Care must be taken in the selection of tool and fixture to insure a “straight line” or axial press only. Push the bearing out with a smooth, steady motion.

    b. The new bearing may be installed with the same equipment used to remove the old bearing. Center the bearing carefully in line with the hub bore before pressing. The bearing material has been selected for its hardness and wear characteristics, but may be chipped or broken if mistreated. Press the bearing into the rotor hub to achieve equal protrusion within 0.005" from both hub faces.

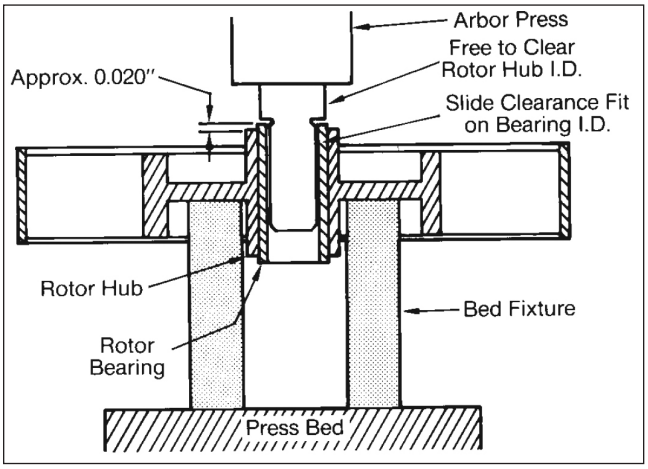

Figure 12

12. Remove upstream stator with shaft and inspect as described in Step 9. On most unidirectional models, holes are in nut end of stator (Figure 13).

    In some bidirectional turbine meters, two downstream stators are used. Therefore, the holes will be located as shown in Figure 10.

13. For a unidirectional turbine meter, it is not necessary to remove deflector ring in order to service meter internals. If ring is removed, it must be relocated exactly in its former position when reinserted as ring properly positions upstream stator in relation to down-stream stator. If necessary to remove, remove set screw and slide ring out from upstream end of meter, Figure 14.

Note: *It will be necessary to remove one deflector ring when servicing a bidirectional turbine meter.*

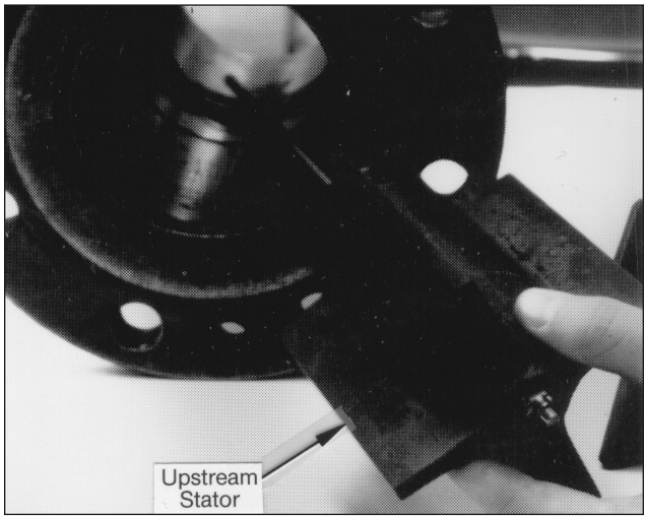

Figure 13

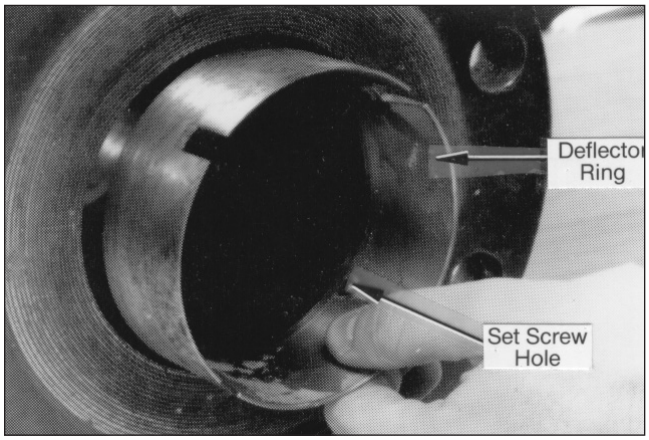

Figure 14

Reassembly of Internals

1. Inspect to make certain all parts are clean and free from defects, especially replacement parts. Make sure the rotor bearing is properly aligned in the rotor (equal amounts of the bearing should be on each side of the rotor).
2. Place upstream stator on shaft and install shaft nut. Note. Before installing the nut on the shaft, the mating surfaces of the nut, the stator, and the threads of the shaft should be cleaned and lubricated with SAE grade 30 oil (or equivalent). The shaft nut should be properly tightened and secured with the cotter pin. See Table 1 for proper torque values.

Table 1 – Shaft Nut Torque Values

Meter Sizes	Thread Size	Torque Required (Lubricated) ±5%
4"	#10-32 UNF-2	22 in-lb
6", 8"	5/6"-18 UNC-2	8 ft-lb
10", 12"	1/2"-13 UNC-2	32 ft-lb
16"	3/4"-16 UNF-2	120 ft-lb
18"	7/8"-14 UNF-2	115 ft-lb
20"	1"-12 UNF-2	170 ft-lb
24"	1-1/4"-12 UNF-2	250 ft-lb

3. Apply blueing or similar compound to downstream side of rotor hub that matches O.D. of stator, Figure 15. ***Rotor is marked "IN" on upstream side of rotor.***
4. Slip platform bearing on shaft with approximately 1/4" of shaft showing. Lubricate O.D. of platform bearing with light machine oil.
5. Assemble rotor to platform bearing and gently push bearing and rotor into housing until positioned by stator. Do not bump bearing ends against stator.

   In a bidirectional turbine meter, reinsert deflector ring. Carefully relocate the ring in its exact former position and insert the set screws, but do not over tighten them because this could cause distortion of the deflector ring.

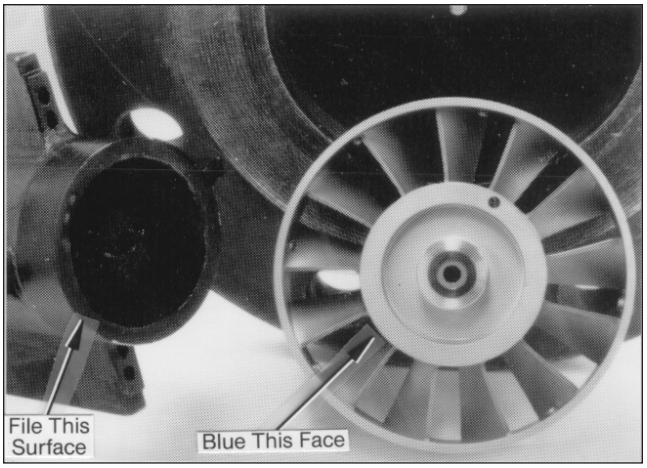

Figure 15

6. Assemble downstream stator. In a unidirectional turbine meter, the stator is positioned with the Woodruff key, Figure 16. In a bidirectional turbine meter, the stator is positioned with the deflector ring. Assemble shaft nut; refer to Step 2.

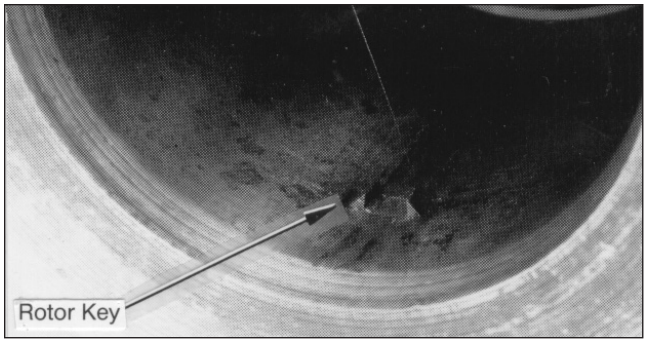

Figure 16

7. With air inserted through upstream end of meter, spin rotor at a reasonable speed not to exceed 100 rpm for 1 minute.

8. Disassemble downstream stator and inspect hub for blue markings. If markings are detected, this indicates rotor is rubbing stator which will affect meter linearity. This can be caused by the rotor bearing not having equal protrusion within 0.005" from the rotor hub, or there may be burrs or high spots on the rotor. First, check the rotor bearing and align as outlined on Page 5, Step IIb. If this does not correct the problem, remove high or blue spots on stator, Figure 15, by light filing. Repeat this inspection until rotor runs smoothly and then assemble internals completely.

9. Position turbine meter on its upstream flange. Spin rotor with a rod, Figure 17, and visually observe if rotor spins free and returns to rest with smooth rotation. If any drag or friction is detected, this indicates upstream face of rotor O.D. is rubbing against O.D. face of deflector ring. This condition will affect meter linearity and may be corrected by repositioning rotor bearing in rotor. Repositioning is accomplished in ac-cordance with procedures in Step 11, Page 5. This procedure can be repeated from the opposite side for a bidirectional turbine meter.

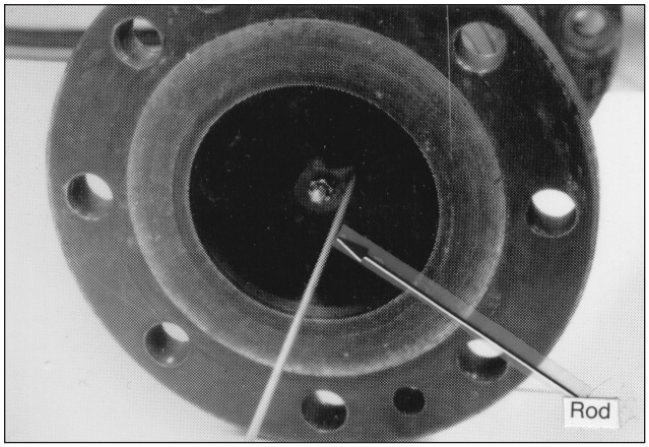

Figure 17

10. Place turbine meter in horizontal position, Figure 18. Hold either up or downstream stator and move internal laterally. Assembly should move approximately 0.010" to 0.032". If assembly has lateral movement or end play, this indicates platform bearing is securely locked in place.

    No end play indicates platform bearing is loose and can rotate about shaft which will result in meter inaccuracy and premature service. Disassemble meter, determine fault, and correct.

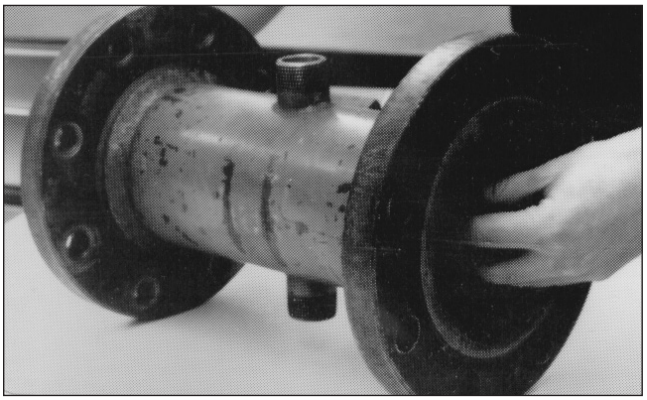

Figure 18

Additional Notes

Check to make certain stators are positioned at 45° to each other, Figure 19. Tests have proven that when stators are positioned in this manner, meter accuracy is improved.

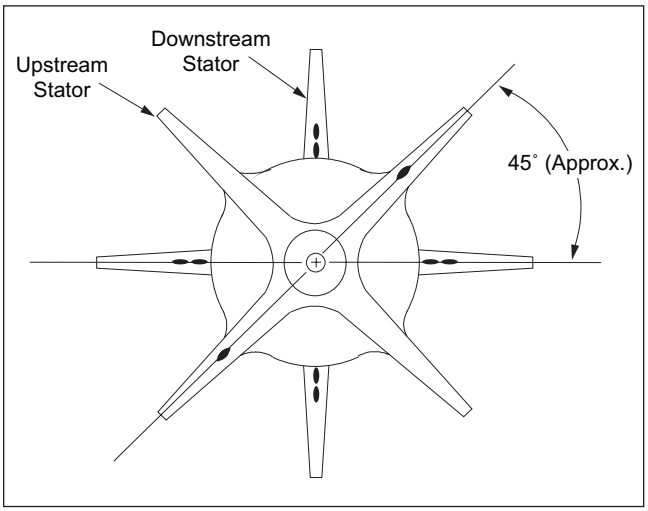

Figure 19

When transporting meter, make certain meter is not subjected to any severe shock as bearings may be damaged. Cover flange openings to protect internals.

Note: *When a meter is disassembled and reassembled, it should be recalibrated for optimum accuracy.*

Test

After meter has been inserted into the product line, meter must be proved in order to obtain new meter factor. This is usually accomplished by the use of a displacement-type prover.

During testing, should repeatability not be obtainable, check to make certain that pick-up coil is tight. If coil is tight and results are still not satisfactory and assuming prover is functioning properly, it may be necessary to recheck rotor and platform bearing for possible damage during installation. Proving the meter should be under the same conditions of flow rate, pressure, temperature, and liquid characteristics as exist during normal operation of the meter.

For meter proving procedures, refer to API Manual of Petroleum Measurement Standards, Chapters 4 and 12.

For maximum accuracy, the meter must be recalibrated after each repair.

Problem	Probable Cause	Corrective Action
Overdelivery (or under registration)	Dirty bearings.	Clean.
	Worn bearings.	Replace.
	Corrosion, erosion.	• Minor: Reprove meter. • Extreme: Replace damaged parts.
	Bent blades.	Replace rotor.
	Missing rotor blade.	Replace rotor.
Underdelivery (or over registration)	Deposits (wax, for example).	Clean.
	Clogging of tube bundles.	Remove and clean.
	Bent blades.	Replace rotor.
	Cavitation.	Higher back pressure.
	Entrained air or gas.	Eliminate source or add air eliminator.
	Noise on transmission line.	• Add or check shielded cable. • Eliminate source. • Check that shield is grounded at instrument end only. • Decrease sensitivity on instrument front end. • Add suppression circuit to preamplifier.
Non-Repeatability	Damaged or missing blade.	Replace rotor.
	Electrical noise interference.	See “Underdelivery.”
	Damaged thrust washer.	Replace.
	Deposits on the bearings.	Clean or use slofted bearings.
	Plugged stator fin holes.	Clean.
	Problems with the prover.	Check prover operation.
	Leaks in the system.	Check system for leaks.
Meter Factor Shift	Refer to Probable Causes of Overdelivery, Underdelivery.	Refer to action to be taken for overdelivery and underdelivery.
Output Without Flow	Noise.	See “Underdelivery”.
	Line vibration transmission through pick-up coil.	Eliminate source of vibration. With pick-up coil only, desensitize coil by inserting a non-ferrous spacer(s) (0.030" increments) in pick-up coil boss. With preamp, refer to Preamplifier Bulletin SS02012 to desensitize.

Maintenance and Calibration Record

Meter No.					
Serial No.					
Product					
Flow Rate					
"K" Factor					
Date Proved		By			
Remarks					

Meter No.					
Serial No.					
Product					
Flow Rate					
"K" Factor					
Date Proved		By			
Remarks					

Meter No.					
Serial No.					
Product					
Flow Rate					
"K" Factor					
Date Proved		By			
Remarks					

Meter No.					
Serial No.					
Product					
Flow Rate					
"K" Factor					
Date Proved		By			
Remarks					

Section 5 – Related Publications

The following literature can be obtained from Measurement and Product Solutions Literature Fulfillment at measurement.fulfillment@technipfmc.com or online at http://info.smithmeter.com/literature/online_index.html.

When requesting literature from Literature Fulfillment, please reference the appropriate bulletin number and title.

Turbine Meters

Manual

4" thru 24" Sentry Series Installation/Operation MN02003

Specifications

4" thru 20" Sentry Series SS02001
Flow Straightening Assemblies..... SS02007
Preamplifier PA-6..... SS02012

Parts Lists

4" Sentry Series..... PO02013
6" Low Flow Sentry Series Model K2DF PO02014
6" Sentry Series..... PO02015
8" Sentry Series Model K2DH, K2DT PO02016
10" Sentry Series Model K2DJ PO02017
12" Sentry Series Model K2DK PO02018
16" Sentry Series Model K2DL..... PO02019
18" Sentry Series..... PO02020
20" Sentry Series..... PO02021

Technical Support

Contact Information:
Field Service Response Center
24/7 Technical Support/Schedule a Technician: 1-844-798-3819
System Installation Supervision, Start-Up, Training, and Commissioning Services Available

Revisions included in MN02004 Issue/Rev. 0.3 (8/02):
Editorial Changes: Changed Preamplifier from PA-4 to PA-6, throughout document.

USA Operation
1602 Wagner Avenue
Erie, Pennsylvania 16510 USA
P:+1 814.898.5000

TechnipFMC
13460 Lockwood Rd.
Building S01
Houston, Texas 77044 USA
P:+1 281.591.4000

Germany Operation
Smith Meter GmbH
Regentstrasse 1
25474 Ellerbek, Germany
P:+49 4101 304.0

TechnipFMC.com