



**TELEDYNE**  
**INSTRUMENTS**  
*Advanced Pollution Instrumentation*

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## Service Note

95-037 Rev B  
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### **MODEL 700 MASS FLOW CONTROLLER CONFIDENCE CHECK AND ADJUSTMENT**

Scope: This Service note outlines a procedure used to verify flow through the diluent and calibration gas circuits of the M700.

Background: The dilution mode of the M700 uses two extremely accurate mass flow controllers (MFC) to provide an accurate dilution of a high concentration calibration gas with zero air. This procedure assumes a good zero air source with a stable output pressure of 30 PSI at a flow rate that will support your MFC's (i.e., >20 LPM for a 20 LPM MFC, > 10 LPM for 10 LPM MFC, etc.)

Some thoughts to keep in mind before making any adjustments to compensate for inaccuracies in flow:

1. The MFC's have a performance specification for accuracy, of  $\pm 1\%$  of full scale. This means that a 10 SLPM MFC set for 500 SCCPM, can produce between 400 SCCPM and 600 SCCPM and still be within specs.
2. The MFC's in the Model 700 have an accuracy of  $\pm 1\%$  F.S. You must use a flowmeter, corrected to read mass flow, capable of this accuracy or better.
3. Very small air leaks can cause fairly large errors in dilution mixes. Air leaks are the most likely cause of flow inaccuracy.
4. The flow rate through the MFC's will only be as accurate as the DAC adjustment, since the DAC's control the drive voltages for the MFC's. If you suspect flow problems, first run DAC CAL as outlined in the M700 manual, section 9.1.4.1. Then evaluate your MFC's.
5. The repeatability of these flow controllers is  $\pm 0.2\%$  of reading. Therefore, once a calibration curve is developed, the instrument will deliver excellent, repeatable results.

In order to establish confidence in the functionality and accuracy of the MFC's installed in your Model 700 calibrator, the following procedure should be employed.

Tools and Equipment:

1. A NIST traceable mass flowmeter with an accuracy of at least  $\pm 1\%$ , calibrated within the past 3 months. Alternatively, a volumetric flowmeter could be used, but it must be corrected for pressure and temperature.
2. A 1/4" swagelock, gyrolock, or equivalent female cap fitting.
3. Misc. tubing and fittings to connect air source, calibrator and flowmeter.

Procedure:

A. To test MFC1 (diluant flow MFC)

1. Disconnect any fittings attached to the "TEST GAS OUT" port at the rear of the M700.
2. Connect your flowmeter, configured to measure the maximum flow your M700 is capable of, to "TEST GAS OUT".
3. At the front panel, from the Main Menu
  - a. Press SETUP - MORE - DIAG.
  - b. Enter 929, press ENTR.
  - c. Press NEXT 6 times which should display DIAG MFC CALIBRATION.
  - d. Press ENTR - MFC1
  - e. Press NEXT. You should now be at step 1 of the 20 point confidence/calibration test for MFC1 (diluant MFC). The display should indicate: DRV=250.00 FLW=FF.fff (FF.fff = 1/20 full scale of your diluent MFC expressed in SLPM. (e.g., 0.500 for 10 SLPM MFC).
  - f. Press OFF. (This step is only required on the first pass).
  - g. Start your mass flowmeter. It is recommended that you take at least 10 readings and average them. Compute your error. If the error is greater than 1% F.S. of the MFC plus the allowable error in your flowmeter, continue with step h. Otherwise, go back to step e. until you have completed all 20 steps, then go to step k.
  - h. Press FLOW.
  - i. Enter the average reading determined in step g. Press ENTR.
  - j. Go to step e.
  - k. Press ENTR - EXIT.

B. To test MFC2 (Cal Gas MFC)

- a. At rear panel, disconnect the zero air source from “DILUENT IN” port.
- b. Put a cap on the “DILUENT IN” port. Using appropriate adapters, connect zero air source to “CYL1” port.
- c. At front panel press MFC2.
- d. Press NEXT. You should now be at step 1 of the 20 point confidence/calibration test for MFC2 (Cal Gas MFC). The display should indicate: DRV=250.00 FLW = FF.fff (FF.fff = 1/20 full scale for your cal gas MFC expressed in SLPM, e.g., 0.0050 for 100 SCCPM MFC).
- e. Press OFF. (This step is only required on the first pass).
- f. Start your mass flowmeter. It is recommended that you take at least 10 readings and average them. Compute your error. If the error is greater than 1% F.S. of the MFC plus the allowable error in your flowmeter, continue with step g. Otherwise, go to back step d. until you have completed all 20 steps then go to step j.
- g. Press FLOW.
- h. Enter the average reading determined in step f. Press ENTR.
- i. Go to step d.
- j. Press ENTR - EXIT.

C. Restore M700 to operation

- a. Disconnect flowmeter
- b. Remove cap installed in step B.b. above.
- c. Remove zero air from “CYL1”
- d. Reconnect “TEST GAS OUT”
- e. Reconnect “DILUENT IN”
- f. Reconnect “CYL1”