SEMI E16-0624
GUIDE FOR DETERMINING AND DESCRIBING MASS FLOW CONTROLLER LEAK RATES

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NOTICE: Paragraphs entitled 'NOTE:' are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

1 Purpose

1.1 The purpose of this Guide is to establish a uniform, worldwide means for describing and measuring leak rates of mass flow controllers (MFCs). The leak integrity of a gas delivery system is important to maintaining product quality and performance. This Guide is intended to prevent confusion and misunderstanding between manufacturers and users. In particular, it distinguishes between mechanical and diffusion leak rates.

2 Scope

2.1 This Guide contains definitions of terms and procedures for determining the leak rates of MFCs as used in the semiconductor industry.

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 Referenced Standards and Documents

3.1 *United States Military Standards*[1]

MIL STD-202E — Test Method Standard Electronic and Electrical Component Parts

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

4.1.1 *leak* — a path or paths in a sealed system which will pass helium when a partial pressure differential exists.

4.1.1.1 *Discussion* — A partial pressure differential can exist for helium even though a total gas pressure differential may not exist. There are two major leak mechanisms, a mechanical passage or a material through which gas can diffuse or permeate. In a real system, a leak may have both mechanisms operating in parallel.

4.1.1.2 A mechanical leak may be a physical crack, pit, scratch or other imperfection in a sealing surface, or contamination or debris on the seals. A diffusion or permeation leak is caused by the movement of helium through gaskets, O-rings, polymers, or other materials through which helium can diffuse.

4.1.2 *sensitivity (minimum detectable leak rate)* — the smallest standard leak rate that an instrument, method, or system is capable of measuring under specified conditions.

5 Testing

5.1 *General Considerations*

5.1.1 *Leak Detector* — The leak detector should be of the helium mass spectrometer type. It should have sensitivity at least equal to or smaller than the specified leak rating of the MFC to be tested. If the actual leak rate is to be reported,

[1] United States Military Standards, available as freely downloadable PDF files from the ASSIST Quick Search website at http://quicksearch.dla.mil.

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the sensitivity should be five times smaller than the leak to be measured. If the sensitivity is not five times smaller, the actual leak rate may be reported if the sensitivity of the detector is also reported.

5.1.2 Helium should have access to all primary seals.

5.1.3 Connections between the MFC and the leak detector should be leak-tight.

5.1.4 The ambient temperature of the MFC should be 25°C ± 5°C unless otherwise specified. If another test temperature is used, it should be recorded during the test.

5.2 *Test Procedures* — There are two basic setups which may be used to measure the leak rate from the external environment to the internal gas passages of the MFC or from the internal passages to the external environment. Results for either test method may be reported. The method used should be reported as well. A third test, the through-the-valve setup, is intended to measure the quality of the valve seat shutoff.

5.2.1 *Internally-Pressurized Leak Test* — The purpose of this test set-up is to simulate operation of the MFC under conditions where the internal pressure is above ambient. The recommended internal pressure is 300 kPa absolute (30 psig) of helium (refer to Figure 1).

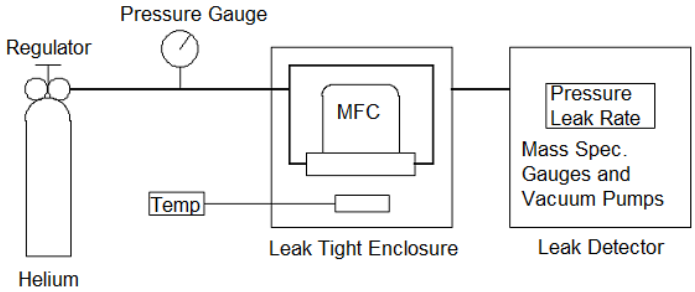

Figure 1
Internally-Pressurized Leak Test

5.2.2 *Externally-Pressurized Leak Test* — The purpose of this test is to simulate operation of the MFC under conditions where the internal pressure is at vacuum. The external pressure should be equal to atmospheric pressure. The internal pressure should be less than 100 kPa (refer to Figure 2).

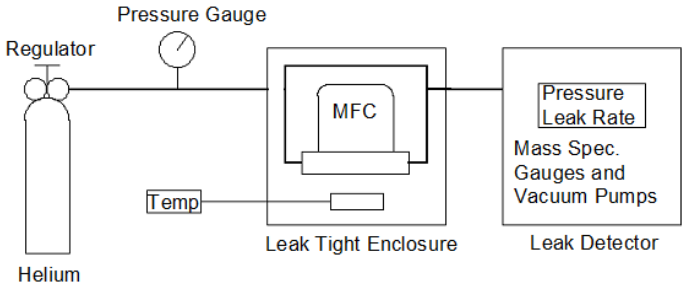

Figure 2
Externally-Pressurized Leak Test

5.2.3 *Control Valve Seat Leak Test* — The purpose of this test is to determine the leakage through the control valve under simulated operation in the closed control mode. The MFC should be electrically energized for normal operation and placed in the closed position as specified for the operation of the MFC. The input pressure to the MFC should be 100 kPa ± 20%. The outlet should be connected directly to the helium leak detector, and pressure should be as low as possible using good leak detector practice (refer to Figure 3).

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