

SEMI E68-0997 (Reapproved 0913) TEST METHOD FOR DETERMINING WARM-UP TIME OF MASS FLOW CONTROLLERS

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 22, 2013. Available at www.semiviews.org and www.semi.org in September 2013. Originally published September 1997; previously published March 2009.

NOTICE: This Standard or Safety Guideline has an Inactive Status because the conditions to maintain Current Status have not been met. Inactive Standards or Safety Guidelines are available from SEMI and continue to be valid for use.

1 Purpose

1.1 The purpose of this method is to provide a standardized method for quantifying the warm-up time of a mass flow controller (MFC).

NOTE 1: Warm-up times affect the initial performance of a MFC. Warm-up time is necessary information in deciding if a process tool is ready to be put back into service. In addition, warm-up data will be useful in calibration labs.

2 Scope

2.1 The test conditions in this method are intended to simulate bench top warm-up, with an MFC that has been equalized to ambient conditions for 24 hours before the application of power.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Conditions in the lab may be different from conditions found in the field and may influence test results. This test is intended to measure warm-up under a controlled condition.

3.2 The MFC is to be at ambient temperature before the beginning of the test.

3.3 Due to manufacturing variability, warm-up times may vary for the same model of MFC. This Specification addresses a method for taking a single data point repetitively from the same MFC. Resulting data will show exactly how warm-up effects change the delivered flow of that particular MFC. To statistically quantify warm-up time for a particular model of MFC, multiple samples should be tested.

4 Referenced Standards and Documents

4.1 None.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *DUT* — device under test

5.1.2 *FS* — full scale

5.1.3 *MFC* — mass flow controller

5.2 Definitions

5.2.1 *device under test* — the MFC being tested for warm-up time.

5.2.2 *indicated flow* — flow indicated by the MFC under test. Electrical output of the DUT.

5.2.3 *stability* — a condition that exhibits only natural, random variations in the absence of unnatural, assignable-cause variations. For the several purposes of this test, stability is defined as $\pm 10\%$ of the accuracy of the DUT at full scale.

5.2.4 *steady state* — state at which the indicated flow is stable for a 15-minute time period.

5.2.5 *warm-up* — a process where the MFC goes from an unpowered condition to a condition where the output is within $\pm 1\%$ full scale, of the final steady state output.

6 Summary of Test Method

6.1 The DUT is connected in series with shut-off valves on either side of the DUT. With no gas flow and the DUT powered, indicated flow is monitored until steady state is achieved. Power is briefly disconnected then reconnected and indicated flow is again monitored until steady state is achieved.

7 Significance and Use

7.1 Data generated by this method is used to estimate the amount of time an MFC should be powered up in a process tool before resuming production. When calibrating an MFC, the warm-up time can be used to estimate the waiting time before calibration. For power interruptions, the power interruption warm-up time may be used to determine the time required following a power interruption to resume production or calibration.

8 Apparatus

8.1 See Figure 1.

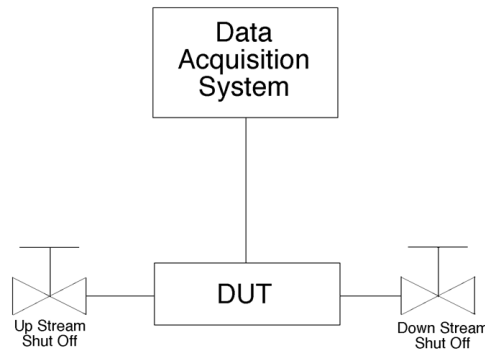


Figure 1
Test Set Up

8.2 *Time-Keeping Apparatus* — Capable of keeping accurate records within ± 10 seconds. Time-keeping requirements are not stringent, and almost any apparatus is acceptable.

8.3 *Data Acquisition System* — Having a resolution of one mV or better and a sample rate of one Hz.

9 Conditioning

9.1 Ambient temperature must be controlled and stable between 20°C and 25°C during testing for all tests. The DUT must be exposed to the ambient environment for 24 hours before the beginning of the test so that it is in equilibrium. The gas temperature must be measured and verified to be at equilibrium with both the DUT and with ambient temperature. Temperatures are in equilibrium if they are within 1°C of each other. Lab temperature may not change more than 1°C during test.

10 Procedure

10.1 Connect the DUT in series with the two shut-off valves, one upstream of the DUT and the other downstream. Electronically connect the DUT to a data acquisition system capable of recording indicated flow from the DUT. The test set-up should be set to give appropriate signals to the DUT so the DUT control valve will not dissipate power. For normally closed MFC's, the setpoint should be zero, and for normally open MFC's, the setpoint should be 100%. Suggested orientation of the DUT is horizontal (base down). If the DUT is positioned otherwise, the orientation should be reported in the test data (see Figure 1). Valves are to be opened in a downstream-to-upstream sequence and closed in reverse fashion. The data acquisition system must be warmed up as per the manufacturer's instructions.