Thermal Mass Flow

Advanced Diagnostics of Thermal Mass Flow Meters

MAGNETROL®

Many thermal mass flow meters are of the insertion type. As a starting point, proper insertion depth and straight run per the manufacturer's recommendations should be adhered to. There will also be a flow arrow located on the probe or flange depending on the process connection. This is because thermal mass flow meters are calibrated in one direction and are only accurate in the direction for which it was calibrated. If not installed properly it can still measure and be repeatable but accuracy will be affected.

Verifying flow meter performance is an essential step in ensuring your flow meter is meeting its specifications. Manufacturers design-in diagnostics tests that can be run in the field, in the pipe (in-situ) or in the instrumentation shop.

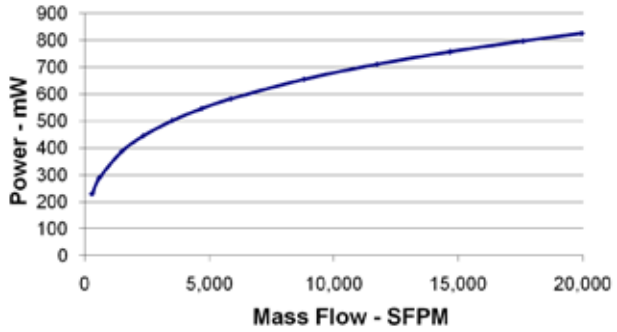
The Thermatel® TA2 thermal dispersion mass flow meter features several convenient tests that an end-user can perform to verify proper operation of the device. The tests include verifying that the heater current is correct, the temperature sensors are reading correctly and the heat transfer characteristics of the probe tips have not changed. These tests can be performed using the software display, HART® or PACT*ware*™. Therefore, no external equipment must be purchased to run the procedures.

Testing the Heater Setting

Thermal mass flow meters commonly include resistance temperature detectors (RTDs) and "heaters" in the small pins at the end of the probe. The probes utilize a heated pin and an unheated pin. The unheated pin operates at the process temperature. The other pin is heated with a variable power to maintain a constant temperature difference between the two pins.

The transmitter measures the amount of current being applied to the heated pin. This current is converted to power (mW) which infers mass flow rate based on the calibration. The relationship between power and mass flow rate is shown in the curve below. Having the right amount of current being measured by the transmitter is essential in ensuring correct flow measurement.

Thermatel® TA2 Thermal Dispersion Mass Flow Meter



The calibration curve shows relationship between Power and Mass Flow Rate

By removing the display and using a multimeter, the user can access the processor board and take readings across the heater bypass to compare to the transmitter. Comparing those readings with the heater current displayed in the Diagnostics menu allows confirmation that the heater current value used by the device to calculate flow matches the actual heater current.

Test the Heater Setting Using a Multimeter

A common concern in combustible gas applications is the amount of heat being added to the process. During agency testing of the THERMATEL TA2, the maximum surface temperature was 4°C above the process temperature. It is important that manufacturers are not adding excessive heat into the system.

Zero Power Test

During calibration, the probe is placed into a water bath to calibrate the RTDs. This is an important step by the manufacturer to verify that the RTDs measure the same in order to maintain the correct constant temperature difference between them. Some manufacturers refer to the temperature difference as the set point.

This Zero Power Test checks that the resistances of the RTDs have not changed since calibration. When the test is initiated, the THERMATEL TA2 automatically turns off the heater current and displays the temperature difference between the two sensor tips. Once the device has determined that the temperature difference has stabilized, the final value is displayed to the user.

The value should be less than 0.5°C to verify that drift in the RTDs has not occurred. Typical results are less than 0.15°C.

The test can be performed in-situ under flowing conditions to provide a quick check of the RTDs. For greater repeatability and reliability of testing, it is recommended that this test be performed in a water bath.

Zero Power Test

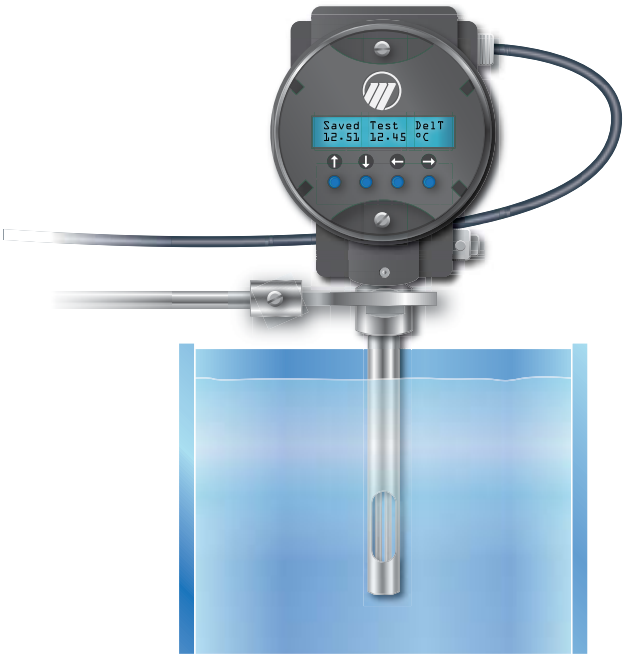
Calibration Verification Procedure

In the past, flow meters had to be returned to the manufacturer in order to verify calibration has not changed. Thermal mass flow meter manufacturers have now provided procedures to perform this verification on-site (unless required to send back by regulation or internal requirement). This capability saves process downtime and the cost of recalibrations.

The THERMATEL TA2 thermal dispersion mass flow meter provides a two-step procedure for field verification of calibration. By performing the High Flow Validate and the Low Flow Validate tests, a user can verify that the device's response to flow, near the two extremes of the calibration curve, has not changed since the original calibration.

The primary procedure is the High Flow Validate. It involves placing the probe into a water bath, making sure the tip is completely covered in water. The transmitter automatically sets the heater current to a relatively high fixed value and displays

the temperature difference between the two sensor tips. Once the device has determined that the temperature difference has stabilized, the final value is displayed as well as an initial value taken by Magnetrol® during calibration. The values should be within 1.5°C. Some variation is allowed to account for different test methods and temperatures. The user can store the newly obtained value or keep the initial, as the initial value will remain on the calibration certificate ("Hi Cal") that is sent with every THERMATEL TA2.



High Flow Validate

The similar Low Flow Validate test is performed under a low flow (no flow) condition. The no flow type test is more common amongst manufacturers. In this case, the sensor tip is covered and the transmitter sets the heater current to a relatively low fixed value. The same procedure applies as the High Flow Validate in comparing to the initial stored values.

Testing that the RTDs measure the same temperature difference at two different points verifies the calibration. It is not simply configuration verification but a true test of heat transfer. The High Flow Validate can be easier to reproduce on-site and is acceptable to perform on its own. It is recommended that either test be conducted at room temperature.

Verifying Configuration

One of the first troubleshooting tips for thermal mass flow meters is verifying the configuration has not changed since it left the factory. Many times, "configuration" and "calibration" are terms that are used interchangeably. Configuration checks are not the same as the aforementioned Calibration Verification Procedure; they are only used to verify that the flow meter is calculating expected values based on the original calibration data. This ensures that parameters have not been altered.

The calibration certificate of the THERMATEL TA2 contains the reference data for confirmation. On the certificate is the power versus mass flow curve with actual values. Through the Diagnostics menu of the transmitter, the user can read a live power with its associated flow rate and compare directly to the certificate. If they match, then the flow meter is still configured correctly. Optionally, the user can input a fixed heater current and compare values directly.

Summary

Market growth for thermal mass flow meters has enabled manufacturers to continue to invest in the technology. Greenhouse gas emission reporting/reduction and energy management projects have fueled this growth. In demanding applications such as these, the user must have confidence in the measurement. The THERMATEL TA2 thermal dispersion mass flow meter provides this with advanced diagnostics that will verify reliability and performance in the field.

CONTACT MAGNETROL FOR MORE INFORMATION:
Phone: 630-969-4000
Email: info@magnetrol.com
www.magnetrol.com

Bulletin: 54-243.0