

SEMI F13-1101

GUIDE FOR GAS SOURCE CONTROL EQUIPMENT

This guide was technically approved by the Global Facilities Committee and is the direct responsibility of the North American Facilities Committee. Current edition approved by the North American Regional Standards Committee on August 27, 2001. Initially available at www.semi.org September 2001; to be published November 2001. Originally published in 1993.

1 Purpose

1.1 The purpose of this document is to provide a guide for the design and operational requirements of gas source control equipment which is used to control pressure and flow from a gas cylinder to the point of use.

2 Scope

2.1 This document describes the components and minimum performance criteria for gas source control equipment used with hazardous production material (HPM) semiconductor gases. This guide also includes recommended component functions and operating requirements.

2.2 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Related Documents

3.1 These documents should be used in the design, fabrication, installation, and operation of gas source control equipment.

3.2 SEMI Standards and Safety Guidelines

SEMI F1 — Specification for Leak Integrity of High-Purity Gas Piping Systems and Components

SEMI F2 — Specification for 316L Stainless Steel Tubing for General Purpose Semiconductor Manufacturing Applications

SEMI F3 — Guide for Welding Stainless Steel Tubing for Semiconductor Manufacturing Applications

SEMI F4 — Guide for Remotely Actuated Cylinder Valves

SEMI F6 — Guide for Secondary Containment of Hazardous Gas Piping Systems

SEMI F14 — Guide for the Design of Gas Source Equipment Enclosures

SEMI S2 — Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

SEMI S4 — Safety Guideline for the Segregation/ Separation of Gas Cylinders Contained in Cabinets

SEMI S5 — Safety Guideline for Flow Limiting Devices

3.3 Compressed Gas Association Documents¹

Pamphlet P-1 — Safe Handling of Compressed Gases in Containers

Standard V-1 — Compressed Gas Cylinder Valve Outlet and Inlet Connections

3.4 National Fire Protection Association Document²

NFPA 704 — Identification of the Hazards of Materials for Emergency Response

NOTE 1: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Referenced Standards

4.1 Various codes and ordinances apply in different municipalities. These documents must be followed for the installation and operation of these systems. These codes may include:

Applicable Occupancy Codes — Uniform Building Code (UBC)³

Article 51 — Uniform Fire Code (companion document to above UBC)

Article 80 — Uniform Fire Code (companion document to above UBC)

Applicable Occupancy Codes — BOCA National Building Code⁴, BOCA National Fire Prevention Code⁴

Local Ordinances — As applicable.

NOTE 2: Unless otherwise indicated, all documents cited shall be the latest published versions.

1 Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202

2 National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269

3 International Conference of Building Officials (OCBO), 5360 Workman Mill Road, Whittier, CA 90601

4 Building Officials and Code Administrators International, Inc. (BOCA), 4051 W. Flossmoor Road, Country Club Hills, IL 60478

5 Terminology

5.1 *automatic shut-off (ASO)* — A remotely actuated valve, preferably the cylinder valve, but possibly a valve located close to the cylinder valve, which can isolate the product as close to the cylinder valve as possible. It may also be a device which attaches to the cylinder valve stem or handle to close the valve.

5.2 *compressed gas association (CGA)* — Organization that sets standards for the handling and safe use of gases. Used in this document to refer to the cylinder valve outlet connection for each product as designated by the CGA.

5.3 *cylinder* — A pressure vessel designed for pressures higher than 276 kPa (40 pounds per square inch absolute) and having a circular cross section. It does not include a portable tank, multi-unit tank car tank, cargo tank, or tank car. It also refers to non-DOT low pressure containers used for liquid product having low vapor pressure.

5.4 *gas source control equipment (GSCE)* — Refers to the equipment assembly beginning at the product exit from the cylinder valve to the beginning of the distribution piping leading to the point of use (POU). These assemblies are usually mounted on panels and are sometimes referred to as process panel systems.

5.5 *hazardous production material (HPM)* — A solid, liquid, or gas that has a degree-of-hazard rating in health, flammability, or reactivity of Class 3 or 4 as ranked by NFPA 704 and which is used directly in research, laboratory, or production processes which have, as their end product, materials which are not hazardous.

5.6 *high pressure isolation (HPI) valve* — A shut-off valve located on the high-pressure side of a gas piping system that, when closed, isolates the purged volume from the pressure regulator and other downstream components.

5.7 *low pressure isolation (LPI) valve* — A shut-off valve located on the low-pressure side of a gas system that, when closed, isolates the purged volume from the distribution piping and all other downstream components.

5.8 *point of use (POU)* — Refers to the manufacturing tool which uses the product. Point of use is distinguished from the GSCE by having its own design criteria, separate function, and physical separation from the GSCE.

5.9 *product* — Refers to the gas phase in the cylinder.

6 Configuration

6.1 Manual/Auto Operation

6.1.1 Manual equipment without automation is adequate if it includes an ASO plus excess flow device. (Where required, per UFC articles 51 and 80.) Automated purging is generally more efficient than manual purging and is, therefore, recommended. The ASO function is achieved if the ASO valve automatically defaults to a closed position via a pneumatically actuated valve, or separate actuator that will close a manual cylinder valve. Either method should be fail-safe (default to a closed position on loss of power and/or pneumatics). This could also be initiated by any number of abnormal circumstances.

6.1.2 *Fully Automatic* — This is a broad category of designs using any number of transducers, remotely operated valves, and logic to accomplish safeguarding, monitoring, and automatic purging. Extension of this approach to central data collection, analysis, and reporting via computers and special programs offers the capability of further reducing hazards and enhancing safety.

6.2 Cylinder Connections

6.2.1 Compressed gas cylinders are connected to the panel equipment using the connection on the outlet of the cylinder valve. The appropriate regulatory agency has designated one or more connections for each product gas.

6.2.2 Other containers for liquid or low vapor pressure materials may require the connection of two fittings. One of these is used to admit gas, which either pressurizes the product, allowing liquid withdrawal, or absorbs the product, allowing withdrawal of a gas-phase mixture of the product and the gas. The other fitting is used for withdrawal. The types and labeling of the connections vary among suppliers.

6.2.3 *High Pressure Pigtail* — A semi-flexible assembly of piping, subjected to cylinder pressure, which is used to connect the cylinder to the rigidly mounted components on the panel. The intent of this flexible assembly is to accommodate the location of the cylinder outlet.

6.2.4 *No Pigtail* — An alternate acceptable method allows cylinders to be elevated or lowered to match the fixed height of the connection point on fixed panel equipment.

6.3 Cross Contamination

6.3.1 *Purge Gas Cylinder Contamination by Process Gas* — Purge gas is supplied from cylinders, with each purge gas cylinder limited to a single process gas panel or several panels using the same process gas class or