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FIELD SERVICE BULLETIN

To: Field Application and Distribution

From: Norm Sellers, John Raditsas

Subject: MFC Zeroing Procedure

Date: 02.04.05

Purpose:

This Bulletin is to instruct customers and field personnel on proper zeroing procedures for Analog and Digital MFC's

Authorization:

Technical Services Group

System Affected:

All MFC's except IFC125

Date Effective:

Immediately

Tools:

N/A

Estimated Time Required:

Depending on MFC's configuration

Background:

It is normal to experience zero drift in the flow meter output during the life of the mass flow controller (MFC). When an MFC is first installed, it is highly recommended to re-zero the device to ensure the best results. Indicated Flow (or "Output") is the signal produced by the mass flow sensor circuitry, and can be monitored to indicate "MFC Zero" when gas is not flowing. The adequate signal level at zero flow condition is considered to be 0% +/-.1% (0V +/- .005V).

Zero offset is a major contributor to flow inaccuracies particularly at lower control setpoints, where the zero offset error becomes a large percentage of the total flow signal. Because of this problem, it is imperative that the MFC zero be set correctly and consistently. There are three common mistakes that can result in errant zeroing.

Gas Inlet pressure:

The inlet pressure is an often overlooked source of potential zero error on MFCs. Many high density, low viscosity gasses exhibit slight changes in zero output as a function of MFC inlet pressure. MFCs flowing gasses such as tungsten hexafluoride and many fluorocarbons are especially sensitive to this problem. A simple way of minimizing this problem is to keep the inlet pressure as low as possible and to zero the MFC filled with the process gas at the operating pressure.

MFC Control Valve Leakage:

Because the MFC is not intended to be used as a positive shut-off device, the MFC valve is not guaranteed to be leak tight when the valve is closed. Consequently setting the MFC zero while there is a pressure differential across the MFC can be a problem because the MFC will be measuring the valve leakage. Setting the zero under these conditions will result in a calibration error. In order to minimize flow errors, it is suggested that the user follow the zeroing procedure below.

Vacuum Purge:

Often, tool owners will perform a vacuum purge in which the MFC is given a 100% setpoint while subjecting the outlet to vacuum. During this process, the MFC commands its valve to be fully open, and the valve will immediately start to heat as it is drawing maximum power. Since no gas is flowing, the valve in turn will heat the sensor causing the zero to artificially move. Sensors configured as HOS are much more susceptible to this phenomenon than sensors configured for HOV. This is because the HOS sensor configuration places one sensor tube in the proximity of the valve coil, which can change in temperature.

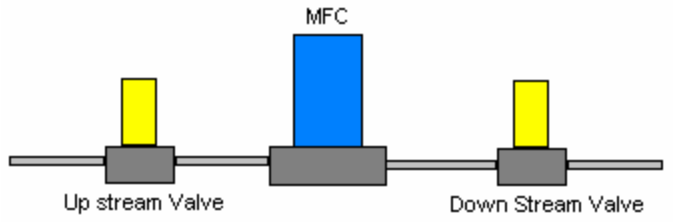
Vacuum purging the MFC can cause the zero to move up to 1% of FS. Zeroing the MFC immediately after a vacuum purge cycle can cause a zero offset of up to 1%. This can cause errors of up to 10% of reading at a 10% setpoint (because a 1% shift in reading represents 1% added or subtracted from 10%).

It is critical to not adjust the zero after a vacuum purge cycle until the MFC has been allowed to thermally stabilize. Thermal stabilization takes about 30 minutes even if the purge cycle is less than 5 min. For longer purges it takes a ***minimum*** 60 minutes for the valve to thermally stabilize. Thermal stabilization must be performed with the control valve off (0% setpoint).

Manual Procedure for Zeroing a Unit:

1. Be certain that the MFC has been inside the user equipment for a minimum of 4 hours and has been powered for a minimum of 60 minutes prior to re-zeroing.
    - This assures that the MFC is in its "use attitude" as well at operating temperature.
    - If the MFC is subjected to vacuum purge for more than one minute, you must turn off the MFC control valve and allow the MFC to settle for a time period equal to twice the vacuum purge time period.

2. Open the upstream isolation valve and close the downstream isolation valve to eliminate the pressure drop by isolating the MFC within the process tool.
    - The pressure drop across the MFC control valve must be eliminated so that the control valve leakage is not a factor.



3. Send the MFC a 100% full scale set point, and allow the system at least sixty seconds to equalize the pressure across the MFC control valve.

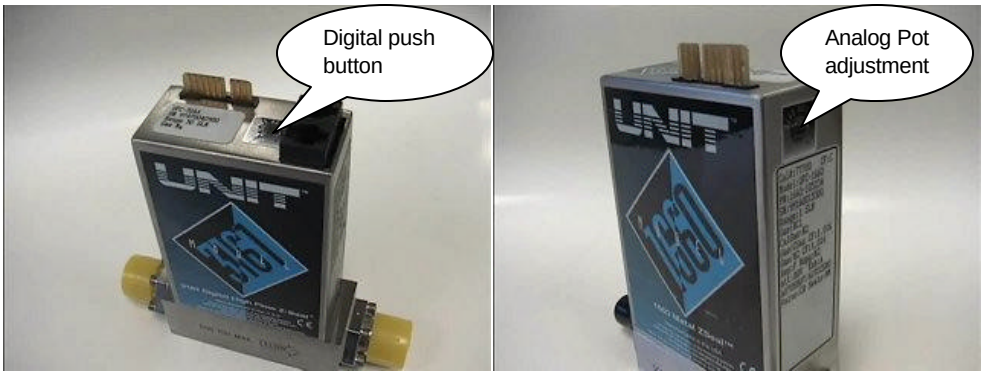
4. Shut the upstream isolation valve to prevent any creep effects in the regulator from affecting the pressure.

5. Close the MFC control valve and wait two minutes.

6. Read the output signal of the MFC.
    - This is now the zero offset, in percent F.S.

7. The MFC output signal should be 0% +/- 0.1% Full Scale.
    - This would be 0.1 SCCM for a 100 SCCM full scale MFC.
    - If you cannot read the output signal to the necessary resolution, you will need to assume that it needs adjustment.
    - If the flow is zero sccm, you will need to assume that it is negative and zero the MFC.
        - The controller is not set up to read negative flow.

8. Zero the MFC.
    - Digital Units:
        - Press the button at the top of the cover, and wait two minutes.
        - After the indicated flow stabilizes press the Zero button again.
    - Analog Units:
        - Adjust the zero potentiometer, and wait until the indication stabilizes.



9. Read the output signal of the MFC it should now be ≤ 0.1% of Full Scale flow.

10. Run MFC at several different flows to verify that the MFC is operating properly.

Conclusion:

Improperly zeroed MFCs can cause significant calibration errors and result in process inconsistencies. Following the above zeroing procedure should eliminate the most often over-looked sources of zero adjustment error.