

## CHAPTER 27

# SEMICONDUCTOR FABRICATION FACILITIES

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### User note:

**About this chapter:** Chapter 27 provides requirements that are intended to control hazards associated with the manufacture of electrical circuit boards or microchips, commonly called semiconductors. Though the finished product possesses no unusual hazards, materials commonly associated with semiconductor manufacturing are often quite hazardous and include flammable liquids, pyrophoric and flammable gases, toxic substances and corrosives. The requirements of this chapter are concerned with both life safety and property protection. However, the fire code official should recognize that the risk of extraordinary property damages is far more common than the risk of personal injuries from fire. Section 415.11 of the International Building Code<sup>®</sup> also addresses these facilities that are classified as Group H-5 occupancies.

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### SECTION 2701 GENERAL

**2701.1 Scope.** Semiconductor fabrication facilities and comparable research and development areas classified as Group H-5 shall comply with this chapter and the *International Building Code*. The use, storage and handling of hazardous materials in Group H-5 shall comply with this chapter, other applicable provisions of this code and the *International Building Code*.

**2701.2 Application.** The requirements set forth in this chapter are requirements specific only to Group H-5 and shall be applied as exceptions or additions to applicable requirements set forth elsewhere in this code.

**2701.3 Multiple hazards.** Where a material poses multiple hazards, all hazards shall be addressed in accordance with Section 5001.1.

**2701.4 Existing buildings and existing fabrication areas.** Existing buildings and existing *fabrication areas* shall comply with this chapter, except that transportation and handling of HPM in *corridors* and enclosures for *stairways* and *ramps* shall be allowed where in compliance with Section 2705.3.2 and the *International Building Code*.

**2701.5 Permits.** Permits shall be required as set forth in Section 105.6.

### SECTION 2702 DEFINITIONS

**2702.1 Definitions.** The following terms are defined in Chapter 2:

**EMERGENCY CONTROL STATION.**

**FABRICATION AREA.**

**GAS DETECTION SYSTEM.**

**HAZARDOUS PRODUCTION MATERIAL (HPM).**

**HPM.**

**HPM ROOM.**

**PASS-THROUGH.**

**SEMICONDUCTOR FABRICATION FACILITY.**

**SERVICE CORRIDOR.**

**TOOL.**

**WORKSTATION.**

### SECTION 2703 GENERAL SAFETY PROVISIONS

**2703.1 Emergency control station.** An *emergency control station* shall be provided in accordance with Sections 2703.1.1 through 2703.1.3.

**2703.1.1 Location.** The *emergency control station* shall be located on the premises at an *approved* location outside the fabrication area.

**2703.1.2 Staffing.** Trained personnel shall continuously staff the *emergency control station*.

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**2703.1.3 Signals.** The *emergency control station* shall receive signals from emergency equipment and alarm and detection systems. Such emergency equipment and alarm and detection systems shall include, but not be limited to, the following where such equipment or systems are required to be provided either in this chapter or elsewhere in this code:

1. *Automatic sprinkler system* alarm and monitoring systems.
2. Manual fire alarm systems.
3. Emergency alarm systems.
4. Gas detection systems.
5. Smoke detection systems.
6. Emergency power systems.
7. Automatic detection and alarm systems for pyrophoric liquids and Class 3 water-reactive liquids required by Section 2705.2.3.4.
8. Exhaust ventilation flow alarm devices for pyrophoric liquids and Class 3 water-reactive liquids and cabinet exhaust ventilation systems required by Section 2705.2.3.4.

**2703.2 Systems, equipment and processes.** Systems, equipment and processes shall be in accordance with Sections 2703.2.1 through 2703.2.3.2.

**2703.2.1 Application.** Systems, equipment and processes shall include, but not be limited to, containers, cylinders, tanks, piping, tubing, valves and fittings.

**2703.2.2 General requirements.** In addition to the requirements in Section 2703.2, systems, equipment and processes shall comply with Section 5003.2, other applicable provisions of this code, the *International Building Code* and the *International Mechanical Code*.

**2703.2.3 Additional requirements for HPM supply piping.** In addition to the requirements in Section 2703.2, HPM supply piping and tubing for HPM gases and liquids shall comply with this section.

**2703.2.3.1 General requirements.** The requirements set forth in Section 5003.2.2.2 shall apply to supply piping and tubing for HPM gases and liquids.

**2703.2.3.2 Health-hazard ranking 3 or 4 HPM.** Supply piping and tubing for HPM gases and liquids having a health-hazard ranking of 3 or 4 shall be welded throughout, except for connections located within a ventilation enclosure if the material is a gas, or an *approved* method of drainage or containment provided for connections if the material is a liquid.

**2703.3 Construction requirements.** Construction of semiconductor fabrication facilities shall be in accordance with Sections 2703.3.1 through 2703.3.9.

**2703.3.1 Fabrication areas.** Construction and location of *fabrication areas* shall comply with the *International Building Code*.

**2703.3.2 Pass-throughs in exit access corridors.** Pass-throughs in *exit access corridors* shall be constructed in accordance with the *International Building Code*.

**2703.3.3 Liquid storage rooms.** Liquid storage rooms shall comply with Chapter 57 and the *International Building Code*.

**2703.3.4 HPM rooms.** HPM rooms shall comply with the *International Building Code*.

**2703.3.5 Gas cabinets.** Gas cabinets shall comply with Section 5003.8.6.

**2703.3.6 Exhausted enclosures.** Exhausted enclosures shall comply with Section 5003.8.5.

**2703.3.7 Gas rooms.** Gas rooms shall comply with Section 5003.8.4.

**2703.3.8 Service corridors.** Service corridors shall comply with Section 2705.3 and the *International Building Code*.

**2703.3.9 Cabinets containing pyrophoric liquids or water-reactive Class 3 liquids.** Cabinets in *fabrication areas* containing pyrophoric liquids or Class 3 water-reactive liquids in containers or in amounts greater than 1/2 gallon (2 L) shall comply with Section 2705.2.3.4.

**2703.4 Emergency plan.** An emergency plan shall be established as set forth in Section 403.7.1.

**2703.5 Maintenance of equipment, machinery and processes.** Maintenance of equipment, machinery and processes shall comply with Section 5003.2.6.

**2703.6 Security of areas.** Areas shall be secured in accordance with Section 5003.9.2.

**2703.7 Electrical wiring and equipment.** Electrical wiring and equipment in HPM facilities shall comply with Sections 2703.7.1 through 2703.7.3.

**2703.7.1 Fabrication areas.** Electrical wiring and equipment in *fabrication areas* shall comply with NFPA 70.

**2703.7.2 Workstations.** Electrical equipment and devices within 5 feet (1524 mm) of workstations in which flammable or pyrophoric gases or flammable liquids are used shall comply with NFPA 70 for Class I, Division 2 hazardous locations. Workstations shall not be energized without adequate exhaust ventilation in accordance with Section 2703.14.

**Exception:** Class I, Division 2 hazardous electrical equipment is not required where the air removal from the workstation or dilution will prevent the accumulation of flammable vapors and fumes on a continuous basis.

**2703.7.3 Hazardous production material (HPM) rooms, gas rooms and liquid storage rooms.** Electrical wiring and equipment in HPM rooms, gas rooms and liquid storage rooms shall comply with NFPA 70.

**2703.8 Corridors and enclosures for stairways and ramps.** Hazardous materials shall not be used or stored in *corridors* or enclosures for *stairways* and *ramps*.

**2703.9 Service corridors.** Hazardous materials shall not be used in an open-system use condition in service corridors.

**2703.10 Automatic sprinkler system.** An *approved automatic sprinkler system* shall be provided in accordance with Sections 2703.10.1 through 2703.10.5 and Chapter 9.

**2703.10.1 Workstations and tools.** The design of the sprinkler system in the area shall take into consideration the spray pattern and the effect on the equipment.

**2703.10.1.1 Combustible workstations.** A sprinkler head shall be installed within each branch exhaust connection or individual plenums of workstations of combustible construction. The sprinkler head in the exhaust connection or plenum shall be located not more than 2 feet (610 mm) from the point of the duct connection or the connection to the plenum. Where necessary to prevent corrosion, the sprinkler head and connecting piping in the duct shall be coated with *approved* or *listed* corrosion-resistant materials. Access to the sprinkler head shall be provided for periodic inspection.

**Exceptions:**

1. *Approved* alternative automatic fire-extinguishing systems are allowed. Activation of such systems shall deactivate the related processing equipment.
2. Process equipment that operates at temperatures exceeding 932°F (500°C) and is provided with automatic shut-down capabilities for hazardous materials.
3. Exhaust ducts 10 inches (254 mm) or less in diameter from flammable gas storage cabinets that are part of a workstation.
4. Ducts *listed* or *approved* for use without internal automatic sprinkler protection.

**2703.10.1.2 Combustible tools.** Where the horizontal surface of a combustible tool is obstructed from ceiling sprinkler discharge, automatic sprinkler protection that covers the horizontal surface of the tool shall be provided.

**Exceptions:**

1. An automatic gaseous fire-extinguishing local surface application system shall be allowed as an alternative to sprinklers. Gaseous-extinguishing systems shall be actuated by infrared (IR) or ultraviolet/infrared (UV/IR) optical detectors.
2. Tools constructed of materials that are *listed* as Class 1 or Class 2 in accordance with UL 2360 or *approved* for use without internal fire-extinguishing system protection.

**2703.10.2 Gas cabinets and exhausted enclosures.** An *approved automatic sprinkler system* shall be provided in gas cabinets and exhausted enclosures containing HPM *compressed gases*.

**Exception:** Gas cabinets located in an HPM room other than those cabinets containing pyrophoric gases.

**2703.10.3 Pass-throughs in existing exit access corridors.** Pass-throughs in existing *exit access corridors* shall be protected by an *approved automatic sprinkler system*.

**2703.10.4 Exhaust ducts for HPM.** An *approved automatic sprinkler system* shall be provided in exhaust ducts conveying gases, vapors, fumes, mists or dusts generated from HPM in accordance with this section and the *International Mechanical Code*.

**2703.10.4.1 Metallic and noncombustible nonmetallic exhaust ducts.** An *approved automatic sprinkler system* shall be provided in metallic and noncombustible nonmetallic exhaust ducts where all of the following conditions apply:

1. Where the largest cross-sectional diameter is equal to or greater than 10 inches (254 mm).
2. The ducts are within the building.
3. The ducts are conveying flammable gases, vapors or fumes.

**2703.10.4.2 Combustible nonmetallic exhaust ducts.** An *approved automatic sprinkler system* shall be provided in combustible nonmetallic exhaust ducts where the largest cross-sectional diameter of the duct is equal to or greater than 10 inches (254 mm).

**Exceptions:**

1. Ducts *listed* or *approved* for applications without *automatic sprinkler system* protection.
2. Ducts not more than 12 feet (3658 mm) in length installed below ceiling level.

**2703.10.4.3 Exhaust connections and plenums of combustible workstations.** Automatic fire-extinguishing system protection for exhaust connections and plenums of combustible workstations shall comply with Section 2703.10.1.1.

**2703.10.4.4 Exhaust duct sprinkler system requirements.** Automatic sprinklers installed in exhaust duct systems shall be hydraulically designed to provide 0.5 gallons per minute (gpm) (1.9 L/min) over an area derived by multiplying the distance between the sprinklers in a horizontal duct by the width of the duct. Minimum discharge shall be 20 gpm (76 L/min) per sprinkler from the five hydraulically most remote sprinklers.

**2703.10.4.4.1 Sprinkler head locations.** Automatic sprinklers shall be installed at 12-foot (3658 mm) intervals in horizontal ducts and at changes in direction. In vertical runs, automatic sprinklers shall be installed at the top and at alternate floor levels.

**2703.10.4.4.2 Control valve.** A separate indicating control valve shall be provided for sprinklers installed in exhaust ducts.

**2703.10.4.4.3 Drainage.** Drainage shall be provided to remove sprinkler water discharged in exhaust ducts.

**2703.10.4.4.4 Corrosive atmospheres.** Where corrosive atmospheres exist, exhaust duct sprinklers and pipe fittings shall be manufactured of corrosion-resistant materials or coated with *approved* materials.

**2703.10.4.4.5 Maintenance and inspection.** Access to sprinklers in exhaust ducts shall be provided for periodic inspection and maintenance.

**2703.10.5 Sprinkler alarms and supervision.** *Automatic sprinkler systems* shall be electrically supervised and provided with alarms in accordance with Chapter 9. *Automatic sprinkler system* alarm and supervisory signals shall be transmitted to the *emergency control station*.

**2703.11 Manual fire alarm system.** A manual fire alarm system shall be installed throughout buildings containing a Group H-5 occupancy. Activation of the alarm system shall initiate a local alarm and transmit a signal to the *emergency control station*. Manual fire alarm systems shall be designed and installed in accordance with Section 907.

**2703.12 Emergency alarm system.** Emergency alarm systems shall be provided in accordance with Sections 2703.12.1 through 2703.12.3, Section 5004.9 and Section 5005.4.4. The *maximum allowable quantity per control area* provisions of Section 5004.1 shall not apply to emergency alarm systems required for HPM.

**2703.12.1 Where required.** Emergency alarm systems shall be provided in the areas indicated in Sections 2703.12.1.1 through 2703.12.1.3.

**2703.12.1.1 Service corridors.** An *approved* emergency alarm system shall be provided in service corridors, with not less than one alarm device in the service corridor.

**2703.12.1.2 Corridors and interior exit stairways and ramps.** Emergency alarms for *corridors*, interior *exit stairways* and *ramps* and exit passageways shall comply with Section 5005.4.4.

**2703.12.1.3 Liquid storage rooms, HPM rooms and gas rooms.** Emergency alarms for liquid storage rooms, HPM rooms and gas rooms shall comply with Section 5004.9.

**2703.12.2 Alarm-initiating devices.** An *approved* emergency telephone system, local alarm manual pull stations, or other *approved* alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.

**2703.12.3 Alarm signals.** Activation of the emergency alarm system shall sound a local alarm and transmit a signal to the *emergency control station*.

**2703.13 Gas detection systems.** A gas detection system complying with Section 916 shall be provided for HPM gases where the physiological warning threshold level of the gas is at a higher level than the accepted permissible exposure limit (PEL) for the gas and for flammable gases in accordance with Sections 2703.13.1 through 2703.13.2.2.

**2703.13.1 Where required.** A gas detection system shall be provided in the areas identified in Sections 2703.13.1.1 through 2703.13.1.4.

**2703.13.1.1 Fabrication areas.** A gas detection system shall be provided in *fabrication areas* where HPM gas is used in the *fabrication area*.

**2703.13.1.2 HPM rooms.** A gas detection system shall be provided in HPM rooms where HPM gas is used in the room.

**2703.13.1.3 Gas cabinets, exhausted enclosures and gas rooms.** A gas detection system shall be provided in gas cabinets and exhausted enclosures for HPM gas. A gas detection system shall be provided in gas rooms where HPM gases are not located in gas cabinets or exhausted enclosures.

**2703.13.1.4 Corridors.** Where HPM gases are transported in piping placed within the space defined by the walls of a *corridor* and the floor or roof above the *corridor*, a gas detection system shall be provided where piping is located and in the *corridor*.

**Exception:** A gas detection system is not required for occasional transverse crossings of the *corridors* by supply piping that is enclosed in a ferrous pipe or tube for the width of the *corridor*.

**2703.13.2 Gas detection system operation.** The gas detection system shall be capable of monitoring the room, area or equipment in which the HPM gas is located at or below all the following gas concentrations:

1. Immediately dangerous to life and health (IDLH) values where the monitoring point is within an exhausted enclosure, ventilated enclosure or gas cabinet.
2. Permissible exposure limit (PEL) levels where the monitoring point is in an area outside an exhausted enclosure, ventilated enclosure or gas cabinet.
3. For flammable gases, the monitoring detection threshold level shall be vapor concentrations in excess of 25 percent of the lower flammable limit (LFL) where the monitoring is within or outside an exhausted enclosure, ventilated enclosure or gas cabinet.
4. Except as noted in this section, monitoring for highly toxic and toxic gases shall also comply with Chapter 60.

**2703.13.2.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to the *emergency control station* when a short-term hazard condition is detected. The alarm shall be both visible and audible and shall provide warning both inside and outside the area where the gas is detected. The audible alarm shall be distinct from all other alarms.

**2703.13.2.2 Shut off of gas supply.** The gas detection system shall automatically close the shutoff valve at the source on gas supply piping and tubing related to the system being monitored for which gas is detected when a short-term hazard condition is detected. Automatic closure of shutoff valves shall comply with the following:

1. Where the gas-detection sampling point initiating the gas detection system alarm is within a gas cabinet or exhausted enclosure, the shutoff valve in the gas cabinet or exhausted enclosure for the specific gas detected shall automatically close.
2. Where the gas-detection sampling point initiating the gas detection system alarm is within a room and *compressed gas* containers are not in gas cabinets or exhausted enclosure, the shutoff valves on all gas lines for the specific gas detected shall automatically close.
3. Where the gas-detection sampling point initiating the gas detection system alarm is within a piping distribution manifold enclosure, the shutoff valve supplying the manifold for the *compressed gas* container of the specific gas detected shall automatically close.

**Exception:** Where the gas-detection sampling point initiating the gas detection system alarm is at the use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve for the branch line located in the piping distribution manifold enclosure shall automatically close.

**2703.14 Exhaust ventilation systems for HPM.** Exhaust ventilation systems and materials for exhaust ducts utilized for the exhaust of HPM shall comply with Sections 2703.14.1 through 2703.14.3, other applicable provisions of this code, the *International Building Code* and the *International Mechanical Code*.

**2703.14.1 Where required.** Exhaust ventilation systems shall be provided in the following locations in accordance with the requirements of this section and the *International Building Code*:

1. *Fabrication areas:* Exhaust ventilation for *fabrication areas* shall comply with the *International Building Code*. The *fire code official* is authorized to require additional manual control switches.
2. *Workstations:* A ventilation system shall be provided to capture and exhaust gases, fumes and vapors at workstations.
3. *Liquid storage rooms:* Exhaust ventilation for liquid storage rooms shall comply with Section 5004.3.1 and the *International Building Code*.
4. *HPM rooms:* Exhaust ventilation for HPM rooms shall comply with Section 5004.3.1 and the *International Building Code*.
5. *Gas cabinets:* Exhaust ventilation for gas cabinets shall comply with Section 5003.8.6.2. The gas cabinet ventilation system is allowed to connect to a workstation ventilation system. Exhaust ventilation for gas cabinets containing highly toxic or toxic gases shall also comply with Chapter 60.
6. *Exhausted enclosures:* Exhaust ventilation for exhausted enclosures shall comply with Section 5003.8.5.2. Exhaust ventilation for exhausted enclosures containing highly toxic or toxic gases shall also comply with Chapter 60.
7. *Gas rooms:* Exhaust ventilation for gas rooms shall comply with Section 5003.8.4.2. Exhaust ventilation for gas rooms containing highly toxic or toxic gases shall also comply with Chapter 60.
8. *Cabinets containing pyrophoric liquids or Class 3 water-reactive liquids:* Exhaust ventilation for cabinets in *fabrication areas* containing pyrophoric liquids or Class 3 water-reactive liquids shall be as required in Section 2705.2.3.4.

**2703.14.2 Penetrations.** Exhaust ducts penetrating *fire barriers* constructed in accordance with Section 707 of the *International Building Code* or *horizontal assemblies* constructed in accordance with Section 711 of the *International Building Code* shall be contained in a shaft of equivalent fire-resistance-rated construction. Exhaust ducts shall not penetrate *fire walls*. Fire dampers shall not be installed in exhaust ducts.

**2703.14.3 Treatment systems.** Treatment systems for highly toxic and toxic gases shall comply with Chapter 60.

**2703.15 Emergency power system.** An emergency power system shall be provided in Group H-5 occupancies in accordance with Section 1203. The emergency power system shall supply power automatically to the electrical systems specified in Section 2703.15.1 when the normal supply system is interrupted.

**2703.15.1 Required electrical systems.** Emergency power shall be provided for electrically operated equipment and connected control circuits for the following systems:

1. HPM exhaust ventilation systems.
2. HPM gas cabinet ventilation systems.
3. HPM exhausted enclosure ventilation systems.
4. HPM gas room ventilation systems.
5. HPM gas detection systems.
6. Emergency alarm systems.
7. Manual fire alarm systems.
8. *Automatic sprinkler system* monitoring and alarm systems.
9. Automatic alarm and detection systems for pyrophoric liquids and Class 3 water-reactive liquids required in Section 2705.2.3.4.
10. Flow alarm switches for pyrophoric liquids and Class 3 water-reactive liquids cabinet exhaust ventilation systems required in Section 2705.2.3.4.
11. Electrically operated systems required elsewhere in this code or in the *International Building Code* applicable to the use, storage or handling of HPM.

**2703.15.2 Exhaust ventilation systems.** Exhaust ventilation systems are allowed to be designed to operate at not less than one-half the normal fan speed on the emergency power system where it is demonstrated that the level of exhaust will maintain a safe atmosphere.

**2703.16 Sub-atmospheric pressure gas systems.** Sub-atmospheric pressure gas systems (SAGS) shall be in accordance with NFPA 318.

## SECTION 2704 STORAGE

**2704.1 General.** Storage of hazardous materials shall comply with Section 2703 and this section and other applicable provisions of this code.

**2704.2 Fabrication areas.** Hazardous materials storage and the maximum quantities of hazardous materials in use and storage allowed in *fabrication areas* shall be in accordance with Sections 2704.2.1 through 2704.2.2.1.

**2704.2.1 Location of HPM storage in fabrication areas.** Storage of HPM in *fabrication areas* shall be within *approved or listed* storage cabinets, gas cabinets, exhausted enclosures or within a workstation as follows:

1. Flammable and *combustible liquid* storage cabinets shall comply with Section 5704.3.2.
2. Hazardous materials storage cabinets shall comply with Section 5003.8.7.
3. Gas cabinets shall comply with Section 5003.8.6. Gas cabinets for highly toxic or toxic gases shall also comply with Section 6004.1.2.
4. Exhausted enclosures shall comply with Section 5003.8.5. Exhausted enclosures for highly toxic or toxic gases shall also comply with Section 6004.1.3.
5. Workstations shall comply with Section 2705.2.3.

**2704.2.2 Maximum aggregate quantities in fabrication areas.** The aggregate quantities of hazardous materials stored or used in a single *fabrication area* shall be limited as specified in this section.

**Exception:** *Fabrication areas* containing quantities of hazardous materials not exceeding the maximum allowable quantities per *control area* established by Sections 5003.1.1, 5704.3.4 and 5704.3.5.

**2704.2.2.1 Storage and use in fabrication areas.** The maximum quantities of hazardous materials stored or used in a single *fabrication area* shall not exceed the quantities set forth in Table 2704.2.2.1.

**TABLE 2704.2.2.1  
QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN GROUP H-5<sup>a</sup>**

HAZARD CATEGORY	SOLIDS (pounds/square foot)	LIQUIDS (gallons/square foot)	GAS (cubic feet @ NTP/square foot)
<b>Physical-hazard materials</b>			
Combustible dust	Note b	Not Applicable	Not Applicable
Combustible fiber Loose Baled	Note b Notes b and c	Not Applicable	Not Applicable
Combustible liquid Class II Class IIIA Class IIIB Combination Class I, II and IIIA	Not Applicable	0.01 0.02 Not Limited 0.04	Not Applicable
Cryogenic gas Flammable Oxidizing	Not Applicable	Not Applicable	Note d 1.25
Explosives	Note b	Note b	Note b
Flammable gas Gaseous Liquefied	Not Applicable	Not Applicable	Note d Note d
Flammable liquid Class IA Class IB Class IC Combination Class IA, IB and IC Combination Class I, II and IIIA	Not Applicable	0.0025 0.025 0.025 0.025 0.04	Not Applicable
Flammable solid	0.001	Not Applicable	Not Applicable
Organic peroxide Unclassified detonable Class I Class II Class III Class IV Class V	Note b Note b 0.025 0.1 Not Limited Not Limited	Not Applicable	Not Applicable
Oxidizing gas Gaseous Liquefied Combination of Gaseous and Liquefied	Not Applicable	Not Applicable	1.25 1.25 1.25
Oxidizer Class 4 Class 3 Class 2 Class 1 Combination oxidizer Class 1, 2, 3	Note b 0.003 0.003 0.003 0.003	Note b 0.03 0.03 0.03 0.03	Not Applicable
Pyrophoric	0.01	0.00125	Notes d and e
Unstable reactive Class 4 Class 3 Class 2 Class 1	Note b 0.025 0.1 Not Limited	Note b 0.0025 0.01 Not Limited	Note b Note b Note b Not Limited

(continued)

**TABLE 2704.2.2.1—continued**  
**QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN GROUP H-5<sup>a</sup>**

HAZARD CATEGORY	SOLIDS (pounds/square foot)	LIQUIDS (gallons/square foot)	GAS (cubic feet @ NTP/square foot)
<b>Physical-hazard materials</b>			
Water reactive			
Class 3	Note b	0.00125	Not
Class 2	0.25	0.025	Applicable
Class 1	Not Limited	Not Limited	
<b>Health-hazard materials</b>			
Corrosives	Not Limited	Not Limited	Not Limited
Highly toxics	Not Limited	Not Limited	Note d
Toxics	Not Limited	Not Limited	Note d

For SI: 1 pound per square foot = 4.882 kg/m<sup>2</sup>, 1 gallon per square foot = 40.7 L/m<sup>2</sup>, 1 cubic foot @ NTP/square foot = 0.305 m<sup>3</sup> @ NTP/m<sup>2</sup>, 1 cubic foot = 0.02832 m<sup>3</sup>.

- a. Hazardous materials within piping shall not be included in the calculated quantities.
- b. Quantity of hazardous materials in a single fabrication area shall not exceed the maximum allowable quantities per control area in Tables 5003.1.1(1) and 5003.1.1(2).
- c. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
- d. The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed the greater of 0.2 cubic feet at NTP/square foot or 9,000 cubic feet at NTP.
- e. The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 5003.8.2.

**2704.3 Indoor storage outside of fabrication areas.** The indoor storage of hazardous materials outside of *fabrication areas* shall be in accordance with Sections 2704.3.1 through 2704.3.3.

**2704.3.1 HPM storage.** The indoor storage of HPM in quantities greater than those *listed* in Sections 5003.1.1 and 5704.3.4 shall be in a room complying with the requirements of the *International Building Code* and this code for a liquid storage room, HPM room or gas room as appropriate for the materials stored.

**2704.3.2 Other hazardous materials storage.** The indoor storage of other hazardous materials shall comply with Sections 5001, 5003 and 5004 and other applicable provisions of this code.

**2704.3.3 Separation of incompatible hazardous materials.** Incompatible hazardous materials in storage shall be separated from each other in accordance with Section 5003.9.8.

## SECTION 2705 USE AND HANDLING

**2705.1 General.** The use and handling of hazardous materials shall comply with this section, Section 2703 and other applicable provisions of this code.

**2705.2 Fabrication areas.** The use of hazardous materials in *fabrication areas* shall be in accordance with Sections 2705.2.1 through 2705.2.3.4.

**2705.2.1 Location of HPM in use in fabrication areas.** Hazardous production materials in use in *fabrication areas* shall be within *approved* or *listed* gas cabinets, exhausted enclosures or a workstation.

**2705.2.2 Maximum aggregate quantities in fabrication areas.** The aggregate quantities of hazardous materials in a single *fabrication area* shall comply with Section 2704.2.2, and Table 2704.2.2.1. The quantity of HPM in use at a workstation shall not exceed the quantities *listed* in Table 2705.2.2.



**TABLE 2705.2.2  
MAXIMUM QUANTITIES OF HPM AT A WORKSTATION<sup>d</sup>**

HPM CLASSIFICATION	STATE	MAXIMUM QUANTITY
Flammable, highly toxic, pyrophoric and toxic combined	Gas	Combined aggregate volume of all cylinders at a workstation shall not exceed an internal cylinder volume of 39.6 gallons or 5.29 cubic feet
Flammable	Liquid Solid	15 gallons <sup>a, b</sup> 5 pounds <sup>a, b</sup>
Corrosive	Gas  Liquid  Solid	Combined aggregate volume of all cylinders at a workstation shall not exceed an internal cylinder volume of 39.6 gallons or 5.29 cubic feet  Use-open system: 25 gallons <sup>b</sup> Use-closed system: 150 gallons <sup>b, e</sup>  20 pounds <sup>a, b</sup>
Highly toxic	Liquid Solid	15 gallons <sup>a</sup> 5 pounds <sup>a</sup>
Oxidizer	Gas  Liquid  Solid	Combined aggregate volume of all cylinders at a workstation shall not exceed an internal cylinder volume of 39.6 gallons or 5.29 cubic feet  Use-open system: 12 gallons <sup>b</sup> Use-closed system: 60 gallons <sup>b</sup>  20 pounds <sup>a, b</sup>
Pyrophoric	Liquid Solid	0.5 gallon <sup>c, f</sup> 4.4 pounds <sup>c, f</sup>
Toxic	Liquid  Solid	Use-open system: 15 gallons <sup>b</sup> Use-closed system: 60 gallons <sup>b</sup>  5 pounds <sup>a, b</sup>
Unstable reactive Class 3	Liquid Solid	0.5 gallon <sup>a, b</sup> 5 pounds <sup>a, b</sup>
Water-reactive Class 3	Liquid Solid	0.5 gallon <sup>c, f</sup> See Table 2704.2.2.1

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L.

- Maximum allowable quantities shall be increased 100 percent for closed system operations. Where Note b applies, the increase for both notes shall be allowed.
- Quantities shall be allowed to be increased 100 percent where workstations are internally protected with an approved automatic fire-extinguishing or suppression system complying with Chapter 9. Where Note a applies, the increase for both notes shall be allowed. Where Note e applies, the maximum increase allowed for both Notes b and e shall not exceed 100 percent.
- Allowed only in workstations that are internally protected with an approved automatic fire-extinguishing or fire protection system complying with Chapter 9 and compatible with the reactivity of materials in use at the workstation.
- The quantity limits apply only to materials classified as HPM.
- Quantities shall be allowed to be increased 100 percent for nonflammable, noncombustible corrosive liquids where the materials of construction for workstations are listed or approved for use without internal fire-extinguishing or suppression system protection. Where Note b applies, the maximum increase allowed for both Notes b and e shall not exceed 100 percent.
- A maximum quantity of 5.3 gallons of liquids and 44 pounds of total liquids and solids shall be allowed at a workstation where conditions are in accordance with Section 2705.2.3.4.

**2705.2.3 Workstations.** Workstations in *fabrication areas* shall be in accordance with Sections 2705.2.3.1 through 2705.2.3.4.

**2705.2.3.1 Construction.** Workstations in *fabrication areas* shall be constructed of materials compatible with the materials used and stored at the workstation. The portion of the workstation that serves as a cabinet for HPM gases, Class I flammable liquids or Class II or Class IIIA *combustible liquids* shall be noncombustible and, if of metal, shall be not less than 0.0478-inch (18 gage) (1.2 mm) steel.

**2705.2.3.2 Protection of vessels.** Vessels containing hazardous materials located in or connected to a workstation shall be protected as follows:

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1. HPM: Vessels containing HPM shall be protected from physical damage and shall not project from the workstation.
2. Hazardous *cryogenic fluids*, gases and liquids: Hazardous *cryogenic fluid*, gas and liquid vessels located within a workstation shall be protected from seismic forces in an *approved* manner in accordance with the *International Building Code*.
3. *Compressed gases*: Protection for *compressed gas* vessels shall also comply with Section 5303.5.
4. *Cryogenic fluids*: Protection for *cryogenic fluid* vessels shall also comply with Section 5503.5.

**2705.2.3.3 Drainage and containment for HPM liquids.** Each workstation utilizing HPM liquids shall have all of the following:

1. Drainage piping systems connected to a compatible system for disposition of such liquids.
2. The work surface provided with a slope or other means for directing spilled materials to the containment or drainage system.
3. An *approved* means of containing or directing spilled or leaked liquids to the drainage system.

**2705.2.3.4 Pyrophoric solids, liquids and Class 3 water-reactive liquids.** Pyrophoric liquids and Class 3 water-reactive liquids in containers greater than 0.5-gallon (2 L) but not exceeding 5.3-gallon (20 L) capacity and pyrophoric solids in containers greater than 4.4 pounds (2 kg) but not exceeding 44 pounds (20 kg) shall be allowed at workstations where located inside cabinets and the following conditions are met:

1. Maximum amount per cabinet: The maximum amount per cabinet shall be limited to 5.3 gallons (20 L) of liquids and 44 pounds (20 kg) of total liquids and solids.
2. Cabinet construction: Cabinets shall be constructed in accordance with the following:
  - 2.1. Cabinets shall be constructed of not less than 0.097-inch (2.5 mm) (12 gage) steel.
  - 2.2. Cabinets shall be permitted to have self-closing limited access ports or noncombustible windows that provide access to equipment controls.
  - 2.3. Cabinets shall be provided with self- or manual-closing doors. Manual-closing doors shall be equipped with a door switch that will initiate local audible and visual alarms when the door is in the open position.
3. Cabinet exhaust ventilation system: An exhaust ventilation system shall be provided for cabinets and shall comply with the following:
  - 3.1. The system shall be designed to operate at a negative pressure in relation to the surrounding area.
  - 3.2. The system shall be equipped with monitoring equipment to ensure that required exhaust flow or static pressure is provided.
  - 3.3. Low-flow or static pressure conditions shall send an alarm to the on-site emergency control station. The alarm shall be both visual and audible.
4. Cabinet spill containment: Spill containment shall be provided in each cabinet, with the spill containment capable of holding the contents of the aggregate amount of liquids in containers in each cabinet.
5. Valves: Valves in supply piping between the product containers in the cabinet and the workstation served by the containers shall fail in the closed position upon power failure, loss of exhaust ventilation and upon actuation of the fire control system.
6. Fire detection system: Each cabinet shall be equipped with an automatic fire detection system complying with the following conditions:
  - 6.1. Automatic detection system: UV/IR, high-sensitivity smoke detection (HSSD) or other *approved* detection systems shall be provided inside each cabinet.
  - 6.2. Automatic shutoff: Activation of the detection system shall automatically close the shutoff valves at the source on the liquid supply.
  - 6.3. Alarms and signals: Activation of the detection system shall initiate a local alarm within the *fabrication area* and transmit a signal to the *emergency control station*. The alarms and signals shall be both visual and audible.

**2705.3 Transportation and handling.** The transportation and handling of hazardous materials shall comply with Sections 2705.3.1 through 2705.3.4.1 and other applicable provisions of this code.

**2705.3.1 Corridors and enclosures for stairways and ramps.** *Corridors* and enclosures for *exit stairways* and *ramps* in new buildings or serving new *fabrication areas* shall not contain HPM, except as permitted in *corridors* by Section 415.11.6.4 of the *International Building Code* and Section 2705.3.2 of this code.

**2705.3.2 Transport in corridors and enclosures for stairways and ramps.** Transport in *corridors* and enclosures for *stairways* and *ramps* shall be in accordance with Sections 2705.3.2.1 through 2705.3.3.

**2705.3.2.1 Fabrication area alterations.** Where existing *fabrication areas* are altered or modified in existing buildings, HPM is allowed to be transported in existing *corridors* where such *corridors* comply with Section 5003.10 of this code and Section 415.11.2 of the *International Building Code*.

**2705.3.2.2 HPM transport in corridors and enclosures for stairways and ramps.** Nonproduction HPM is allowed to be transported in *corridors* and enclosures for *stairways* and *ramps* where utilized for maintenance, lab work and testing when the transportation is in accordance with Section 5003.10.

**2705.3.3 Service corridors.** Where a new *fabrication area* is constructed, a service corridor shall be provided where it is necessary to transport HPM from a liquid storage room, HPM room, gas room or from the outside of a building to the perimeter wall of a *fabrication area*. Service corridors shall be designed and constructed in accordance with the *International Building Code*.

**2705.3.4 Carts and trucks.** Carts and trucks used to transport HPM in *corridors* and enclosures for *stairways* and *ramps* shall comply with Section 5003.10.3.

**2705.3.4.1 Identification.** Carts and trucks shall be marked to indicate the contents.

