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# **Examination Standard for Storage Cabinets for Ignitable (Flammable or Combustible) Liquids**

**Class Number 6050**

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# Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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# 1. INTRODUCTION

## 1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for cabinets used to store ignitable (flammable or combustible) liquids.
- 1.1.2 Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

## 1.2 Scope

- 1.2.1 This standard sets performance and construction requirements for storage cabinets for ignitable (flammable or combustible) liquids.

## 1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, and loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of storage cabinets for the purpose of obtaining certification. Storage cabinets having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

## 1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
  - the suitability of the product;
  - the performance of the product as specified by the manufacturer and required for certification;
  - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.
- 1.4.3 This standard includes the option of recognizing any cabinet that has met all the requirements of the latest version of the EN14470 Standard, Part 1 only, with the following stipulations:
  - a) the cabinet must pass a load test per FM Approvals Examination Standard 6050;
  - b) flame arrester assemblies must pass the requirements of FM Approvals Examination Standard 6050;
  - c) a representative from the certification agency must be present to witness tests in their entirety.

Note: Part 2 of the EN14470 Standard is not included nor covered in this standard.

- 1.4.4 Cabinets submitted for certification that are to be tested in accordance with the latest version of the EN14470 standard must be performed at a facility capable of meeting all testing requirements per the latest version of the EN14470 Standard. The lab must have an active relationship with the certification agency and be ISO 17025 certified or have been certified at the time of the testing.
- 1.4.5 The following must be submitted in order to gain recognition from the certification agency of cabinets tested to the EN14470 Standard:
- 1.4.5.1 Submittal of a signed formal report describing which cabinets were tested and have met the minimum requirements of the latest version of the EN 14470 Standard. The report must include and not limited to the following as outlined in Section A.6 of the latest version of the EN14470 Standard:
- fire rating for each cabinet for which certification is being sought;
  - testing facility name and location;
  - which tests were performed;
  - and all other requirements as outlined in Section A.6 of the latest version of the EN14470 Standard.
- 1.4.5.2 Documentation describing the cabinet regarding to its size, capacity, door style, material selection and method of automatic closing must be submitted for our review and evaluation.
- 1.4.5.3 Assembly drawings showing cabinet and door construction, material thickness and self-closing door mechanism. Other detailed information may be requested, if deemed necessary.

## 1.5 Basis for Continued Certification

The basis for continual certification may include the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

## 1.6 Effective Date

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

## 1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

## 1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies:

American Society for Testing and Materials (ASTM International) Standards:

- ASTM E119: Standard Test Method for Fire Tests of Building Construction Materials

European Standards:

- EN 14470 Fire Safety Storage Cabinets; part 1 Safety storage cabinets for flammable liquids

## 1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

*Bi-fold doors* - Sliding doors with a continuous piano hinge guided by a track guidance system

*Flame Arrester* - A device which prevents a flame from progressing through a flammable gas/air mixture. The flame is quenched on the surfaces of a series of heat sinks through which the flame must pass. The emerging gases are sufficiently cooled to prevent re-ignition.

*Fusible link* - The fusible type link consists of two nickel alloy or steel plates joined together by a solder alloy. The solder melts at a predetermined temperature allowing the plates to separate at a specific temperature.

*Ground Connection* - A threaded connection allowing a ground wire to be installed to reduce static electricity build up.

*Ignitable (flammable or combustible) Liquids Cabinet* - A cabinet to contain hazardous chemicals to reduce the risk of fire.

*Self-Closing Door* - Self-indexing, self-latching and self closes to automatically close the doors upon release.

*Shelves* - Cabinet shelves structurally support the containers being stored in the cabinet

*Sump area* - A liquid tight containment at the inside bottom of the cabinet designed to retain spills.

*Vent bung cap* - Cabinets supplied with 2" NPT vent holes are supplied with vent bung cap to keep the holes sealed unless 2" pipe is attached for venting vapors.

## **2. GENERAL INFORMATION**

### **2.1 Product Information**

Ignitable (flammable or combustible) liquid cabinets may be supplied in capacities ranging from 4 gallon (15 L) to 120 gallon (454 L) capacities. Other cabinet capacities (less than 4 gallons [15 L]) may be considered if they meet the intent of this standard. Depending on the physical size of the cabinet, the cabinets are supplied with various door configurations. These doors can be manual closing or self-closing style. Ignitable (flammable or combustible) liquid cabinets are supplied in various colors depending on which products are being stored in the unit, where applicable.

### **2.2 Certification Application Requirements**

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures, and
- the number and location of manufacturing facilities

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

### **2.3 Requirements for Samples for Examination**

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency following review of the preliminary information.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the product.

### 3. GENERAL REQUIREMENTS

#### 3.1 Maximum Capacity

Storage capacity of a cabinet for ignitable (flammable or combustible) liquids shall not exceed 120 gallons (455 L). This requirement is applicable for cabinets seeking certification for both FM Approvals Examination Standard 6050 and recognized by the latest version of the EN14470 Standard.

#### 3.2 Construction Requirements for FM Approvals Examination Standard 6050

##### 3.2.1 Requirements

- A. Cabinet doors must be equipped with a lockable latching mechanism. A separate latching system is not required for both doors of two door models if one of the doors is designed to secure both doors in the closed position.
- B. Cabinets shall be equipped with a leak-tight spill containment sump or pan not less than 2 in. (51 mm) deep.
- C. Cabinets may be equipped with upper and lower side vents, or vents located on the top portion of the cabinet. Upper and lower vents in the rear wall are allowed in those instances where the cabinet is designed for applications that would render side vents ineffective, typically under-counter laboratory use. All vents shall be equipped with a flame arrester assembly and a means of plugging the vents externally.
- D. A means shall be provided for attaching a separate grounding wire to the exterior of the cabinet. The attachment means shall be such that the cabinet finish does not interfere with the establishment of a proper ground. This requirement applies to steel cabinets only.

##### 3.2.2 Verification

The manufacturer shall provide drawings related to the construction of the cabinet and cabinet door(s); hinging, latching, and locking provisions; self-closing, hold-open, and release provisions (if so equipped); and the flame arrester assembly. In addition, drawings of all labels and the certification agency's mark of conformity shall be provided, including information as to their location. Sample cabinets shall be examined for conformance to the manufacturer's drawings and specifications and the certification agency's requirements. If certification is granted, all drawings shall state in bold print that any revisions require the certification agency's approval prior to implementation.

##### 3.2.3 Construction Requirements to the latest version of the EN14470 Standard.

###### 3.2.3.1 Requirements

All cabinets seeking recognition based on the latest version of the EN14470 Standard must meet the construction requirements as outlined in Section 5 of that standard.

#### 3.3 Markings

##### 3.3.1 Marking on the product shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, size, rating, capacity, etc., as appropriate;
- the conspicuous legend: FLAMMABLES – KEEP FIRE AWAY

When hazard warnings are needed, the markings should be universally recognizable.

- 3.3.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.
- 3.3.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.
- 3.3.4 In addition to all the required certification agency markings, all certified EN 14470 cabinets must be labeled per the requirements of Section 8 of EN14470 standard and must include but not limited to the following:
- Fire resistance capability, specified in minutes eg: 15, 30, 60 or 90
  - Model number and year of production
  - Appropriate warning sign
  - Maximum volume of single container
- 3.3.5 All markings shall be legible and durable.

### **3.4 Manufacturer's Installation and Operation Instructions**

- 3.4.1 The manufacturer shall provide the user with:
- prepare instructions for the installation, maintenance, and operation of the product;
  - provide facilities for repair of the product and supply replacement parts, if applicable; and provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

### **3.5 Calibration**

- 3.5.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.
- 3.5.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

## 4. PERFORMANCE REQUIREMENTS

### 4.1 Loading

#### 4.1.1 Requirement

Cabinets shall withstand the load imposed by their maximum storage capacity.

#### 4.1.2 Test/Verification

The cabinets shall be loaded with an equally distributed 8 lbs (3.6 kg) of concrete blocks per gallon of rated capacity. After remaining shut for 72 hours, the cabinets shall not exhibit any permanent deformation or malfunction of the door opening and closing mechanism.

### 4.2 Fire Exposure

#### 4.2.1 Requirement

Cabinets shall withstand exposure to fire in accordance with the ASTM E119 time temperature curve.

#### 4.2.2 Test/Verification

A corrugated sheet metal baffle shall enclose the cabinet at a distance of 1 ft (305 mm) all around and at least 1 ft (305 mm) above the final cabinet height. The baffle shall have legs to provide a gap of 8-12 in. (203-305 mm) at the bottom to allow airflow. The cabinet shall be mounted on concrete blocks and surrounded with a piping loop manifold containing the required number of oil burner type nozzles. The cabinet shall be loaded with concrete blocks per the Loading test procedure in Section 4.1.2.

One 3 gal/h (11L/h) – 80° hollow cone oil burner type nozzle shall be used for every 18 in. of perimeter, with no fewer than five nozzles in total – two at the rear of the cabinet, one at each of the other sides. If an odd number of nozzles is required then the odd nozzle shall be at the rear of the cabinet. For example, if 7 nozzles are required, 3 shall be placed at the rear, 2 at the front, and 1 on each side.

A hole shall be drilled through the center of the top of the cabinet to allow for a thermocouple to be placed 1 in. (25 mm) below the top of the cabinet. Non-combustible material shall be used to seal the hole with the thermocouple in proper position. Two or three other thermocouples shall be placed at the back of the cabinet, even with the top edge of the cabinet and in the middle of the air space between the cabinet and the baffle. Spacing between these thermocouples should be such that each are directly over the manifold nozzle. A grating shall then be placed over the top of the baffle enclosure with a piece of sheet metal on top of the grating.

Using cotton wicks soaked in isopropyl alcohol to ignite the nozzles, the fire temperature shall be kept as close as possible to the ASTM E119 time-temperature curve for the 10 minute test period. At any point during the test, the interior temperature of the fire cabinet shall not exceed 325°F (163°C). The cabinet must remain upright and not exhibit any open seams, joints or doors.

### 4.3 Flame Arresters

#### 4.3.1 Requirement

Flame arresters shall prevent a flame from progressing through a flammable gas/air mixture.

#### 4.3.2 Test/Verification

Flame arresters, unless previously certified, shall be subjected to a fire exposure test within a controlled environment. A minimum of five tests shall be conducted on the flame arrester. A 16 in. (406 mm) diameter steel cylinder shall be placed on a table. The cylinder shall have a gas in and gas out connection point. A Swagelok fuel inlet valve shall be attached to the gas in propane supply line which is then attached to the flame arrester fixture. A Swagelok valve used for gas out shall be connected from the test fixture to a gas analyzer and an exhaust line.

Using a pipe tee connection, thread the Type K thermocouple through the exhaust line and into the flame arrester test fixture. The thermocouple bulb should be located near the spark plug. The flame arrester and the spark plug cable shall be connected to the test fixture, and the spark plug shall be connected to the grounding connection. A plastic sheet shall be placed over the open top of the cylinder and secured to the steel fixture with a rubber band and clamp.

With the exhaust valve closed the propane gas line shall be opened with a 4-4.2% air mixture, with airflow set at 130 lpm. Once the mixture has stabilized the exhaust valve shall be opened and the spark plug shall be energized simultaneously. Ignition should be confirmed from the temperature plot. If ignition is not confirmed the procedure shall be repeated. Explosion of the plastic sheet during any of the five tests indicates a failure of the flame arrester.

### 4.4 Self-Closing/Latching Operation

#### 4.4.1 Requirement

The cabinet may be equipped with a self-closing mechanism. On two door models, a sequencing mechanism may be required so that one door closes prior to the other. Cabinets equipped with self-closing doors shall close and latch properly during and after a cycling test.

#### 4.4.2 Test/Verification

The cabinets shall be loaded with an equally distributed 8 lbs (3.6 kg) of concrete blocks per gallon of rated capacity. The cabinet door(s) shall be held in the open most position and then released in order to freely close. The process shall be repeated for 100 cycles and the door(s) shall close and latch properly each time.

### 4.5 Release Operating Temperature

#### 4.5.1 Requirement

On cabinets equipped with self-closing doors, the door assembly shall also self-latch. If a means for holding the door(s) open is provided, this device shall automatically release the doors in the event of a fire or exposure to excessive heat. The device shall release the closing mechanism when exposed to a temperature of 212°F (100°C) or less. The mechanism for holding the doors in the open position shall either be a certified fire door link, used within its load range, or shall release properly when subjected to the heat release test.

#### 4.5.2 Test/Verification

A minimum of five samples of the heat-sensitive device used in the door holding mechanism shall be tested to determine the actual release temperature. The heat-sensitive device shall be connected to an aluminum fixture that allows for weight to be attached. The aluminum fixture shall be placed in a bowl with an immersion heater and a water agitator. The bowl shall be filled with water such that the heat sensitive device is submerged with the help of the weight.

A thermocouple shall be placed in the water and connected to a fluke meter to read the temperature

of the water. The immersion heater and water agitator shall be turned on. The immersion heater must be set to a temperature 20°F less than the heat-sensitive device's rated release temperature and left to stabilize for 5 minutes. The temperature programmer shall be set to increase 1°F per minute until the device releases.

There shall be no failure to release within -10 percent to +5 percent of the specified release temperature when exposed to a heat source.

#### 4.6 Spill Containment

##### 4.6.1 Requirement

The spill containment sump or pan shall be at least 2 in. (51 mm) deep and shall be leak-tight.

##### 4.6.2 Test/Verification

The spill containment sump or pan shall be measured to confirm a depth of at least 2 in. (51 mm). The sump or pan shall be filled with water until the water level reaches the top lip of the sump or pan area. After 24 hours the spill containment sump or pan shall show no signs of leakage.

#### 4.7 Fire Exposure Test- Self-Closing Doors

##### 4.7.1 Requirement

The doors will be held in the fully open position, exposed to a fire. The doors will close and latch after being exposed to this fire.

##### 4.7.2 Test/Verification

The cabinet will be subjected to 1 minute fire exposure test. A heptane basin measuring 1.5 in. (38 mm) deep by 6 in. (12 mm) wide by 12 in. (305 mm) longer than the cabinet width shall be centered in front of the open doors of the test cabinet, with both the basin and cabinet sitting on a piece of gypsum board. The three sides of the cabinet with no doors shall be surrounded by a non-combustible sheathing or welding curtains that extend 12 in. (305 mm) past the front of the cabinet. The cabinet shall be loaded with concrete blocks per the Loading test procedure in Section 4.1.2.

The heptane basin shall be filled with a minimum of ½ in. (13 mm) of fuel and the doors shall be in the open position. After igniting the fuel, the cabinet door mechanism must release the doors allowing them to close and latch properly prior to the conclusion of the 1 minute fire exposure test.

#### 4.8 Performance Requirements per EN14470 Standard

**Note:** All examinations and tests must be conducted in accordance with the latest version of EN14470 Standard which includes the following:

1. Section 5.1-Fire Protection
2. Section 5.2-Doors
3. Section 5.3-Side and back walls
4. Section 5.4-Ventilation
5. Section 5.5-Shelves
6. Section 5.6-Spill containment sump
7. Section 6-Fire Resistance

## 5. OPERATIONS REQUIREMENTS

### 5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

#### 5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

#### 5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

#### 5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

## 5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agencies surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

## 5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

# 6. BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

NFPA 30, *Flammable and Combustible Liquid Code*