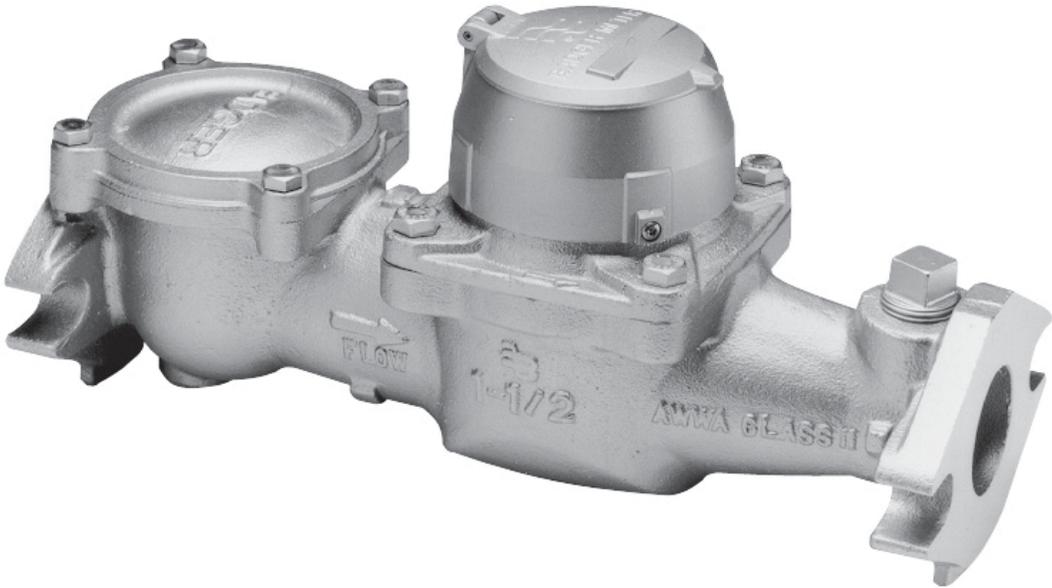


**Recordall® Turbo
Series Meters**

**Sizes 1 1/2", 2", 3", 4", 6", 8",
10", 12", 16" and 20"**

**Installation &
Operation Manual**



PREFACE

SCOPE OF MANUAL

This manual contains information concerning the installation, operation and maintenance of Recordall® Turbo Series meters with magnetic drive. To ensure efficient operation of the meters, the instructions in this manual should be thoroughly read and understood. Retain this manual in a location where it is readily available for reference.

Section I GENERAL INFORMATION

1-1. DESCRIPTION

Recordall® Turbo Series meters utilize proven design features such as thrust compensated rotor geometry, direct drive magnetic coupling and dual outboard rotor bearings to achieve high accuracy over a broad flow range. Extended product service life is achieved at higher levels of accuracy, in addition to lower meter maintenance costs. Recordall Turbo Series meters are available in 1 1/2", 2", 3", 4", 6", 8", 10", 12", 16" and 20" sizes.

Incorporating unitized construction with corrosion-resistant assemblies, the basic components of the Recordall Turbo Series consist of the housing and completely removable measuring element. Permanently sealed for greater product reliability, the straight-reading local register and Recordall Transmitter Register (RTR®) allow in-line servicing. The meter housing and cover plate are bronze (1 1/2" - 10"). The 12" - 20" meter housings are cast iron with a heat fused epoxy coating. The measuring element is constructed of high-impact strength thermoplastics. Recordall Turbo Series meters are also equipped with an integral calibration mechanism for in-line accuracy calibration.

In the operation of a turbo meter, water flows through the straightening vanes and a nose cone at the inlet side of the meter so that the swirling effect of upstream piping is minimized. The water then strikes the rotor blades, causing the rotor to turn. A downstream nose cone includes straightening vanes to limit the downstream effects of flow profile distortions. Optional NPT test ports are provided for field performance testing.

Motion of the rotor is transferred by means of a worm drive to a vertical shaft driving a gear set, which transmits the rotation to the meter's registration device. The direct drive magnetic coupling provides accurate flow registration during line surges, and allows the permanently sealed register to be easily removed to facilitate in-line service.

A pictorial description of the meter's components and location can be found in the illustrated parts list RTS-P-1 which is provided as a supplement to this manual. Each assembly or part has an item number that is cross-referenced to an associated parts list which consists of the service assemblies and parts shown in the exploded illustration. The list provides the following information:

- a. Item number
- b. Name of part
- c. Part number

1-2. CONFIGURATIONS AND SPECIFICATIONS

A descriptive brochure, exploded parts list, pressure loss and accuracy charts are available and show the available sizes, flow range, head loss, laying length and weight for Recordall Turbo Series meters. The difference between various meter configurations relate primarily to flange connections and options for units of registration, i.e., U.S. gallons, cubic feet, etc. Materials used in the construction of the meters are also described in the accompanying literature.

1-3. ACCESSORIES

Badger's Recordall Transmitter Register (RTR) is available as an option for Recordall Turbo Series meters. The RTR provides system connectivity to the Itron® ERT®, ORION® and TRACE® meter reading systems.

Badger Plate Strainers 2" - 20" are also available. Recommended for use with all turbo meters, Badger Plate Strainers provide exceptional meter protection while improving meter accuracy and reliability. The 1 1/2" - 4" Turbo Series meters are available with integral stainless steel plate strainers.

Section II INSTALLATION

2-1. UNPACKING AND INSPECTION

To avoid damage in transit, Badger® Recordall Turbo Series meters are shipped to the customer in special shipping containers. Upon receipt of shipment, be sure to follow these unpacking and inspection procedures:

NOTE

If damage to a shipping container is evident upon receipt of a meter, request that a representative of the carrier be present when the meter is unpacked.

a. Carefully open the shipping container, following any instructions that may be marked on the container. Remove all cushioning material surrounding the meter and carefully lift the meter from the container. Keep the container and all packing material for possible use in reshipment or storage.

b. Visually inspect the meter and applicable accessory devices for any signs of damage such as scratches, loose or broken parts or other physical damage that may have occurred during shipment.

NOTE

If damage is found, request an inspection by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A claim for equipment damaged in transit is the responsibility of the customer.

2-2. INSTALLATION

Procedures for installing Badger Turbo Series meters are essentially the same for all meter sizes. Any special instructions required for the installation or connection of accessory devices such as strainers will be provided as supplements to this manual. Figure 1 outlines a recommended meter installation.

A. PRELIMINARY CONSIDERATIONS. Before proceeding any further with the installation, first read the instructions in the paragraphs immediately following to become familiar with the requirements and procedures involved.

NOTE

Badger Recordall Turbo Series meters are designed for operation in HORIZONTAL piping arrangements.

1. Be sure that the meter flow range and size of the meter coincide with the intended service and demand for water.

CAUTION

The life of the turbo meter will be curtailed if operated at flow rates higher than specified. (Reference Technical Briefs).

2. The meters are designed for use in cold water service (up to 120°F or 49°C) within the applicable flow requirements for turbo

meters. For use with water at higher temperatures, consult your Badger Meter representative or nearest Badger regional sales office.

3. Installation of a strainer is recommended upstream of the meter. The strainer, in addition to protecting the meter from debris in the line, minimizes the effect of velocity profile distortions or turbulence caused by changes in pipe direction or valving resulting in more accurate registration. Contact your Badger Meter representative for information on Badger® Plate Strainers.

4. Avoid locating the meter in close quarters. Allow sufficient space to permit access for meter reading, testing, and maintenance.

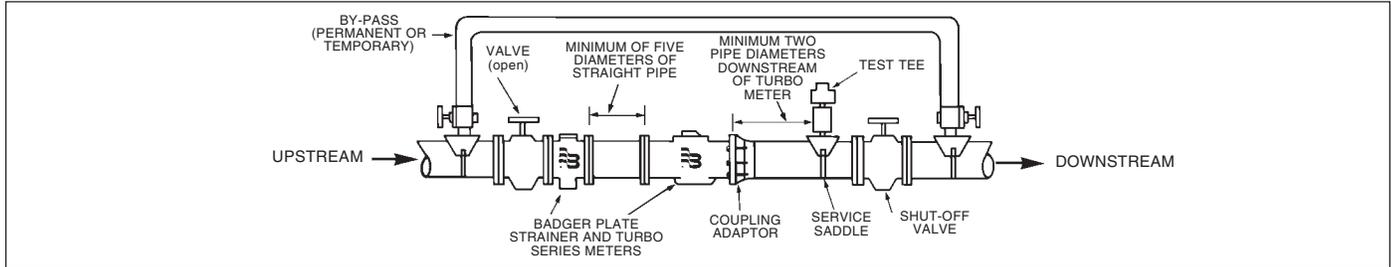


Figure 1. Recommended Meter Installation

5. Because of the need to test large meters periodically to verify their performance, it is recommended that a bypass system be incorporated into the piping arrangement. This will also provide a means of performing periodic cleanout and routine maintenance without interrupting service to the customer. A test tee can be installed downstream of the meter for field accuracy testing.

6. The Recordall® Turbo Series is accuracy and pressure tested prior to shipment, therefore no field adjustments are required. As turbine performance is directly related to the flow conditions of the water stream entering the meter, upstream fittings and piping changes can adversely affect flow registration. To insure valid registration and proper performance, the following factors should be considered when installing Recordall Turbo Series meters and Turbo Series meters with integral strainers.

a. When installing the meter with a separate Badger Plate Strainer or integral strainer, a minimum of five (5) pipe diameters of straight, unobstructed pipe is recommended upstream of the meter. For optimum protection and accuracy, this straight pipe spool piece should be installed between the separate strainer and meter as illustrated in Figure 1. (A minimum of ten (10) pipe diameters (minimum of 25 pipe diameters for smallest size) of straight unobstructed pipe is recommended upstream of a meter installed without a plate strainer. The deletion of a strainer, however, is not recommended.) This allows for dampening of velocity profile distortions caused by elbows, pumps, dirt traps, etc., prior to the meter. Where spiral flows are created by three dimensional elbows or rotary pumps, additional distance to dampen the effect is beneficial. If a basket or Y-type strainer is utilized, it is recommended that it be placed five (5) to ten (10) pipe diameters prior to the meter to dampen velocity profile distortions created by this design.

b. Do not install check valves or pressure reducing devices upstream of the meter.

c. Valves immediately upstream of the meter should only be fully-open gate valves. Butterfly valves are acceptable if they are five (5) pipe diameters or more upstream from the meter. Downstream, fully open gate or butterfly valves can be used.

d. The service saddle (or reducing tee) which is used for field accuracy testing should be at least two (2) pipe diameters downstream of the meter's outlet flange.

e. Unweighted check valves should not be located closer than three (3) pipe diameters downstream of the meter.

f. Externally weighted check valves and pressure reducing devices should not be located closer than five (5) pipe diameters of the meter.

g. When installing a turbo meter and plate strainer of a size smaller than the pipe installation, to reduce the effect of jetting caused by the increase in flow velocity, a minimum of five (5) pipe diameters is recommended upstream of the meter. Additional length is recommended if a sharp contraction or an eccentric reducer, rather than a concentric, tapered reducer is used.

B. INSTALLING THE METER. Overall dimensions and laying lengths of each meter size are shown on the Technical Briefs. After reviewing the applicable dimensional requirements, choose an appropriate installation point in the piping and proceed as follows:

1. Measure precisely the overall length of the meter with gaskets attached to the inlet and outlet flange connections.

2. Provide proper gap length in service piping.

3. Install meter in the pipeline so that the flow arrow on the meter housing points in the same direction as water flow.

4. With meter and gaskets in place, tighten flange connection bolts.

5. To relieve possible strain on the piping, it is recommended that a meter support be used under the meter housing where appropriate.

CAUTION

Turbine meters must operate in a completely filled line at all times. The downstream piping must always be arranged to provide sufficient back pressure to maintain a full line at the meter. By eliminating air in the line, as well as sudden flow surges, inaccurate registration and damage to the turbine mechanism can be avoided.

2-3. RECORDALL TRANSMITTER REGISTER OPTION

Badger Meter Recordall Transmitter Registers are designed for use with the Recordall Turbo Series. If the meter has been purchased with a RTR®, the installation guidelines as outlined in the Installation Data Sheet should be followed.

Before proceeding with the installation, be sure that the Recordall Transmitter Register corresponds to the meter size, and unit of measure.

2-4. PERFORMANCE CHECKS

Any valves or devices controlling the flow of water through a turbo meter must always be opened and closed SLOWLY to prevent shock loads that may damage the meter's rotor assembly.

Complete the following checks to ensure that a turbo meter is properly installed and operational:

a. Slowly open upstream valve to apply water pressure to the meter and check to see if there are any leaks. Tighten flange bolts as required.

b. Perform a functional test of the meter. Slowly open valve on downstream (consumer) side of the meter to evacuate any air that may have been trapped in the service line. When air has been eliminated, increase demand flow rate by further opening of downstream valve or valves. Observe register for correct direction of flow. The large test pointer will now move in the proper direction. Now open all applicable service valves.

c. Adjust rate of flow by throttling with the downstream valve so the flow does not exceed the maximum continuous duty specification as defined in the Technical Briefs. The rate of flow can be quickly checked by timing the quantity registered through the meter in one minute.

2-5. SHUTDOWN INSTRUCTIONS

If the turbo meter is to be shut down for an extended period of time or if it is being removed from service, Badger recommends that the meter and measuring components be thoroughly flushed to prevent the settling out of undissolved solids or the accumulation of corrosive deposits. If there is an upstream strainer in the line, it also should be flushed at this time.

Section III MAINTENANCE

3-1. GENERAL

This section is limited to information about general preventative maintenance and calibration procedures for Badger® Recordall® Turbo Series meters, whereas instructions for disassembling the meters for servicing can be found in Section IV. A repair parts list, exploded views and other illustrations are provided as a supplement to this manual.

3-2. MAINTENANCE EQUIPMENT

The tools and equipment recommended for servicing and maintenance of Recordall Turbo Series meters consist of the usual complement of hand tools used by plumbers and mechanics.

3-3. PREVENTATIVE MAINTENANCE

The purpose of preventative maintenance is to ensure efficient operation and long life by detecting and correcting any condition that may damage the meter or cause it to fail. Maintenance intervals are a function of the water quality and operating flows experienced by the meter. Preventative maintenance includes periodic inspection, accuracy testing and cleaning procedures.

a. PERIODIC INSPECTION

1. Visually inspect the meter for missing hardware, loose screws, broken or scratched register lens or any other signs of wear or deterioration. Replace worn parts as required.

2. Verify that the meter operates at the proper flow rate and pressure. A loss in pressure coupled with a decrease in flow rate may indicate that the screen in the upstream strainer or the meter itself is clogged and needs cleaning.

b. CLEANING

1. Clean all dirt, grease, moisture or other foreign material from the exterior of the meter. Use a cleaning solvent or volatile mineral spirits to remove grease or oil. To clean the measuring element, soak for 12 hours in a mild soap-based cleaner or detergent, and then use a stiff nylon bristle brush to remove any deposits. After cleaning, rinse thoroughly with water and dry.

2. In the event that the system pressure has been reduced and the upstream strainer or meter is clogged, the foreign material must be flushed out. To flush the strainer, open the cleanout plug and purge the foreign material with fresh water from the service line. After the strainer has been cleaned, purge the meter with fresh water and run discharge out the nearest downstream outlet.

3. Integral Strainer Units. Before attempting service/maintenance of strainer section, system pressure must be removed. See Section 4-2 to prepare meter for service. After system pressure is removed, remove cover bolts and cover. Clean out/flush strainer section of all loose particles/debris. After cleaning is complete, reinstall screen and reassemble. See Section 2-4 and follow instructions to return meter to normal service.

3-4. CALIBRATION CHECK AND ADJUSTMENT

The accuracy of Badger Recordall Turbo Series meters is tested at the factory before shipment. However, after a long period of service, it may be necessary to recalibrate a meter. The meter can be tested for accuracy using appropriate connections with either a test tank of known volume or a test meter. The meter can be tested in the setting by running output flow through the optional test port, if so equipped. The Recordall Turbo Series integral calibration mechanism can be adjusted under line pressure, simplifying and reducing calibration time. The following instructions are provided to assist in performing a calibration check and adjustment.

a. ACCURACY TEST

⚠ CAUTION

If the optional test port is to be used, upstream and downstream valves must be closed prior to removing plug and installing appropriate connections. Failure to do so can lead to plug being ejected from housing, causing personal injury and/or property damage. Whenever an installation is equipped with a drain valve for

meter flushing, open the drain valve to relieve pressure within the meter. If the installation does not have a drain valve, carefully loosen test plug until it begins leaking. Stop and wait for pressure to bleed down, then continue to slowly loosen, making certain pressure is completely bled off before removing.

1. After installing appropriate connections, meter can be tested by leaving setting downstream valve closed (if using integral test port), and slowly opening upstream valve. Finally, the test circuit downstream valve can be slowly opened and used to throttle flow for test purposes.

2. Place a test tank of known volume at the output of the meter. (An alternative is to connect a calibrated test meter to the output.) Accuracy testing requires test volumes at least as large as the register test circle.

3. As in testing the accuracy of any meter, the Recordall Turbo Series meter must first be purged of air by running water through the meter.

NOTE

Good test practices are required to perform reliable field accuracy tests such as those outlined in the AWWA M6 manual. Register "jump" can occur in some instances if valves are abruptly opened or closed. While this jump is not accumulative (no affects in service billing), it can affect accuracy results (1% per division on a one test circle volumetric test). Care during tests must be taken to insure this does not occur.

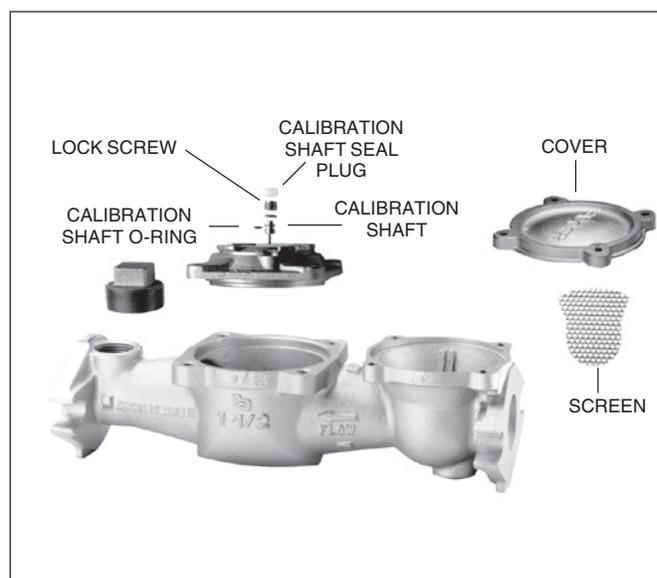


Figure 2. Calibrating Recordall Turbo Series Meters, shown with Optional Test Plug

4. Operate the meter until the test tank is filled to the calibrated level or the predetermined quantity has registered on the calibrated test meter. Because accuracy may vary slightly with flow rate, it is recommended that the meter be tested at low, intermediate and high flows.

5. Record the quantity registered on the meter during the test.

6. Perform the following calculations to determine meter accuracy:

$$\frac{\text{Quantity Registered on Meter}}{\text{Test Tank or Test Meter Quantity}} \times 100 = \text{Meter Accuracy}$$

b. CALIBRATION. The meter's calibration ring is preset at the factory and sealed. In normal service, it should not have to be reset. If a retest is required in which a calibrated test stand reveals that the meter needs recalibration, proceed as follows (see Figure 2):

1. Remove calibration shaft seal plug by puncturing plug in slot provided and twist/pry plug from hole.
2. Loosen calibration shaft lock screw.
3. Adjust calibration ring with screw driver as follows:

TO INCREASE REGISTRATION. Turn the calibration shaft clockwise. This will speed up the rotor, increasing registration.

TO DECREASE REGISTRATION. Turn the calibration shaft counter clockwise. This slows down the rotor, decreasing registration.

NOTE

The total range of the calibration adjustment is about 10%. Tested and calibrated at the factory, the calibration mechanism will allow for a $\pm 5\%$ adjustment in the field.

Due to the floating rotor design principle, the calibration mechanism contains some clearance for proper part fit resulting in some hysteresis or "deadband" when changing directions with calibration shaft. Adjustments should be made in small increments in one direction to avoid need for counter rotation. If desired setting is exceeded, counter rotations in small increments should be made, even though first reverse setting may result in no apparent change. This is normal, and subsequent changes will cause reverse accuracy curve shift.

4. With the calibration shaft turned to the desired setting, tighten the lock screw while maintaining the calibration shaft position.
5. Retest the meter to confirm the accuracy of the calibration setting. If the meter is still out of calibration, repeat the procedure.
6. Replace the calibration shaft seal plug with a new one.

Section IV SERVICING

4-1. GENERAL

When the performance of the meter indicates a need for servicing, refer to the following instructions pertaining to removal, inspection and installation of service parts and assemblies. With the Recordall® Turbo Series unitized construction, service is simplified with a reduction in required product maintenance training. Also refer to the illustrated repair parts list RTS-P-1 for part numbers of replaceable components for ordering information. If satisfactory repair cannot be achieved, contact the Utility Division of Badger Meter, Inc.

4-2. REMOVAL OF METER HEAD

Recordall Turbo Series meters can be serviced without removing them from the line. A typical installation would be equipped with drain and piping valves. To inspect or replace components of the head assembly, close the upstream and downstream valves. However, if the installation does not have a drain valve, proceed as follows to relieve pressure:

⚠ WARNING

Upstream and downstream valves must be closed before attempting to remove meter head from housing. Failure to do so can lead to head being "ejected" from housing, causing personal injury and/or property damage!

- a. Loosen each of the head bolts about one and one-half turns. Do not completely remove the bolts.
- b. If the O-ring between the meter head and the housing is secure and not leaking, pry the measuring element assembly loose by inserting a screwdriver blade where the head and housing join together.

⚠ CAUTION

Be sure that any water coming out of the meter head does not spray onto electrical equipment to create a shock hazard.

- c. Allow the meter to drain and relieve internal pressure.
- d. When pressure is relieved, remove the head bolts. Lift the measuring element assembly from the housing.

NOTE

A dummy cover plate is available to close the meter in the line and continue service while the measuring element assembly is being inspected or serviced. (See illustrated repair parts list RTS-P-1.)

4-3. LOCAL REGISTER AND RTR REMOVAL

The Recordall Turbo Series meter register is easily removable to facilitate in-line service. Remove the register lid and shroud by removing the seal screw. The shroud is removed by rotating the register assembly counter clockwise until it stops. This provides clearance so it can be lifted off the measuring element assembly (see Figure 3a and 3b). To reinstall the register, follow the above procedure in reverse order.

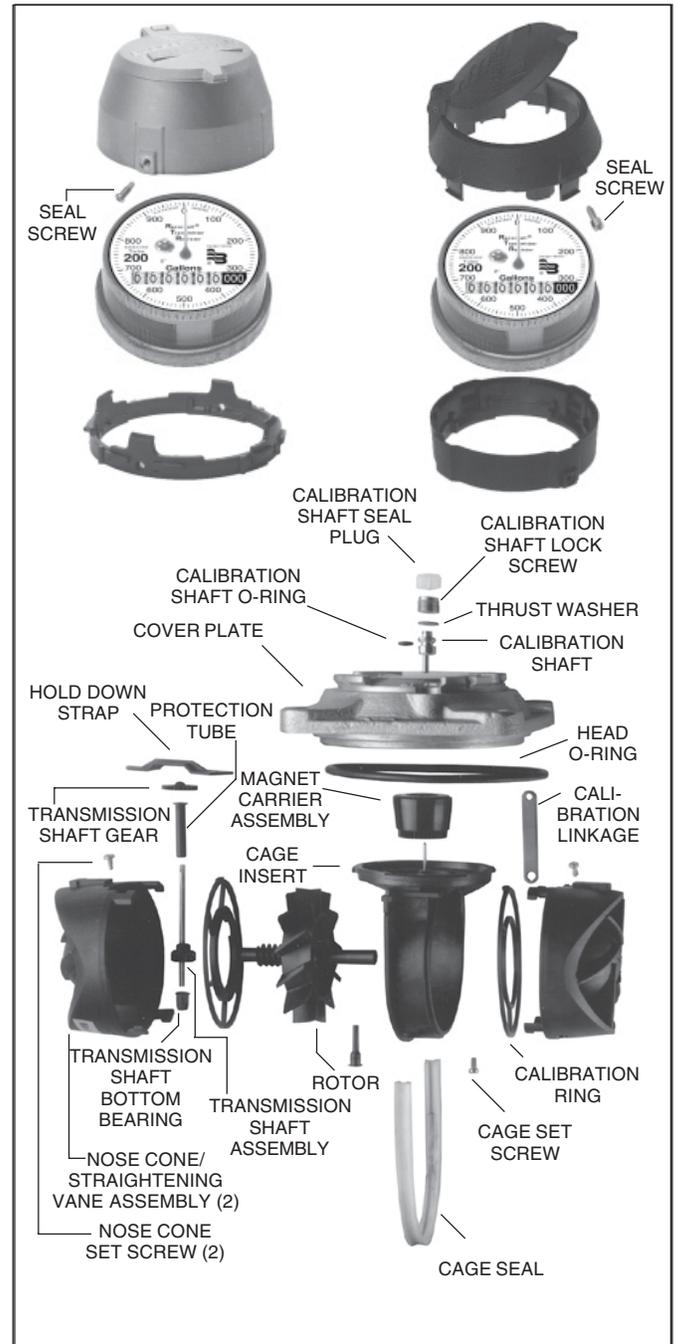


Figure 3a. Register and Measuring Element Assembly, 1 1/2" - 4"

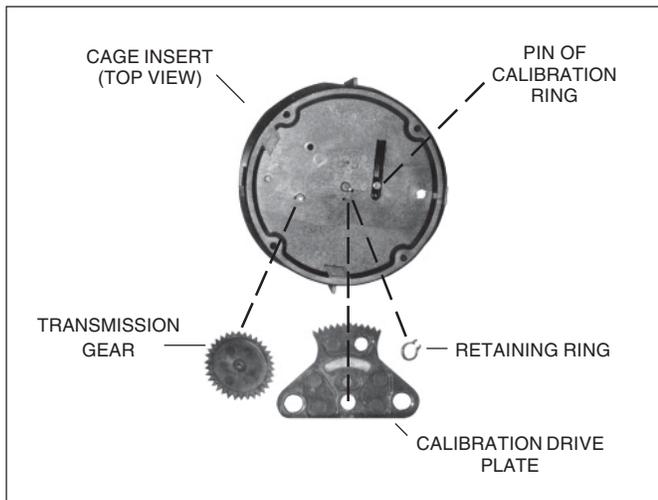


Figure 4b. Calibration Ring/Linkage Assembly, 6"

NOTE

When reassembling, the pin on the perimeter of the calibration ring must be aligned with the arrow tip located on the nose cone assembly (see Figure 4a). For 1 1/2"-4" sizes, the calibration linkage is to be installed into cage with larger hole to engage calibration ring tab, and side of chamfered edge of hole towards nose cone assembly (see Figure 4a). With calibration linkage fully inserted to cage stop, install nose cone onto cage and rotate counter-clockwise. This rotation engages pin of ring to calibration linkage. The hole of the calibration linkage has to be aligned onto the calibration shaft, engaging it fully so that the calibration ring cannot vibrate during operation. The calibration shaft lock screw should also be tightened securely to hold the calibration ring in its desired position.

After the calibration mechanism is serviced or replaced, be sure to check the accuracy and calibration in accordance with the instructions in section 3-4 of this manual.

4-7. MAGNET CARRIER/TOP GEAR SET

Remove the magnet carrier from the measuring element insert by lifting it off the stainless steel pin (see Figures 3a and 3b). Check the condition of the magnet and gear on the magnet carrier for damage or wear. If significant wear or damage is present, replace the magnet carrier.

Remove the hold down strap (see Figures 3a and 3b.) Check the condition of the transmission shaft gear for damage or wear. If significant wear or damage is present, replace the gear. Remove gear by lifting off the shaft.

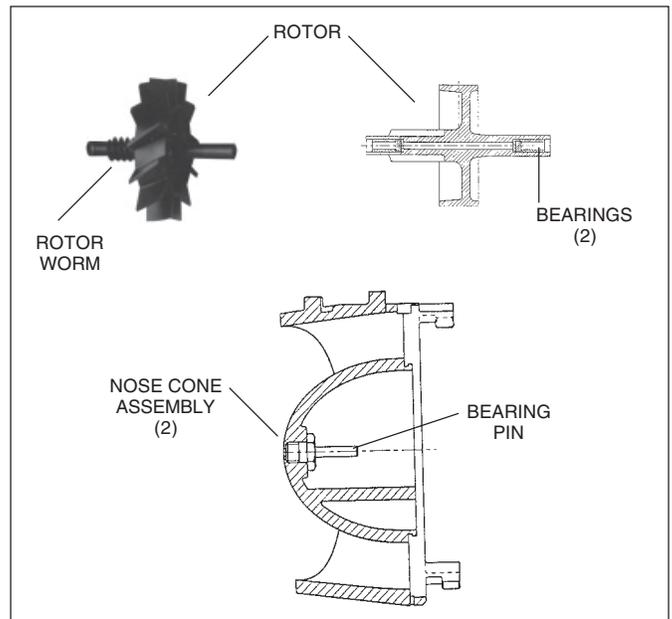


Figure 5. Rotor and Nose Cone Assembly (1 1/2" - 6" Turbo Meters)

4-8. ROTOR AND BEARINGS

The rotor can be inspected by removing the nose cone assembly from the measuring element insert as outlined in section 4-5 of this manual.

Check the rotor worm and blades for signs of damage and wear. Also inspect the bearing bushings in the front and rear shaft. If damage or wear has occurred, replace the part (see Figure 5).

The rotor bearing pins in the straightening vane and nose cone assembly should be inspected for signs of damage and wear (see Figure 5). The spherical end of the bearing pin must not show any drag lines and/or wear.

NOTE

Only highly-polished bearing pin ends insure a minimum of friction and optimal meter performance. Bearing pins are an integral part of the straightening vane and nose cone assembly. Wear or damage would require the replacement of this component.

To reassemble, the rear nose cone must be installed to cage. See section 4-5. Now place the rotor assembly with worm gear side leading through the cage, place on the rear rotor bearing pin, while tipping the assembly back so that the opening is up. See section 4-6 to insure calibration rings are properly assembled with nose cone assembly. Insert the front nose cone assembly partially onto the cage insert, engaging the bearing pin with the front bearing of the rotor. Tilt the measuring element insert assembly forward and back to see that the rotor now engages the bearing pins on the straightening vane/nose cones and is free to rotate and slide fore and aft.

⚠ CAUTION

Be careful not to force the nose cone assembly into the cage insert. Be sure that rotor engages both front and rear rotor bearing pins prior to pressing the nose cone assembly fully into the cage insert.

Press the nose cone assembly fully into the cage insert and turn it counter clockwise catching the calibration linkage in the slot. Check to see that the rotor spins freely. If not, remove the nose cone assembly and repeat the procedure. Install and tighten nose cone assembly setscrew.

Holding the cover plate in one hand, align the thermoplastic cage bayonette-like tabs with the slots in the cover plate (1 1/2" - 4" only). Rotate the element clockwise until the cage set screw hole is aligned. Install the cage set screws (quantity 1 for 1 1/2" - 4", quantity 4 for 6") and tighten.

4-9. REINSTALLING METER HEAD ASSEMBLY

Badger recommends that a new housing O-ring be used after each teardown and reassembly of the Recordall® Turbo Series. To provide a tight seal, make sure the surfaces of the housing and meter head are clean and free of any old O-ring material. Be careful not to force the measuring element insert into the meter housing. If you experience any binding, do not force the element into the housing. Remove the element from the housing and properly reinsert the unit.

NOTE

Head bolts should be tightened similar to that on car tire. First insert the bolts and snug-fit each. Then using a crisscross pattern, tighten the bolts down. Following this pattern, the meter head will not turn allowing the rotor to remain perpendicular to the flow and eliminating any potential flow distortion. Head bolts should be tightened to 10-11 ft. lbs. for 1 1/2" and 2" sizes, and 35-40 ft. lbs. for 3" - 6" sizes.

The registration device should be reinstalled on the meter body.

To place the meter back in service, close the flushing system drain valve. Open the upstream valve partially, then open the downstream valve slightly to purge air from the service line. Then open both valves completely.

ORDERING INFORMATION

Order replacement service parts for your Recordall Turbo Series through your local Badger Meter sales representative. When placing an order, please provide the following information:

- Size of meter.
- Registration units, i.e., U.S. gallons, cubic feet, etc.
- Complete description of assembly or parts required.
- Part number of item as shown in the repair parts list (RTS-P-1).
- Quantity required.
- Purchase order number, plus exact return and billing address.

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BadgerMeter, Inc.

P.O. Box 245036, Milwaukee, WI 53224-9536
(800) 876-3837 / Fax: (888) 371-5982
www.badgermeter.com