INSTALLATION & OPERATION MANUAL

This document contains the recommended installation, operation and maintenance regimen authorized and approved by Turbines, Inc., the manufacturer of the referenced equipment. No substitutions of specified components, improper handling or installation procedures, or use that is abusive or outside the specified range or capability specifications of the referenced equipment is permitted hereunder, and may, if evident or present, serve to void any warranties that might otherwise be operative or effective.

In the event installers or end users require additional assistance and/or clarification in any respect, contact the manufacturer at the address indicated below. Technical questions must be accompanied by proper product model number and serial number of subject equipment.

HA SERIES
HIGH ACCURACY TURBINE FLOW METER

DOCUMENT NUMBER: HA-MANUAL REV-A

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Introduction

This document is the ***Installation, Operation, and Maintenance Manual*** pertaining to the Turbines, Inc. High Accuracy Liquid Turbine Flow Meter. This manual will provide all information necessary to insure a successful metering installation.

Users unfamiliar with this equipment are strongly recommended to thoroughly familiarize themselves with the contents of this manual.

Please do not hesitate to contact an applications specialist at Turbines, Inc. should further information or clarification be necessary. Be sure to have the model and serial number of the subject equipment ready when you call or contact us via e-mail.

WARNING: GAS AND LIQUID TURBINE FLOW METERS ARE NOT INTERCHANGEABLE. SEVERE DAMAGE TO THE EQUIPMENT MAY RESULT.

Thank you for choosing Turbines, Inc. for your equipment needs.

Table of Contents

Description of the Equipment

BASIC TURBINE METER PRINCIPLE OF OPERATION

The Turbines, Inc. High Accuracy Turbine Flow Meter is a rugged, highly accurate volumetric flow measuring device designed to handle a broad range of line fluids. The turbine flow meter consists of a magnetic rotor that is freely suspended in the flow stream. A magnetic pickup coil is positioned above the rotor. Fluid passing through the flow meter causes the rotor to rotate at an angular velocity proportional to the fluid velocity. As the rotor rotates, each rotor blades pass though the magnetic field produced by the pickup coil, generating an electrical pulse. Each pulse represents a discrete volume of fluid. The frequency of the pulses represents the flow rate and the accumulated pulses represent the total volume of flow.

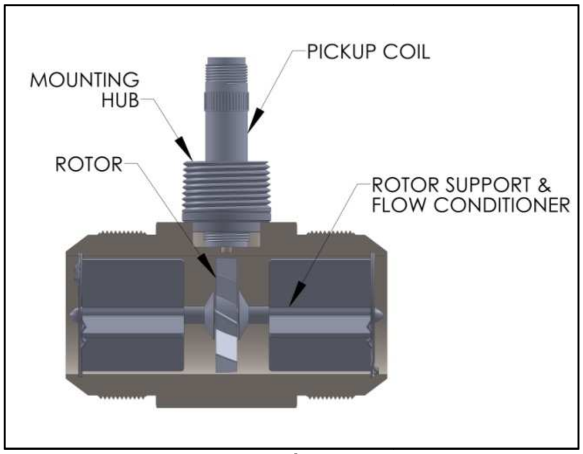

Figure 1

The Turbines, Inc. High Accuracy Turbine Flow Meter can be configured with a variety of end arrangements including threaded, flanged, grooved, or other means specified by the customer. The basic operating principles governing the installation, operation and maintenance remain essentially the same.

CALIBRATION AND K-FACTOR

Every turbine flow meter manufactured by Turbines, Inc. is factory calibrated in order to provide a unique K-factor. The K- factor provided with each meter is the reference value used to configure the accompanying flow monitor in order to achieve the specified accuracy in service.

The unique K-factor is an expression of the number of output pulses recorded by the pickup coil per unit of volume flow passing through the meter.

Installation of the Equipment

Various elements that must be considered in order to obtain a proper turbine flow meter installation are provided in this section.

PRE-INSTALLATION INSPECTION

The Turbines, Inc. High Accuracy Turbine Flow Meter is a high quality measuring instrument capable of providing high precision metering performance over an extended period of time. It should be treated with care and not subjected to rough or abusive handling.

Unpack the turbine flow meter from the packaging carefully, verify the information on the packing list for Model number and Serial number. Remove the end-fitting protectors from the turbine meter housing. The turbine meter should be inspected to verify that no damage, either external or concealed has been sustained during transit. Insure that the internal parts are clean and completely free of any packing materials, debris or foreign matter. The rotor should spin freely.

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DO NOT USE HIGH PRESSURE AIR TO CLEAN OR TEST ROTOR FOR ROTATION. THIS MAY DAMAGE THE FLOW METER.

Immediately report any visible damage to the seller. Do not discard the packaging materials in the event damage claim and/or product return is indicated.

Upon confirming that the turbine meter is in good condition and free of any damage, replace the end-fitting protectors and return the meter to its original packing, if the intention is to the store the unit until subsequent installation.

METER RUN ARRANGEMENT

Turbines, Inc. recommends the following standard flow metering piping configuration to obtain optimum metering performance. Components must be arranged in order beginning upstream. They include: a strainer, ten straight pipe diameters including flow straightener, the turbine flow meter, 5 straight pipe diameters, and a flow control and/or blocking valve.

The strainer should use an 80 mesh screen for 1.0” line size flow meters and smaller, while a 40 mesh screen is appropriate for meters larger than 1.0” line size.

Flow straighteners should conform to ANSI/ISA RP 31.1.

It is recommended that the meter be installed in such a way that it remains full of line fluid even when no flow occurs. If a meter is left in a line that is partially or fully drained, bearing corrosion may occur. If feasible, the turbine meter should be removed, cleaned and properly stored when out of service for any length of time.

The meter run depicted in Figure 2 incorporates a flow straightener to reduce any swirl effects and condition the stream. This configuration requires only 10 straight upstream pipe diameters.

The meter run in Figure 3 demonstrates a configuration without flow straightening. In this case, 20 upstream pipe diameters are necessary to accomplish the same function.

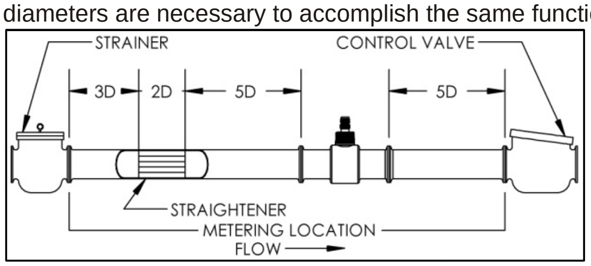

Figure 2

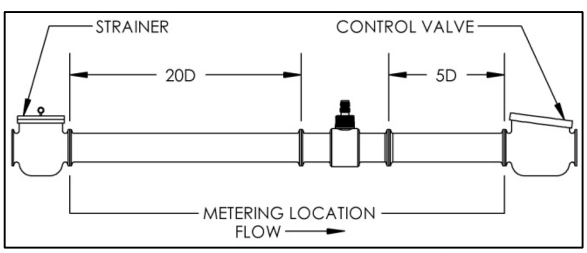

Figure 3

Figures 2 & 3 also illustrate the arrangement of the basket strainer upstream of the meter along with a control valve downstream. The purpose of the strainer is to protect the turbine flow meter from rotor damage by large foreign objects in the line fluid.

The control valve will permit the adjustment of flow rate as well as apply the proper amount of back pressure for the turbine meter.

The recommended arrangement of piping in Figures 2 & 3 indicates minimum lengths which are expressed as nominal pipe diameters.

GENERAL PIPING CONSIDERATIONS

As explained in earlier sections, the line fluid moving through the flow meter causes the rotor to rotate. Thus the rotational velocity of the rotor is a function of the line fluid velocity and the blade angle engagement. Since the calibration is performed under controlled flow conditions, swirl present in the line fluid stream can effectively change the angle of engagement between the fluid stream and the rotor blades and therefore result in a deviation from the calibrated k-factor supplied with the turbine meter. Proper installation as described elsewhere herein minimizes the harmful effects of fluid swirl.

Meter By-Pass - When possible, it is advisable to include a valved by-pass around the “metering location”. This foresight will allow the turbine flow meter to be removed without interrupting the operation of the line.

Line Purge - In a new or revised piping system, the line should be flushed prior to the installation of the turbine flow meter to minimize damage from foreign materials otherwise present in the line.

Air-Bleed - In liquid turbine applications, air should be bled from the liquid line fluid prior to start up.

METER INSTALLATION

Meter Position- The turbine flow meter is calibrated horizontally. Therefore, to achieve the best correlation of calibration conditions to installed conditions, it is recommended that the turbine meter is installed in the same (horizontal) orientation. Meters may, however, be operated in any position.

Flow Direction- All Turbines, Inc. Turbine Flow Meters are calibrated in the direction indicated by the flow arrow inscribed on the meter housing. Although the turbine flow meter will indicate flow in either direction, the meter must be installed in the direction indicated by the flow arrow in order to achieve stated accuracy.

Meter Location- When intermittent flow conditions are anticipated, the turbine flow meter should not be mounted at the lowest point of the piping system. Accumulation of sedimentary deposits or congealing of susceptible fluids may occur at this point. The consequences may include reduced meter performance or damage to the meter internal components.

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Tolerance to Electrical Interference-In order to obtain optimum electrical signal output, consideration must be given to the isolation of the turbine flow meter from any source of ambient electrical interference such as nearby motors, transformers, or high voltage power transmission lines.

Maximum Allowable Working Pressure (MAWP) – The maximum safe working pressure of the turbine flow meter is determined by the meter size and type of the connecting end fittings clamps. Consult the factory for specifications for your specific meter.

System Pressure- A minimum operating pressure should be maintained to reduce the possibility that two-phase flow may occur within the flow meter under test. The minimum operating pressure is a function of the line fluid vapor pressure and the presence of other undissolved gases. Maintaining the proper back pressure serves to prevent cavitation and fluid separation.

Calculation of the required back pressure for liquid line fluid applications is calculated as follows:

$$BP = (2 * \Delta P) + (1.25 * VP)$$

where: $BP = Back\ Pressure(psig)$
$\Delta P = Meter\ Pressue\ Drop\ \ @Max\ Flow(psig)$
$VP = Fluid\ Vapor\ Pressure\ @Max\ Temp(psia)$

PICKUP COIL INSTALLATION

Pickup coils should be inserted into the threaded hub of the turbine flow meter, with the electronic connector end of the pickup coil facing out. This component should be finger tightened to approximately 4 in-lb.

Pickup coils for Turbines, Inc. Turbine Flow Meters are designed to mate with a two pin MS3106A-10SL-4S connector.

Precaution should be taken when installing or removing the pickup coil from the turbine flow meter. Turbines, Inc. warranty does not cover physical damage to the coil.

The ***magnetic pickup coil*** produces a low level AC sine wave output that requires an amplifier to convert the signal to 0 to 10 volt peak to peak pulse signal suitable for process instrumentation.

The ***modulated carrier (RF)*** pickup has the required amplifier built into the pickup. This also produces a 0 to 10 volt peak to peak pulse.

The following must be observed to obtain proper operating performance:

Use a twisted and shielded cable (Belden 8761 or equivalent) to carry the signal. The shield should only be connected at one end. This will prevent a ground loop.

Do not mount the meter/pickup close to electrical noise generating equipment (motors, relays, etc.)

The conduit for the pickup cable must not be shared with other service(s).

Operation of the Equipment

Proper performance of the equipment is dependent upon correct installation and proper operating procedures. The operating procedures described below are necessary and must be carefully observed.

OVER RANGE

The greatest hazard to any turbine flow meter is **OVER RANGING** of the meter. If the flow rate present through the meter exceeds the specified flow range for the meter, the meter is said to be "over ranged."

When over ranging occurs, the performance of the turbine meter will generally remain linear. However, the pressure drop will increase and the radial velocity of the rotor will exceed its design limits, quite likely resulting in permanent damage due to over speeding of the bearings.

In liquid applications, over speed usually occurs during startup when air is present in the metering line. Air should be bled from meter line prior to a startup operation to prevent over ranging.

UNDER RANGE

As suggested by the nomenclature, under ranging is defined as operating the turbine flow meter below the minimum flow rate for which the meter is rated. While this will not cause physical damage to the equipment, operating beneath the minimum rated range limit of a turbine flow meter will cause the performance to become non-linear.

LIQUID FLOW CHARACTERISTICS

Each turbine flow meter has a unique k-factor, as derived by calibration wherein a known volume of liquid is passed through the meter in a known span of time.

The turbine meter's linearity is expressed as the variation in the k-factor over its flow range. The k-factor changes slightly over the flow range of the turbine meter; therefore the linearity is the change (deviation) of the actual k-factor from the nominal k-factor.

If the application line fluid differs from water (the calibration medium) the k-factor provided with the turbine flow meter may not accurately reflect the actual performance that will obtain. In order to achieve high accuracy in connection with given non-water liquid installation, it is recommended that the turbine meter be proved in place.

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Equipment Specifications

PERFORMANCE SPECIFICATIONS

Accuracy & Linearity:	±0.5% of reading
Repeatability:	±0.1% of reading
Temperature Range:	-450ºF to 450ºF w/ standard coil
Pressure Drop:	5 psi @ Max Flow

MATERIALS OF CONSTRUCTION

Turbines, Inc. offers the High Accuracy Turbine Flow Meter line with the following standard material configuration:

Meter Body:	316 Stainless Steel
Rotor Support:	316 Stainless Steel
Shaft:	316 Stainless Steel
Rotor:	17-4 PH Stainless Steel
Bearing:	440C Stainless Steel Ball Bearing
Retaining Rings:	316 Stainless Steel

Optional materials of construction are available, consult factory.

PICKUP COILS

The following standard pickup coils are available:

330 Gauss Magnetic pickup coil to +450 ºF
(Standard for meters size 1" and smaller)

1000 Gauss Magnetic pickup coil to +450 ºF
(Standard for meters size 1 1/4" and larger)

Magnetic pickup coil with preamplifier

Modulated carrier (RF) with preamplifier

STANDARD CALIBRATION

Turbines, Inc. offers the following calibration options for High Accuracy Turbine Flow Meters. The selected option must be specified at the time of order placement.

Standard Calibration: A standard calibration consists of 5 data points covering the stated flow range using water as the line fluid. All Turbines, Inc. Turbine Flow Meters are factory calibrated based on this calibration procedure in order to determine the applicable k-factor.

Non-Standard Calibration: At additional charge, Turbines, Inc. offers 10 point and 20 point calibrations, upon request. Other line fluids may be substituted for water as option offered at additional charge.

Turbines, Inc. also offers periodic re-certification and calibration of turbine flow meters. Contact the company for additional information or instructions on how to obtain calibration services.

FLOW MONITORS-TOTALIZERS

Turbines, Inc. offers several proprietary flow monitor/totalizer units as well as a number of OEM units. Operation and maintenance literature for these units are provided separately.

Generally, monitor/totalizers offer Nema 4X enclosures with LCD read-out configured to units of measure suitable to the user's application. Such units can be directly mounted onto the hub of the turbine flow meter, or remote mounted using additional cable set. Local indication can be augmented by the addition of 4 - 20 mA output features.

Options include: explosion proof, intrinsically safe design, as well as certification to various industry standards depending upon application requirements.

Monitor/totalizer equipment can be expanded to handle batching, control, reporting, and other functions. Consult factory for further information and applications support.

Operating Limitations Notes

INSTALLATION

To achieve stated accuracy, the flow directional arrow on the body of the turbine flow meter must coincide with the direction of flow of the process line fluid.

TEMPERATURE

Do not subject the meter electronics (monitors/totalizers, etc.) to temperatures in excess of 160 ºF. Do not subject the meter or electronics to temperatures below the freezing point of the process line fluid.

Unless a high temperature pickup coil is selected and secondary electronics are remotely mounted, temperatures exceeding the rated maximum may cause irreparable damage.

Lower temperatures can cause the electronic display(s) to cease functioning until acceptable temperature is restored.

PRESSURE

Never exceed the pressure rating of the turbine meter. Excessive pressure may result in the rupture or explosion of the flow element.

When pressurizing an empty line, gradually increase pressure incrementally until line pressure is achieved. Line pressure must be compliant with rated pressure of the flow element(s). Do not quickly approach full pressurization.

Damage to the turbine flow meter due to failure to comply with the foregoing shall immediately void any warranty otherwise operative.

WARNING: DO NOT REMOVE METER FROM A PRESSURIZED LINE.

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CORROSION

The standard design for Turbines, Inc. High Accuracy Turbine Flow Meters consists of stainless steel internal components. It is essential that the user confirms that these materials are compatible with the process line fluid. Incompatible process line fluids may cause premature deterioration of meter components, and lead to inaccurate meter registration and eventual failure.

If the compatibility of an intended process line fluid is unknown, contact the factory for application assistance. Alternate and/or non-standard materials selections can be utilized resulting in flow elements that will be fully compatible with process fluids.

PULSATING FLOW ISSUES

Severe pulsation of flow will affect the accuracy of the turbine flow meter, and shorten the useful service life of the equipment.

VIBRATION AND SHOCK

Severe mechanical shock and/or vibration may decrease the useful service life of the meter. Excessive mechanical shock and/or vibration may cause structural failure of the connection between meter and secondary equipment (monitor/totalizer).

CONTROL OR THROTTLING VALVE(S)

Throttling valves should be installed downstream of the turbine flow meter only.

FILTRATION

A strainer should be installed upstream of the turbine flow meter. Suspended particles and/or foreign matter may damage rotor and/or other internal components.

LINE FLUID-FLOW CONDITIONS

Never introduce air or gaseous substances or flow into a liquid turbine flow meter.

The turbine flow meter should be operated within the specified rated range of the meter. Don not run below the minimum limit of the flow range as it will result in inaccuracies. Do not exceed the maximum limit of the flow range as this may damage the turbine flow meter.

Equipment Maintenance

By observing proper maintenance procedures the useful service life of the High Accuracy Turbine flow meter can be prolonged.

PERIODIC MAINTENANCE

Maintenance for Turbines, Inc. High Accuracy Turbine Flow Meters consists of periodic inspection of the internal components; rotor supports, rotor, and bearings. Excessive wear, physical damage, or clogging must be identified promptly. Should evidence of such conditions be present, it is recommended that the meter be returned to the factory to be rebuilt.

Complete sets of calibrated internal retro-fit kits are available if field repair and/or replacement is desired. Consult with factory for assistance.

INSPECTION

In order to inspect or clean the turbine flow meter, the internal components must be removed. Detailed disassembly and assembly instructions are included below.

As components are removed from the housing, inspect each part for visible wear or damage. A severely worn bearing may allow the rotor to contact the housing. This condition will immediately affect the performance of the meter and, if left uncorrected, permanently damage the meter housing.

One of the primary sources of turbine meter failure is the bearing wear caused by foreign material build-up. A large number of process line fluids will leave residue that severely degrades the free motion of the rotor, resulting in permanent damage.

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Disassembly and Assembly

An exploded view of the internal components is provided in Figure 4. Additional assistance, if required, may be obtained by contacting the factory.

DISASSEMBLY

Step 1
Prior to removing any flow element from the process line, VERIFY PRESSURE HAS BEEN RELIEVED FROM THE LINE and that no flow is present.

Step 2
Make sure that all power to any connected secondary device(s) has been disconnected. Remove any connections to the **Pickup Coil**. Remove **Pickup Coil** from the **Meter Housing**.

Step 3
Remove **Retaining Rings** from both ends of the **Meter Housing**.

Step 4
Remove **Upstream Rotor Support**, **Rotor**, and **Downstream Rotor Support** carefully by gently pushing entire assembly through the **Meter Housing**.

Step 5
Thoroughly inspect all internal components for evidence of wear, degradation, corrosion, foreign debris entanglement, and physical damage. Nicks, dents, misalignment of blades, or build up on the **Rotor** can cause the turbine flow meter to register incorrectly.

Step 6
If any components show signs of excessive wear, a factory calibrated replacement kit should be installed.

RE-ASSEMBLY

Step 1
Internal components must be reassembled in the same orientation as they were removed.

Step 2
Install a **Retaining Ring** into the upstream retaining ring groove in the **Meter Housing**.

Step 3
Install upstream and downstream **Bearings** into the **Rotor** bearing bores.

Step 4
Slide the **Rotor** and **Bearing** assembly onto the shaft of the **Upstream Rotor Support**. Check **Rotor** orientation by verifying the mark on the **Rotor** is facing the **Upstream Rotor Support**.

Step 5
Complete the internal assembly by mating the **Downstream Rotor Support** with the **Upstream Rotor Support**.

Step 6
Insert the internal assembly into the **Meter Housing** while aligning the **Upstream Rotor Support** with the **Anti-Rotation Humps** in the **Upstream Retaining Ring**.

Step 7
Install **Retaining Ring** the downstream retaining ring groove in the **Meter Housing**.

Step 8
Verify that the **Rotor** spins freely, without any disruption, bias or binding, and that the **Rotor Supports** do not rotate within the **Meter Housing**.

Step 9
Thread **Pickup Coil** into **Meter Housing**.

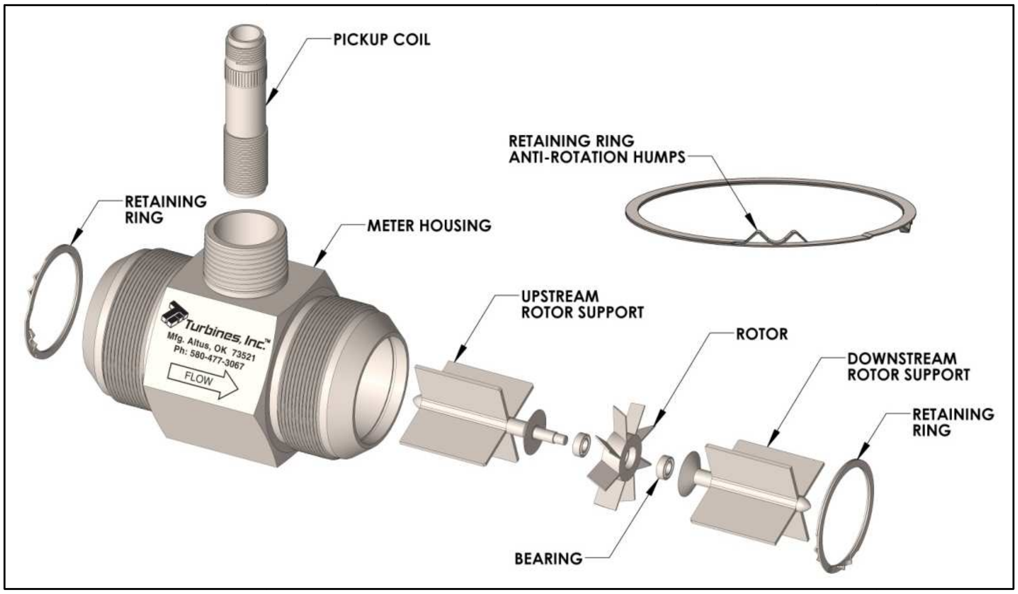

Figure 4

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