

Auto-Adjust™ II Turbo-Meters

Construction and Design Features

Auto-Adjust Turbo-Meters use the same bodies and nose cones as are used in the Mark II product line of Turbo-Meters. Also, the same mechanical and electronic readout registers can be installed on the Auto-Adjust Turbo-Meters as on the Mark II meters. As a consequence, the external appearance of the Auto-Adjust and Mark II Turbo-Meters is very similar.

The unique differences of the Auto-Adjust Turbo-Meters are contained in the internal measuring mechanism assembly as outlined in the schematic below. As a result of this design approach, it is a simple procedure to substitute an Auto-Adjust Turbo-Meter calibrated mechanism into an existing Mark II or PTB Turbo-Meter Body. Therefore upgrade of existing Mark II or PTB Turbo-Meter is simplified.

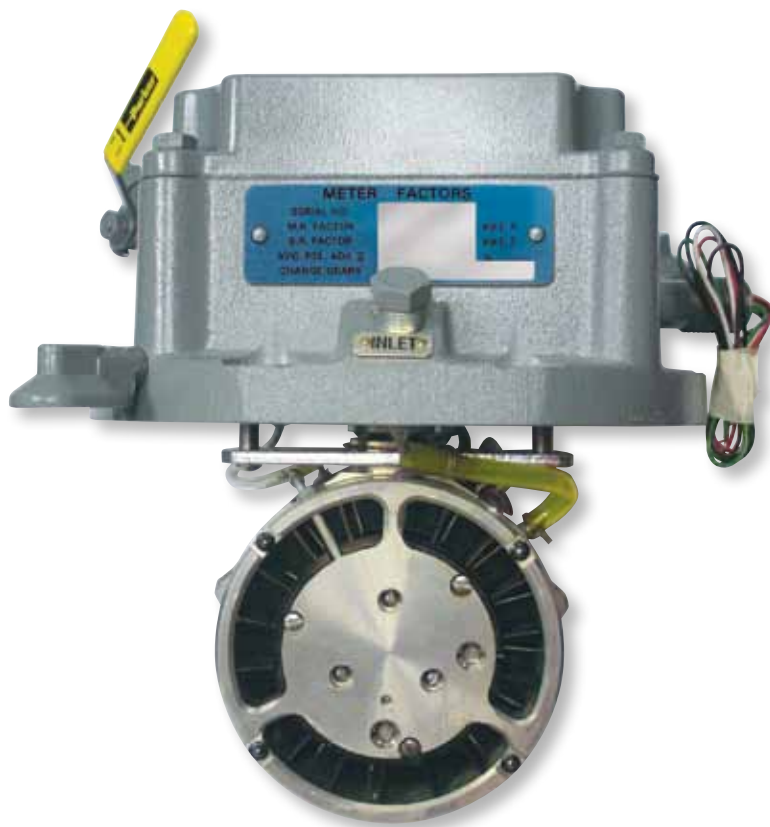
The illustrations in this bulletin show a 4" AAT-18 175# internal mechanism assembly. The construction of this size is typical of all sizes and working pressures of Auto-Adjust Turbo-Meters.



CAUTION

Prior to any disassembly, all pressure inside the meter body must be relieved.

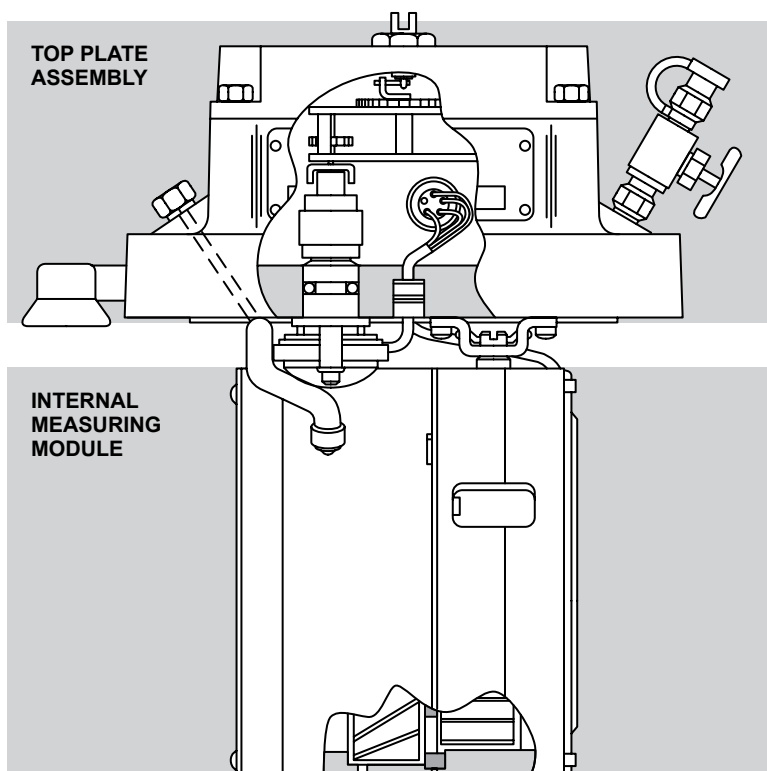




GDC1073-010

1 – “502” Assembly

Shown here is what is termed as the “502” assembly. This complete mechanism assembly consists of the internal measuring module coupled with a top plate of the appropriate pressure class. The complete mechanism assembly is available as a calibrated measuring unit. Note that both the internal module and the top plate are serialized for identification. If a complete meter is purchased, the same number as the top plate and internal module.



GDC1073-015

2 – Cross Sectional Schematic of “502” Assembly

This Schematic view of the module shows the basic components of the “502” assembly. The Top Plate Assembly provides a pressure seal and houses the speed reduction and calibration change gears for the mechanical output of the meter. The design of the mechanical output is similar to that in the MK II, using the same magnetic coupling arrangement and similar intermediate gear train. Other similarities of the Top Plate Assemblies include the external lubrication connection, the venting of the gear chamber, and the index mounting plate. However, the Top Plate Assembly is unique for the Auto-Adjust in that it incorporates a feed-thru and a terminal connection for the electrical pulse wiring. The internal measuring module assembly comprises three separate components. Starting from the left, these are the main or metering rotor module, the center plate, and the sensing rotor module. Each of these components will be described in detail later.

3 – Manufacturer's Badge (Top Plate)

The manufacturer's badge details the Auto-Adjust meter model, size, months and year of manufacture, and the Sensus serial number. This badge is mounted on the outlet side of the Top Plate. A customer badge can also be mounted on the Top Plate.



GDC1073-020P

4 – CSA Badge (Top Plate)

A CSA approval badge is mounted on every Auto-Adjust Turbo-Meter. This documents the registration and approval of the Auto-Adjust electronic output system for use in "hazardous areas."



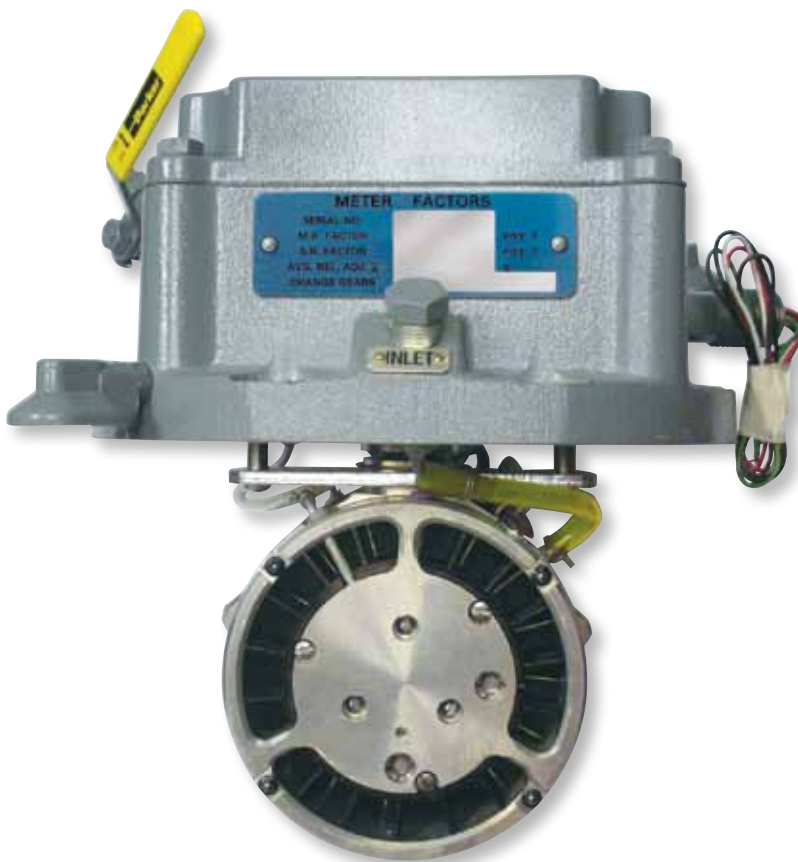
GDC1073-025P

5 – "502" Assembly (Inlet End)

This inlet end view of the internal mechanism assembly shows the meter factor badge on the top plate. The serial number on this badge must match that on the internal module badge. The meter factor badge is fastened with two machine screws. This provision allows for a new badge to be affixed in the event that an internal measuring module is changed.

NOTE

The serial number on the body badge may not match the 502 module serial number if the module was replaced.



GDC1073-030P

METER FACTORS

SERIAL NO.	640001	
M.R. FACTOR	46.947	P/FT ³
S.R. FACTOR	79.444	P/FT ³
AVG. REL. ADJ.A	9.476	%
CHANGE GEARS	71-69T/50-49T	

**AUTO-ADJUST TURBO-METER
METER FACTOR BADGE**

GDC1073-035

6 – Meter Factor Badge

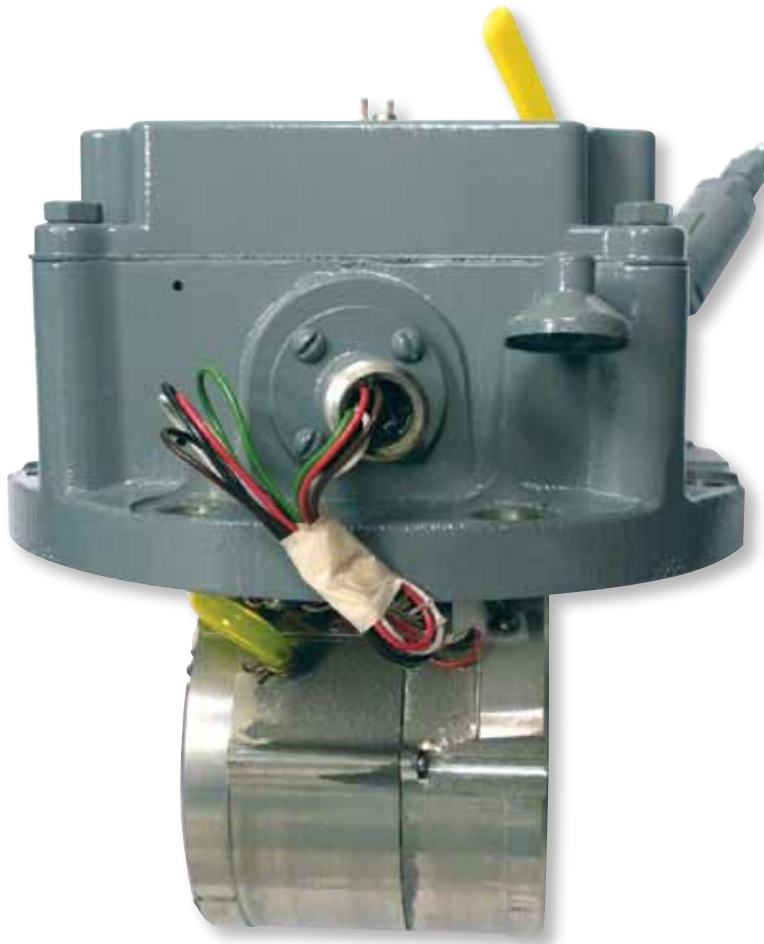
The meter factor badge contains the specific data for each individual AAT meter. The main rotor (M.R.) factor and the sensing rotor (S.R.) factor are determined by testing for each AAT Turbo-Meter. Also shown is the AVG. REL. ADJ. Å, which is the average amount of adjustment that the sensing rotor makes at all flow rates. These Meter Factors are unique for each AAT Meter and they are used to make electronic adjusted volume totalization and self-checking calculations.

NOTE

Since 502 modules can be interchanged in AAT meters, refer only to the serial number stamped on the 502 module when citing meter factors for chips, change gears or calibration curves.

7 – Electrical Connector

The side of the Top Plate Assembly is shown here with the flow from left to right. Either a "Bendix" type plug-in connector, or a conduit adapter (shown) is mounted on the top plate to provide wiring connections or to a Field Test Unit. Also shown is the pressure communication tube that runs from the main rotor carrier to the top plate pressure tap.



GDC1073-040P

8 – Index Mounting Plate

A standard MK II type Turbo-Meter index plate is mounted on the AAT Meter top plate. This index plate is drilled to accept any of a wide variety of totalizing indexes, recording gauges, or pressure and temperature correcting instruments. The meter's mechanical output shaft, shown at the center of the index plate, makes one 360 degree revolution counterclockwise per a precisely known unit of volume at line conditions. The standard output units are shown as follows:

	Cubic Ft.	Cubic Meters
4" AAT-18	100	1
6" AAT-35	100	1
8" AAT-60	1000	10
12" AAT-140	1000	10

The index mounting plate may be mounted in any of four possible positions.

The brass shear pin through the output drive dog is designed to break and protect internal gearing from damage in the event of an index or instrument freeze-up.



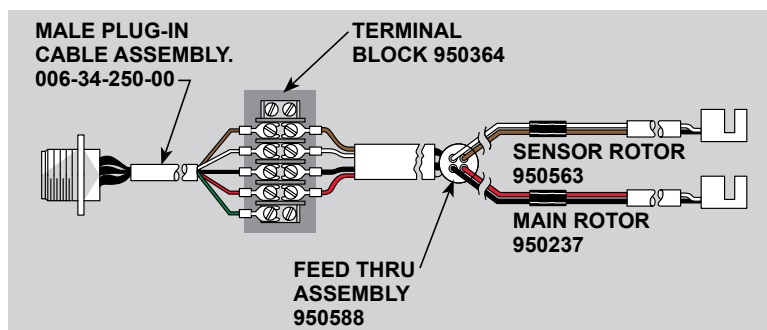
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9 – Index Plate Wiring Diagram Label

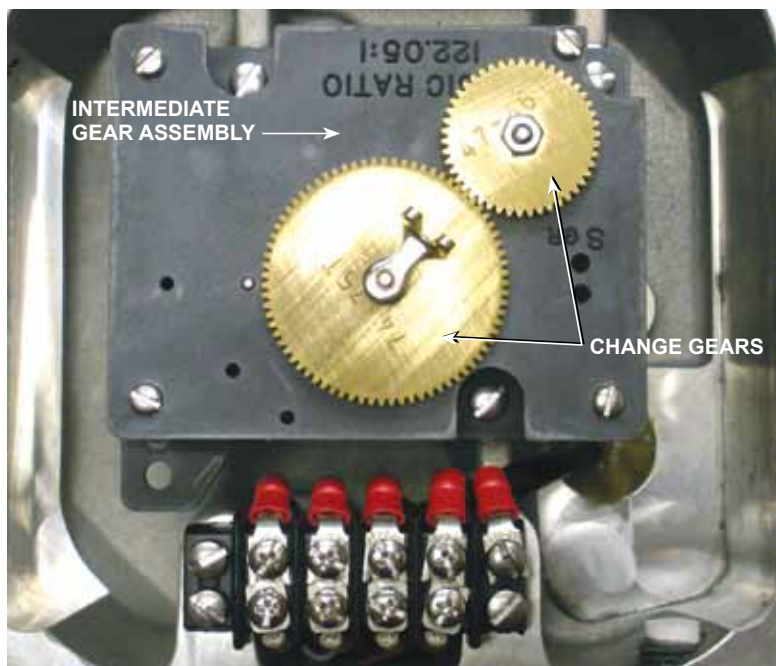
A color coded wiring diagram label is mounted on the underside of the index plate.



GDC1073-050P



GDC1073-055



GDC1073-060P

10 – Top Plate Gear Box

Removal of the index plate reveals the top plate gear box chamber which houses the intermediate gear train assembly. A cork gasket provides a weather seal. Cross ventilation and condensation drainage is provided for the gear box with two ¼" NPT holes. The vent holes are protected with plastic bug vent caps and porous filters. This top plate chamber is outside the meter's pressure boundary and may be accessed even while a meter is pressurized. The intermediate gear train shown is for cubic foot (CF) output. To obtain metric output, the appropriate metric gear train assembly is needed.



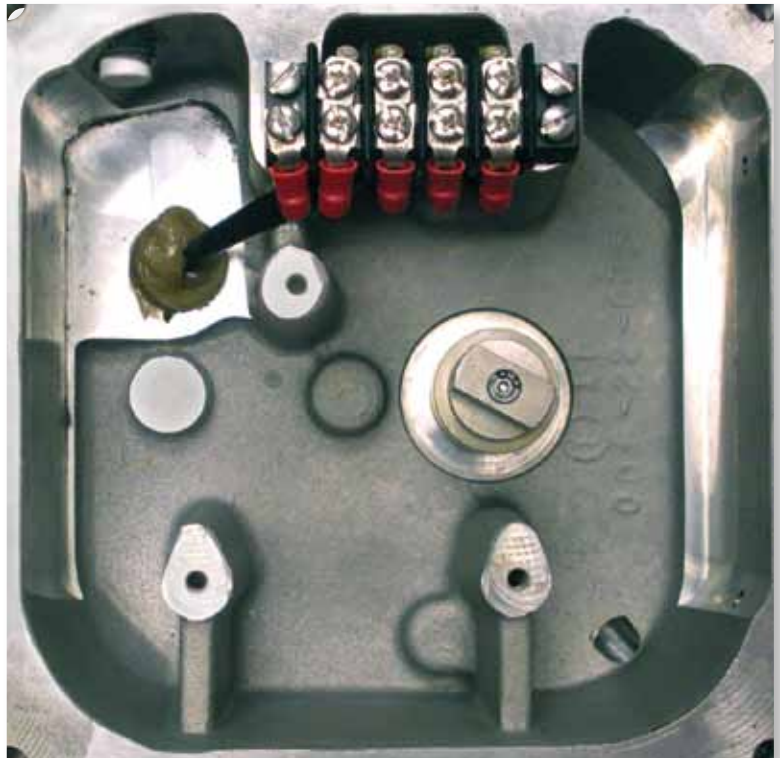
GDC1073-065P

11 – Intermediate Gear Train

Removal of the three retaining screws allows the intermediate gear train assembly to be lifted out of the top plate chamber. Use of engineering plastics in the plates, gears and stainless steel shafts of this assembly results in lower torque, greater corrosion resistance, minimized tolerances, and improved wear characteristics. As shown in the picture, one small and one large brass change gears are used to provide calibration of the meter output shaft revolutions in precise engineering units.

12 – Top Plate Terminal Connections

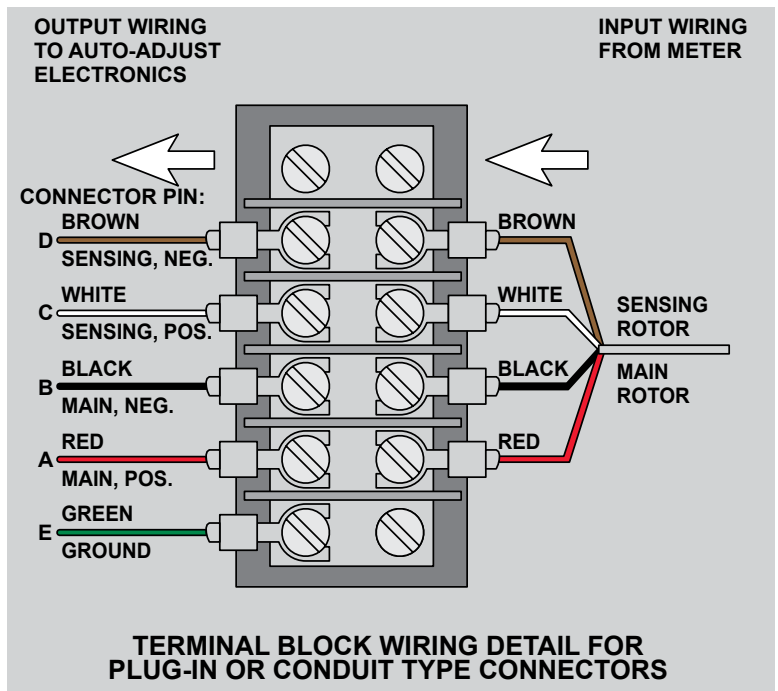
Also housed in the top plate chamber is the wiring terminal block. On this terminal, wires are connected between the external connector and the internal wiring which leads to the slot sensors mounted in each of the main and sensing rotor modules. Wiring from these individual slot sensors passes through a pressure feed-thru seal in the top plate chamber is provided with both a protected drain and a vent to prevent any condensation build-up. The follower magnet assembly can also be seen in the top plate chamber.



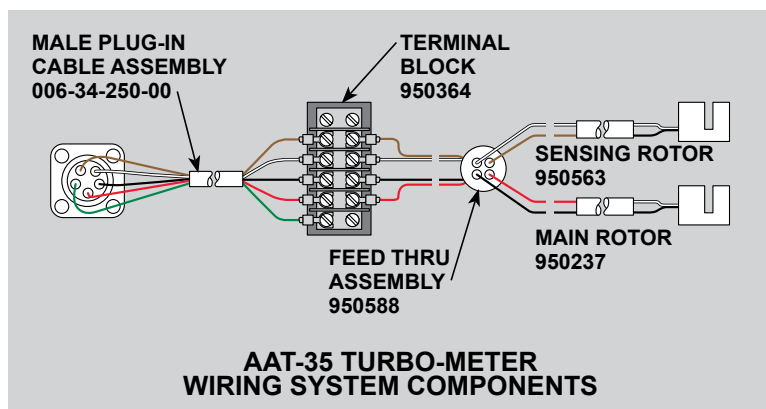
GDC1073-070P

13 – Terminal Block Wiring

All of the wiring in the Auto-Adjust Turbo-Meter is color coded to facilitate servicing. This illustration shows the details of the terminal block wiring. Note that the green wire is grounded to the top plate casting through one of the terminal block mounting screws. The top plate in-turn is grounded to the meter body through the bolted connection. The green ground wire is provided for use where the meter body is insulated from the pipeline, and as local codes dictate.



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GDC1073-080

14 – Wiring Diagram

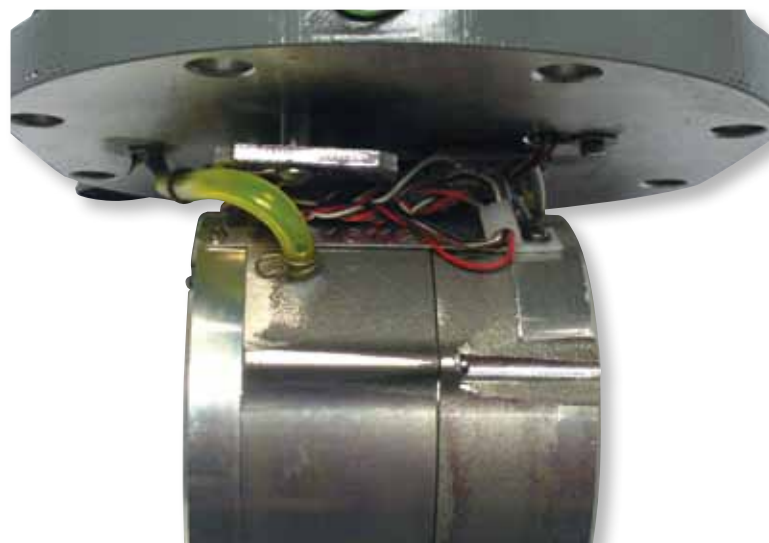
This overall wiring diagram depicts the complete wiring of an Auto-Adjust Turbo-Meter. Two wires, either Red/Black for the main rotor or White/Brown for the sensing rotor, are provided for each of the two slot sensors. These wires are connected to a pressure feed-thru seal assembly using solder joints covered with Teflon shrink tubing. The pressure feed-thru allows the wires to pass through the top plate casting. The diagram also shows the color coded wires connected to the terminal block and to a plug-in connector.



GDC1073-085P

15 – Lubrication Fittings

This view of the top plate and internal module assembly shows the external and internal fittings used for lubricating both sets of rotor shaft bearings. A routine maintenance procedure to pressure lubricate the Turbo-Meter can be accomplished while the meter is in operation. Hose clamps are used to connect the flexible internal lubrication tubing with the module and top plate fittings. A tee fitting divides the delivery of oil to both the main rotor and sensing rotor bearings.



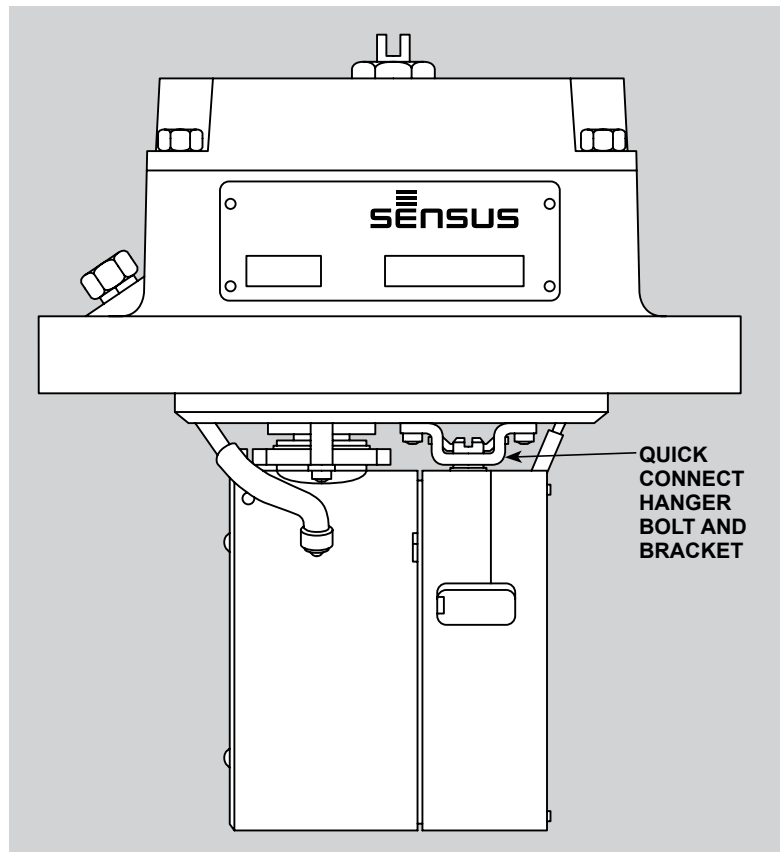
GDC1073-090P

16 – Pressure Reference Tap and Connections

This view of the module and top plate assembly shows the pressure reference tap fitting and its connection to the main rotor module. This is the pressure tap used in the factory calibration and should be used for connecting any pressure correcting instruments. Hose clamps are used to connect the flexible internal pressure reference tubing with the module and top plate fittings.

17 – Module Quick Disconnect

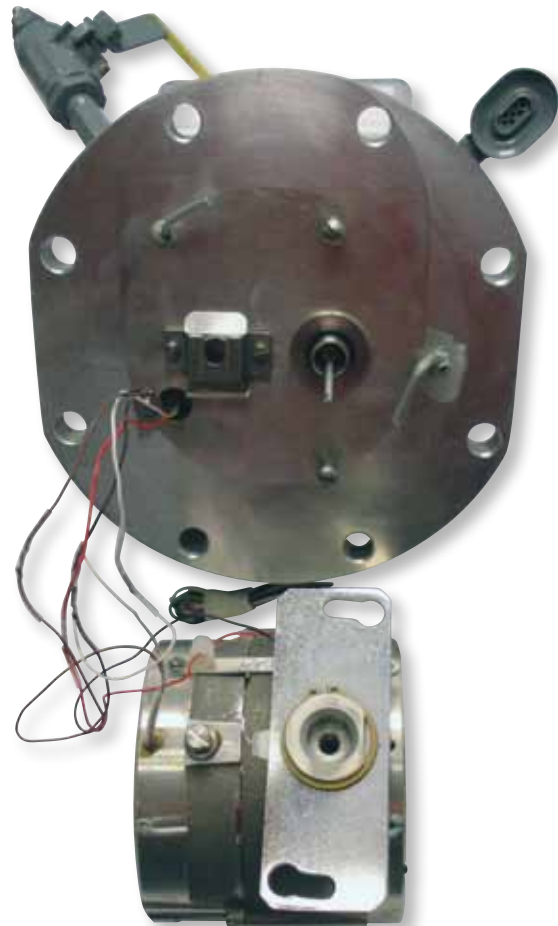
To separate the internal measuring module from the top plate, first disconnect the lubrication and pressure reference tubing, untwist the wiring, then lift the spring clip on the module hanger bracket. The module can now be rotated to uncouple the slotted adapter plate and the hanger bracket from their respective shoulder bolts.



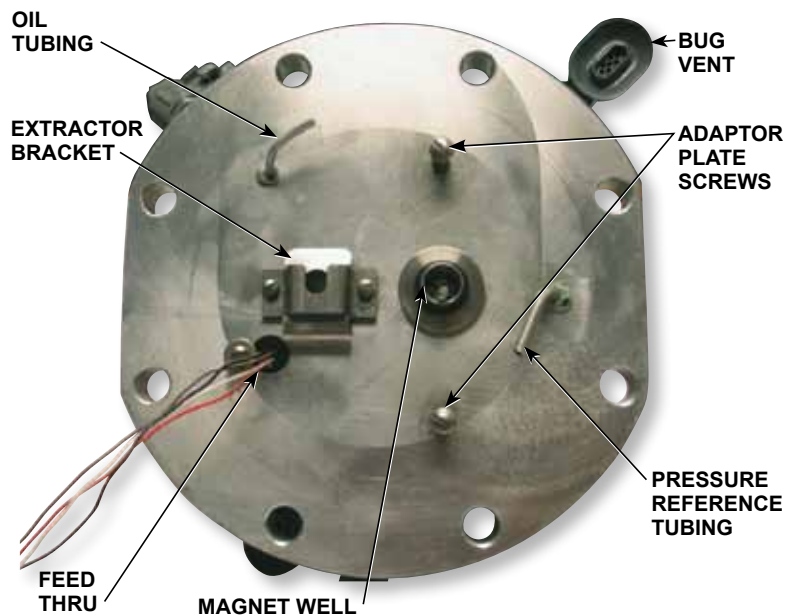
GDC1073-095

18 – Module & Top Plate Uncoupled

Once the internal measuring module is uncoupled from the top plate, it can be separated. There is sufficient length of wire cable to allow the module and top plate to be separated and set along side each other. **Care should be taken to avoid damaging the mechanical up-shaft when separating or re-connecting the module and top plate.** The module can be completely separated from the top plate by either cutting the four wires at the solder joints or by removing the feed-thru assembly.



GDC1073-100



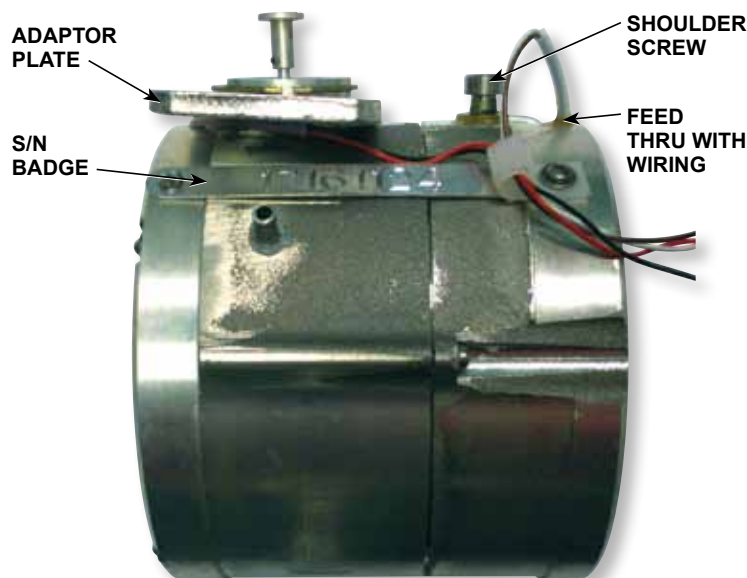
GDC1073-105P

19 – Top Plate (Underside)

The wiring feed-thru seal can be removed from the top plate by removing the retaining screw, disconnecting the four wires from the terminal block in the gear box, and gently pulling the module seal and wires down through the hole. The magnetic coupling assembly and magnet well can be removed by gently pushing the well down through the top plate. Other features shown on this view are the two adapter plate screw, the extractor bracket, the bug vent screens, the 1/8" oil tubing, and the 1/4" pressure reference connection tubing.

NOTE

Use caution in handling the Top Plate as not to damage the aluminum oil and pressure tubing components located on the underside of the plate.



GDC1073-110P

20 – Internal Measuring Module

This picture shows the internal Measuring Module which is termed the "302" assembly. This module assembly can be calibrated and supplied with the appropriate set of change gears, upshaft and O-ring, and a meter factor badge for attachment to an existing top plate. The following features are shown in this photo: the module serial number badge, the slotted adapter plate, the feed-thru seal and wiring assembly and the hanger bracket shoulder screw.



GDC1073-115P

21 – Main/Sensing Module Separated

The main and sensing rotor modules are held together with two retaining screws. The center plate is installed between the two module sections. The two retaining screws are tightened equally so that the gap between the module sections is even all around. They should not be over-torqued. Thread lubricant should be used to avoid seizing. Note that there are screw driver notches at several places around the module connection joint and center plate to allow for ease of disassembly.

22 – Main Rotor Module

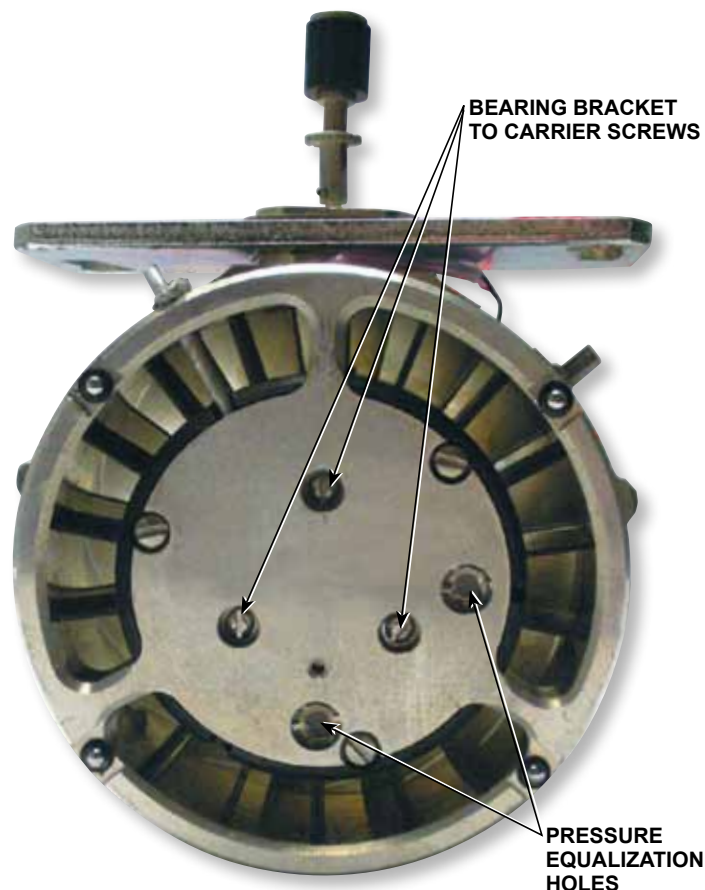
This view of the main rotor module outlet end shows the machined aluminum main rotor. All Auto-Adjust Turbo-Meter main and sensing rotors are precisely machined from aluminum bar for high strength and excellent dimensional control. The rotors are dynamically balanced at an elevated speed to insure minimum bearing loading and smooth, repeatable operation.



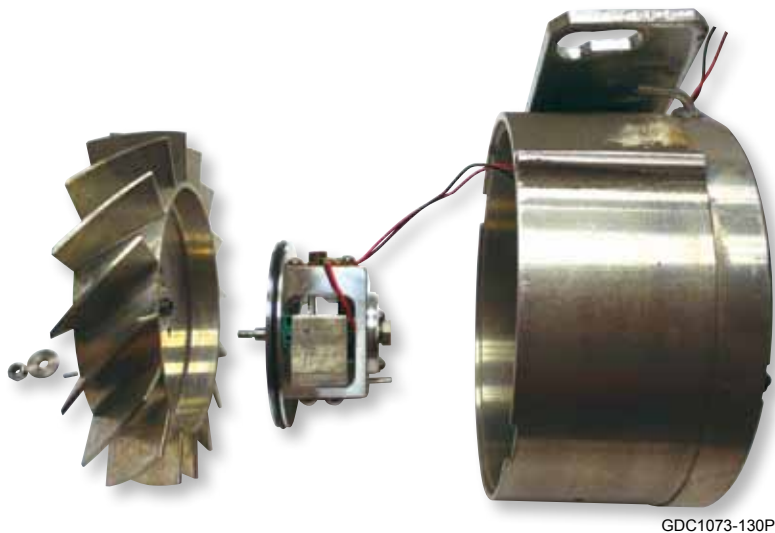
GDC1073-120P

23 – Main Rotor Module (Inlet End)

A view of the main rotor module from the inlet end shows the flow conditioning vanes upstream of the main rotor. These are an integral part of the calibrated internal module assembly and act to condition the flow immediately ahead of the main rotor. Also shown are the spring loaded ball plungers that act to properly position the module and module seal within the body cavity. Three screw heads (shown) attach the main rotor bearing bracket assembly inside the carrier. Two pressure equalization holes with fine mesh stainless steel screens are located at the three o'clock and six o'clock positions on the carrier front.



GDC1073-125P



GDC1073-130P

24 – Main Rotor Bearing Bracket

Removal of the three retaining screws allows the complete main rotor bracket assembly to be lifted out of the one-piece precision-machined aluminum carrier. The O-ring seal between the bearing bracket flange and the carrier prevents line contaminants from fouling the bracket assembly components. Channeling and portholes through the carrier and the bearing bracket create a passage for lubricant to reach the rotor shaft bearings. The rotor shaft bearings are held in precisely machined bores within the bearing bracket. Tolerances of one half of a thousandth of an inch (0.0005") maintain alignment of the bearings and shafts.

NOTE

The O-ring seal creates a tight seal between these parts. To aid in removal, install one or two retaining screws a couple of turns, then push on the heads of the retaining screws to help remove the bearing bracket from the carrier.



GDC1073-135P

25 – Main Rotor Bearing Bracket, Upshaft and Driver Magnet

This view of the bearing bracket assembly shows the gearing for the mechanical output of the main rotor module. The gearing and shafts are in a very compact arrangement. Oil wicks and a small reservoir are under the cover plate. Channeling to both rotor shaft bearings provides for both flushing and slow wicking of oil.

26 – Main Rotor & Bracket Separated

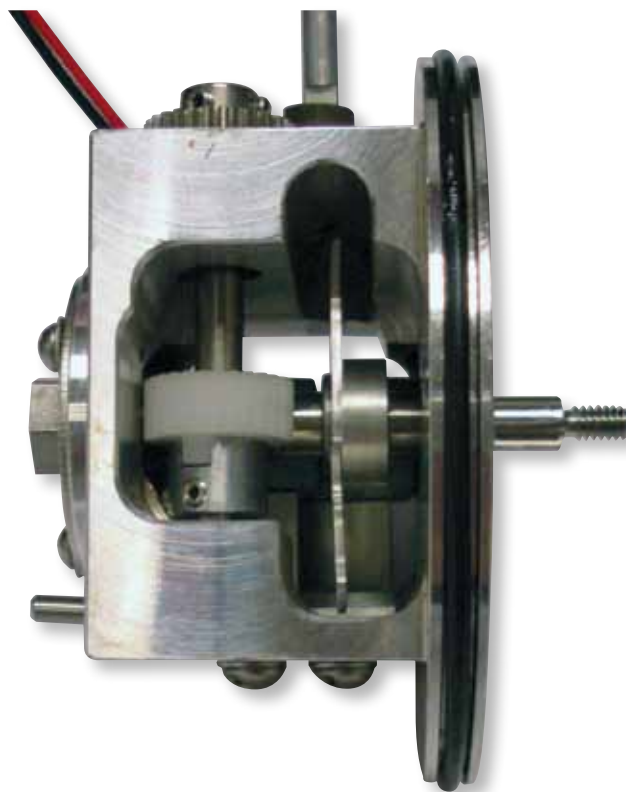
The rotor is held to the shaft with an aircraft type locking nut. A spherical washer insures true self alignment of the rotor hub on the shaft and against the bearing and rotor hub. The key pin engages both the rotor and shaft. All the aluminum parts of the AAT Meter are given a chromate conversion coating to prevent corrosion. All fasteners are locked by one of various means to insure the integrity of the assembly. The main rotor is the single most important component within the AAT Meter. Damage to-or dirt build up on-the main rotor blades can affect measurement accuracy.



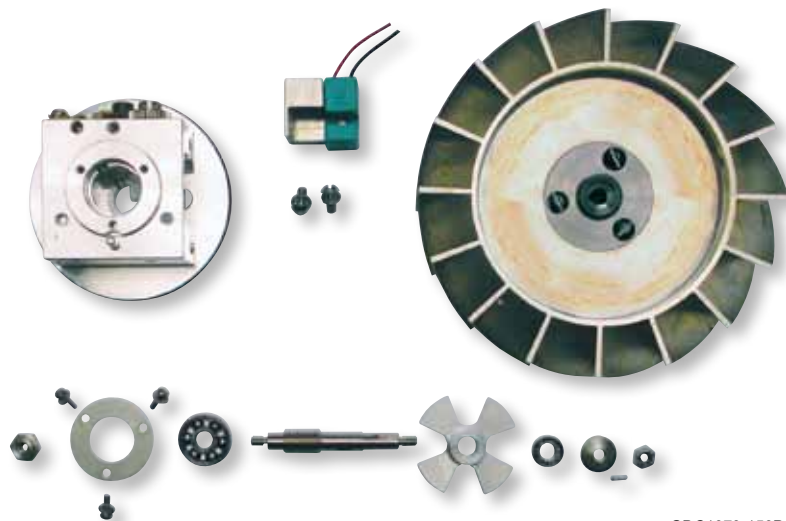
GDC1073-140P

27 – Main Rotor Bearing Bracket

This view of the main rotor bearing bracket shows the main shaft, the cross shaft with gearing, and slot sensor chopper. The stainless steel main shafts is short and heavy in size. The main rotor shaft bearings are considerably larger than those of their MK II counterparts. The shaft worm engages a worm-wheel to transfer rotation to the mounted in the bearing bracket with the chopper disk centered in the switch opening.



GDC1073-145P



GDC1073-150P

28 – Rotor & Bracket Tear Down

This picture shows a complete tear down of the bearing bracket assembly. The shaft is retained onto the main bearing with a special nut which is affixed with loctite and torque in place. The main shaft bearings are shielded on one side and open on the inside facing the lubrication channels. The worm is machined as an integral part of the shaft. The chopper engages the hub with a positive “D” flat. The number of vanes on the chopper were selected for each size meter to give a frequency of approximately 500 Hz at maximum capacity. The slot sensor is an inductive proximity type that generates a square wave pulse signal in the alternating presence and absence of metal.



GDC1073-155P

29 – Center Plate

The center plate is captured between the main rotor module and the sensing rotor module. The counter bore in its center is oriented toward the sensing rotor nut to provide clearance. The groove around the circumference is to aid in removal.



GDC1073-160P

30 – Center Plate

The center plate is a precisely machined aluminum plate with no moving parts. It provides dynamic flow control behind the main rotor to maintain accurate performance throughout the meter's intended measuring range. Also, it balances the flow thrust loading on the main rotor. This provides optimum bearing life and performance.

31 – Sensing Rotor Module

This view shows the sensing rotor module from the inlet end. The shoulder screw and spring washer assembly is shown at the top of the picture. This shoulder screw engages with the hanger bracket on the underside of the top plate. The spring washer and O-ring provide a cushion which is compressed by the top plate hanger bracket.



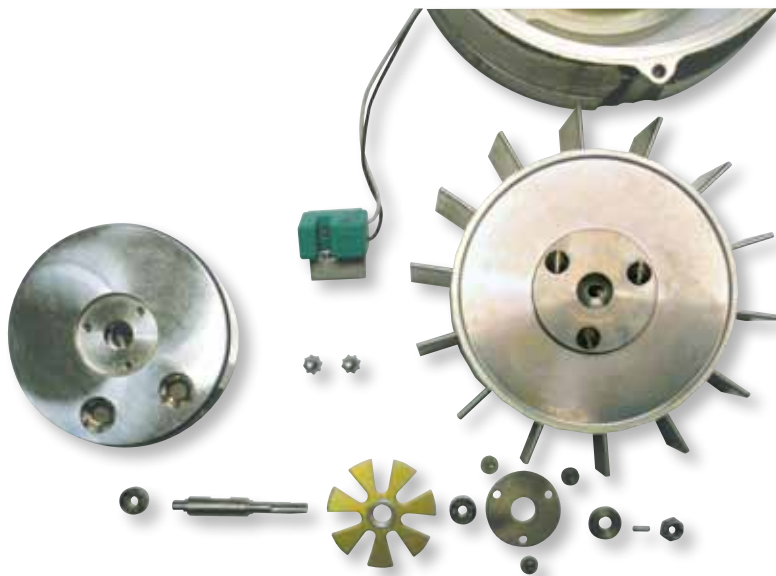
GDC1073-165P

32 – Sensing Module Outlet

A view of the downstream outlet end of the sensing rotor module shows the module seal ring. This provides a positive seal between the internal measuring module and the body. The machining on the back face of the module is stepped to protect the seal as the module is inserted into the body. The seal ring is lubricated to facilitate assembly and sealing. Also shown is the pressure equalization hole in the bearing bracket cover plate.



GDC1073-170P



GDC1073-175P

33 – Sensing Rotor, Bracket and Carrier

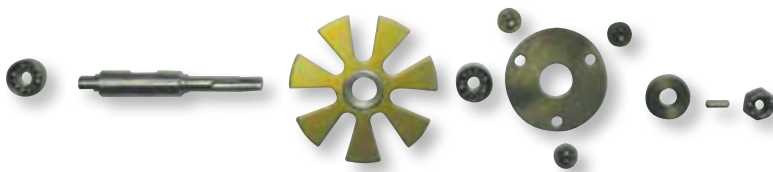
Remove the back cover plate and retaining screws to disassemble the bearing bracket from the carrier. The bearing housing is sealed from line contamination. The rotor is held to the shaft with an aircraft type lock nut, spherical washer, and key pin. The sensing rotor blade angle is about 3.5 degrees in comparison to the 45 degree main rotor (30 degrees in expanded capacity models). Therefore the sensing rotor runs at about one tenth of the speed of the main rotor, to monitor and correct for changes that may occur to the main rotor. Proper maintenance and cleaning of the sensing rotor and its support bearings provide maximum performance.



GDC1073-180P

34 – Sensing Rotor Bearing Bracket

Two screened pressure equalization holes can be seen in the front face of the bearing bracket flange. The slot sensor and mounting block are held in the bracket with two bearings and does not drive any mechanical gearing.

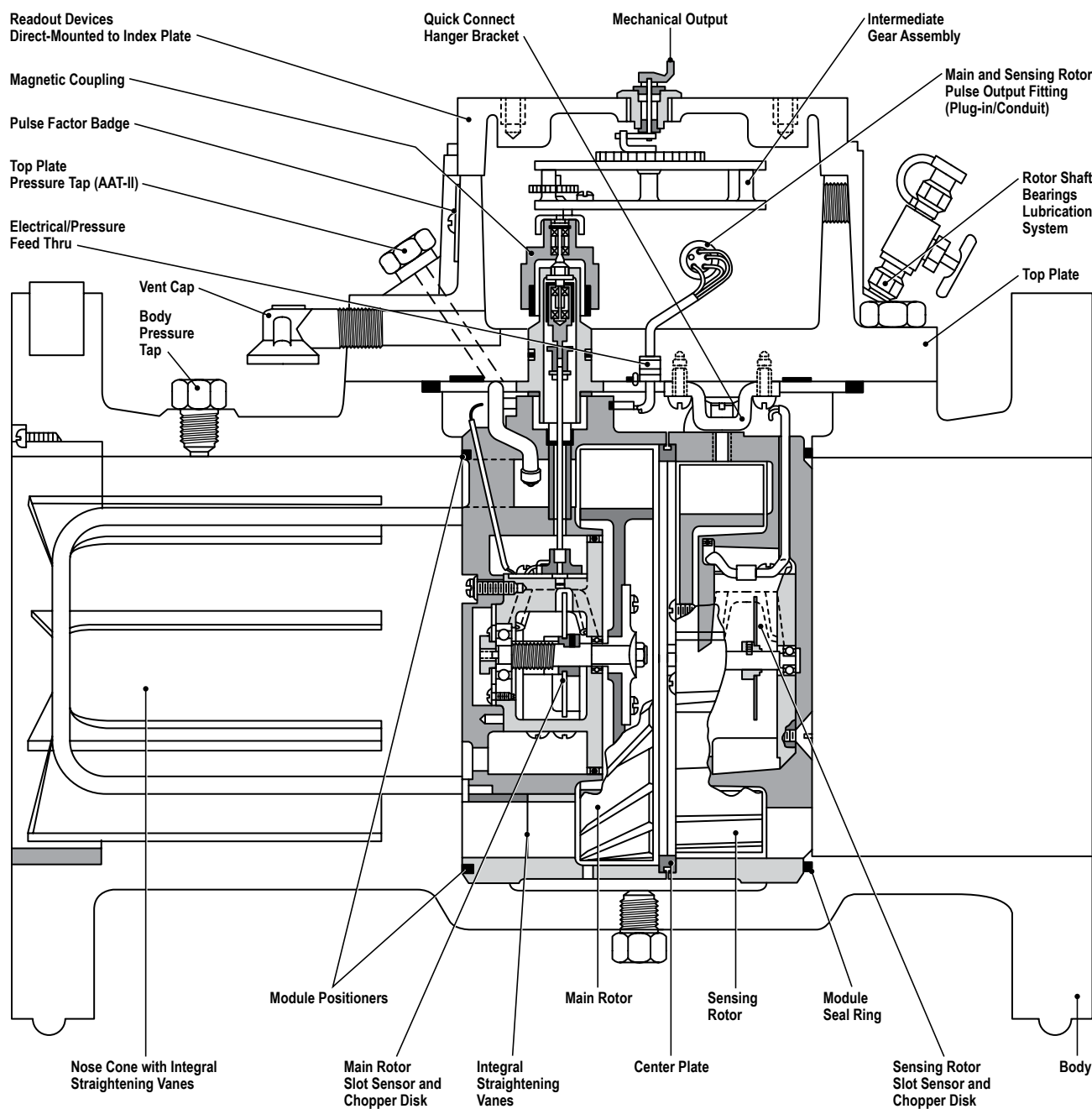


GDC1073-185P

35 – Sensing Bracket & Shaft

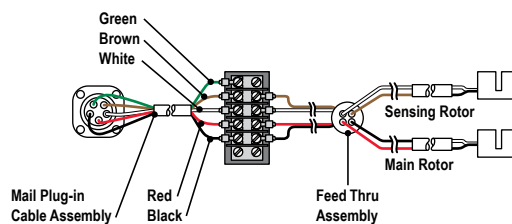
The bearing bracket is precisely machined for exact alignment of the shaft bearings. The stainless steel shaft is simply supported by two precision miniature ball bearings. These bearings each have one shielded side and one open side. The open sides faces inward toward the oil lubrication delivery system. The bracket contains an oil reservoir with flushing channels and slow feed wicks leading to the open face of both bearings. The only component driven by the sensing rotor is the chopper disk.

The following schematic depicts major AAT components in relation to the complete unit.



GDC1073-190

ELECTRICAL COMPONENTS



GDC1073-195

Auto-Adjust™ II Turbo-Meters

Construction and Design Features

Authorized Distributor:

All products purchased and services performed are subject to Sensus' terms of sale, available at either; <http://na.sensus.com/TC/TermsConditions.pdf> or 1-800-METER-IT. Sensus reserves the right to modify these terms and conditions in its own discretion without notice to the customer.

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