

SP Method 2369

Protection System for Storage of Inflammable Goods in Retail Environments – Fire Safety Cabinets

English translation of a Swedish test method “SP Metod 2369 - Skyddssystem för förvaring av brandfarlig vara på försäljningsställen - Brandavskiljande skåp.” The Swedish method text always takes precedence over this English translation.

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1 Introduction

Retail outlets of all different sorts, from small shops to large department stores and supermarkets, sell products classified as inflammable goods. The packaging material is often plastic, and tests (e.g. SP Rapport 2007:24) have shown that, from a fire safety standpoint, this can lead to serious situations, due to of the rapid speed at which fires can spread. The Swedish National Inspectorate of Explosives and Flammables (Sprängämnesinspektionen, SÄI), thus produced a set of regulations (SÄIFS 1996:2)¹, governing how inflammable gases and liquids must be handled in retail outlets. These regulations require, among other things, that “Inflammable gas and liquid shall be handled and stored in such a way that satisfactory safety precautions exist. The manner in which they are handled may neither obstruct nor complicate evacuation or rescue efforts.”

The accompanying section General recommendations (“Allmänna råd”) gives examples of acceptable quantities of inflammable goods in various premises as well as storage distances from other goods. Both quantity and distance requirements, however, result in considerable limitations to retailers, and the regulations thus concede that these guidelines may be adjusted on the condition that measures are taken to maintain designated safety levels. An example of such measure might be storing the inflammable goods in a separate space or in special fire safety cabinets. SP Method 2369 was developed to provide a tool for the validation of these enclosures.

SP Method 2369 describes the testing conditions and requirements that may be applied to evaluate protective systems in the form of a freestanding cabinets. The methodology and requirements are based on experience and experiments with inflammable goods (as defined by SP-Arbetsrapport 1997:35). This report was developed in cooperation with a reference group composed of interested representatives from authorities, emergency rescue services, retail, insurance providers and protection system manufacturers.

The Swedish Civil Contingencies Agency (MSB), while developing new guidelines, identified a future need for allowing inflammable liquids and gases to be stored together. However, existing tested cabinets were designated and evaluated for storing either inflammable gas or inflammable liquids. These requirements thus had to be modified. This included revised fire testing as well as design and functional requirements in SP Method 2369, to ensure it meets MSB’s new guidelines in “Handbok Brandfarliga gaser och vätskor i butik,” 2018/2019.

Version 6 of SP Method 2369 incorporates the new guidelines published by MSB. This update was founded on tests with increased burning time during external fire exposure testing. The research in SP-Arbetsrapport 1997:35 was also complemented with tests of aerosol cans’ critical temperature. Results of this test have also contributed to changes in testing methodology and requirements concerning the effect of external fire in comparison to previous versions of SP Method 2369.

¹ These guidelines are no longer valid. They have been replaced by the Swedish Civil Contingencies Agency’s (MSB) “Handbok Brandfarliga gaser och vätskor i butik.”

2 Extent and Area of Use

The purpose of this SP Method is to describe testing and evaluation procedures for various forms of safety equipment to verify that it fulfills its intended protective function and complies with the intentions of MSB's "Handbok Brandfarliga gaser och vätskor i butik." This method, SP Method 2369, describes experiments, methodology and requirements for cabinets designated for storage of inflammable goods. These cabinets may be placed freely within the retail premises. Sales occur via doors in the cabinet. The aforementioned cabinets may be safeguarded by an extinguishing system.

Protection systems which are not considered in these testing methods can be evaluated according to applicable sections, supplemented where necessary with specially designed testing procedures to confirm that they comply with the intentions of MSB's "Handbok Brandfarliga gaser och vätskor i butik." On the other hand, protection systems that in fact fulfill the specified requirements can, according to this test methodology, fail to meet criteria if other conditions result in unsatisfactory functionality and a consequent failure to comply with the intentions of the regulations.

This method only covers cabinets with a storage capacity below 1000 liters. Cabinets with a storage capacity greater than 1000 liters and storage rooms for inflammable goods are not covered by this SP Method.

Cabinets deemed to have fulfilled the posted requirements can be certified and attain eligibility for P-marking, on the condition that they meet SPCR 102 requirements.

3 References

Bobert, M., Persson, H. "Framtagning av underlag till rekommendationer för förvaring av brandfarlig vara i försäljningsställen" SP Rapport 2007:24.

SÄIFS 1996:2, "Sprängämnesinspektionens föreskrifter om hantering av brandfarliga gaser och vätskor på försäljningsställen. Sprängämnesinspektionens allmänna råd till föreskrifterna."

Milovancevic, M., Persson, H., "Förvaring av brandfarlig vara i försäljningslokaler-Referensförsök," SP-Arbeitsrapport 1997:35.

MSB's "Handbok Brandfarliga gaser och vätskor i butik," 2018/2019.

Karlsson, P. "Skåp för förvaring av brandfarlig vara: förlängt utvändigt brandprov, studie," MSB1070, 2017

Karlsson, P. "Brandprovning av aerosolburkar i brandavskiljande skåp," RISE Uppdragsrapport 7P08230, 2017-12-05

SS-EN 1154/A1/AC:2006, "Building hardware – Controlled door closing devices – Requirements and test methods."

SS-EN 1935/AC:2004, "Building hardware – Single-axis hinges – Requirements and test methods."

Wickström, U, "The Plate Thermometer-A Simple Instrument for Reaching Harmonised Fire Resistance Tests," SP-Report 1989:03, Swedish National Testing Institute, 1989.

SPCR 102 Certifieringsregler för skåp för brandfarlig vara.

4 Definitions

Concepts addressed by this experimental method are defined as follows:

Inflammable goods –In SP Method 2369 this collective term is limited to inflammable gases, aerosols and liquids, in closed retail packaging.

Protective function – The protective functions a functional protection system shall provide.

Protection system - Collective notion of various types of equipment for preventing fires in or around inflammable goods from growing over such a period and to such an extent that emergency evacuation or rescue efforts are complicated or prevented.

Cabinet for inflammable goods - Protection system in the form of a freestanding cabinet, with self-closing doors, shelves and spill trays, intended for appropriate placement in the retail environment.

Storage capacity – The maximum liquid volume of inflammable goods intended for storage in each respective precautionary system.

5 Samples

The test object shall constitute a complete cabinet, representative of those cabinets to be sold.

Basic technical drawings and material specifications shall be made available for examination of the object. Installation and maintenance instructions shall be included and will constitute the basis for set-up and connection procedures before the test.

The installation instructions shall make evident any other possible subsequently required measures following the installation of the protection system, such as construction or connection and installation of ventilation systems.

6 Design and Functional Requirements

6.1 General

Cabinets must be manufactured of such materials and with such construction methodology as to meet the requirements made for mechanical strength and for the effects of fire exposure both on the inside and outside of the cabinet. If combustible material is employed, such use in itself may not significantly contribute to the extent and intensity of combustion. In addition, the cabinets shall have the same construction on all sides.

Cabinets shall have sufficient mechanical strength to sustain a physical load equal to its storage capacity, without distortion or effects resulting in a decline in cabinet seal quality overall, or a deteriorated door function.

The cabinet must be equipped with (a) self-closing door(s), with a closing mechanism providing a minimum closing torque in accordance with table 1 in SS-EN 1154. The doors may not have the capacity to be held or propped open.

The door-closing mechanism must provide sure service over a long time. Door closing mechanisms meeting the requirements in SS-EN 1154 are considered to fulfill this requirement.

Cabinet hinges shall meet the demands in table 1 in SS-EN 1935, where Category of use (column 1) will at least correspond to Heavy Duty. In addition, Fire/smoke suitability shall fulfill the requirements in Appendix B, B.1 and B.2, or be set to 1. Finally, the lowest permissible value for Hinge grade (column 8) is 11.

The hinge construction shall function safely over a long period of time. Hinges that fulfill these requirements according to SS-EN 1935, or equivalent tests, are considered to fulfill this requirement.

The cabinet must be equipped with spill trays with a volume equivalent to at least 10 % of the storage capacity yet also to the volume of the smallest single container (normally 25 l) The cabinet must be so designed that any spills or fluid streams from leaking bottles or containers are guided down to the spill tray and do not run out onto the floor. Occasional drops are acceptable, however. The cabinet shall be designed such that no goods may be stored inside spill trays and in any way affect their effective volume.

Cabinets with a storage capacity of less than 1 000 liters should be as tightly sealed as possible and thus should not use ventilation.

In cases where the cabinet is equipped with lighting, the transformers, circuit breakers etc. shall be placed outside of the cabinet. Only the lighting armatures may be placed inside.

6.2 The Effect of Internal Fire

The cabinet shall be constructed as to prevent the spread of an internal fire over a period of at least 30 minutes, as described in section 7.5. Over this time period, the average temperature increase on the outer walls of the cabinet may not exceed 140°C and the maximum temperature measured at any measuring point shall not be greater than 180°C. Fluid may not spill outside the cabinet as a consequence of leaks in the cabinet or door construction. Any spill on the floor during the first 60 seconds when doors are intentionally help open shall not be taken into account.

The temperature on the plate thermometer(s) mounted above the cabinet may not exceed 400°C (30 seconds average value) as a result of any leaks in the door(s) or the construction with the exception of the initial temperature influence due to the doors being held open.

The temperature inside the cabinet may not exceed 200°C (measured with plate thermometers, 30-second average value), with the exception of the initial temperature influence due to the doors being held open.

6.3 The Effect of External Fire

The cabinet shall be so constructed that its function in protecting the inflammable goods is not affected by an external fire, as described in section 7.6. Thus during this test, there can be no damage, leakage, spillage, or combustion of the inflammable goods such that the fire intensity increases beyond that affected by the experimental fire.

The temperature measured inside the cabinet may not exceed 75°C (measured with plate thermometers, 30-second average value).

6.4 Documentation

The manufacturer, must before testing, provide complete basic design drawings and specifications of materials used in the design and integrated components. For extinguisher medium and components that are included, respectively, in a fire extinguisher and detection system, the documentation must provide basic information relevant to evaluation of their functionality and reliability.

The manufacture must also provide clear installation and operating instructions. These shall clearly state maximum storage capacity and possible limitations in the sort of inflammable goods which can be stored in the cabinet.

7 Testing Methodology for Verifying Functionality Requirements

7.1 Experimental Apparatus

The following experimental apparatus is required:

- Weights, 1-10 kg a piece, equivalent to the cabinet's storage capacity
- Dynamometer for testing the torque exerted by the door-closing mechanism
- Ceiling construction for mounting above the cabinet during the internal fire exposure test
- Plate thermometer, 100 x 100 mm, constructed in accordance with "SP Rapport 1989:03"
- Type K thermocouple, dimension AWG 24 (wire diameter 0.51 mm)
- Ignition source made of porous fibreboard
- Inflammable goods in 1-liter plastic bottles equivalent to the cabinet's storage capacity
- Two gas burners for the external fire exposure test
- Photo camera
- Video camera

WARNING: The fire tests are conducted in an environment suited for the purpose. For safety reasons, the cabinet must be walled off in such a way as to avoid a large fire resulting from a spill, if the cabinet fails to fulfill its safety function. Test personnel must wear fireproof clothing and have access to necessary extinguishers.

7.2 Mechanical Load Test

The cabinet is filled with weights equivalent to its storage capacity, over a period of 72 hours. For the mechanical load test, 1 kg takes the place of 1 liter of stored liquid. At the end of the 72-hour period, the cabinet is inspected with regards to the following:

- Whether all joins and welds are sealed/unaffected.
- Whether there are permanent deformations or changes in shape that could affect the cabinet's tightness or function.
- Whether there are permanent deformations or changes in shape that could affect the tightness or function of the cabinet door(s).

7.3 Door-Closing Mechanism

The closing force of the door(s) is measured directly before and after the cabinet is fully loaded, as described in section 7.2. The closing force is measured again directly before the conclusion of the mechanical load test, as described in section 7.2. The torque exerted by the closing mechanism is calculated for comparison with the requirements in section 6.1.

7.4 Spill Trays

The spill tray and construction of the cabinet shall be controlled to confirm that no containers can be placed in the spill tray, thus potentially reducing its effective volume when in use.

The volume and tightness of the spill tray is verified by filling it with a volume of water equivalent to the spill tray's minimum allowable volume. Any leakage or spillage is noted.

After the mechanical load test, as in section 7.2, a total of about 4 liters of water is sprayed, at a pressure of $2 \pm 0,5$ bar within the cabinet, toward the door(s) and walls over a period of 2 minutes. Any spillage onto the floor is noted.

7.5 Internal Fire Exposure

A "ceiling construction" of non-flammable material equipped with a plate thermometer (see below) is mounted 0.5 m above the cabinet's upper surface as in Figure 1. The ceiling must be at least 1 m x 2 m.

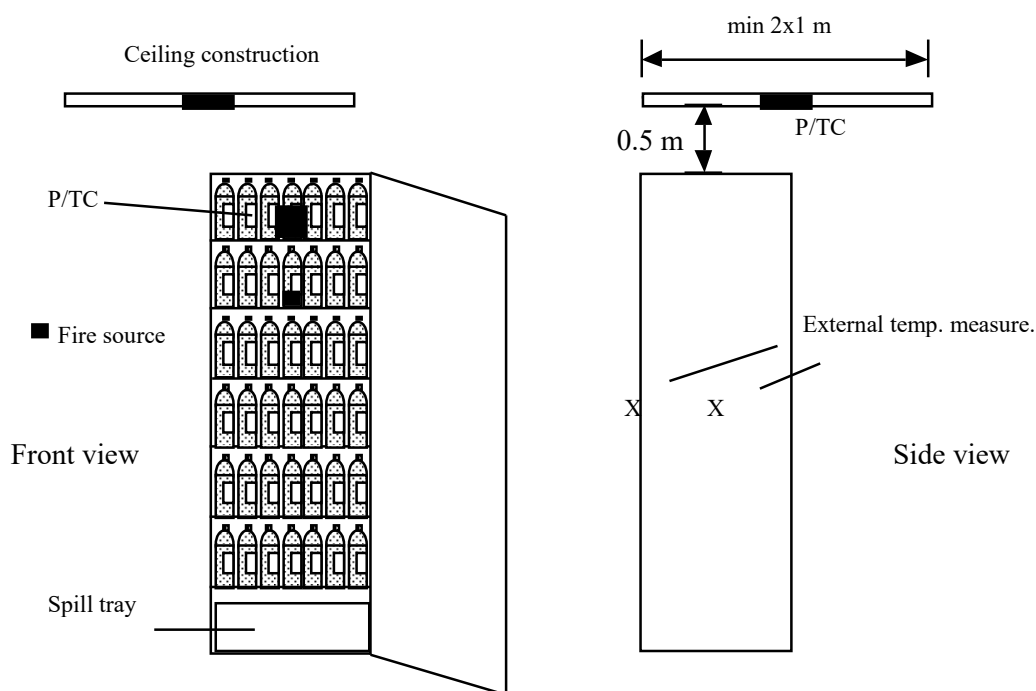


Figure 1 Principal experimental set-up for the "Internal Fire Exposure" test.

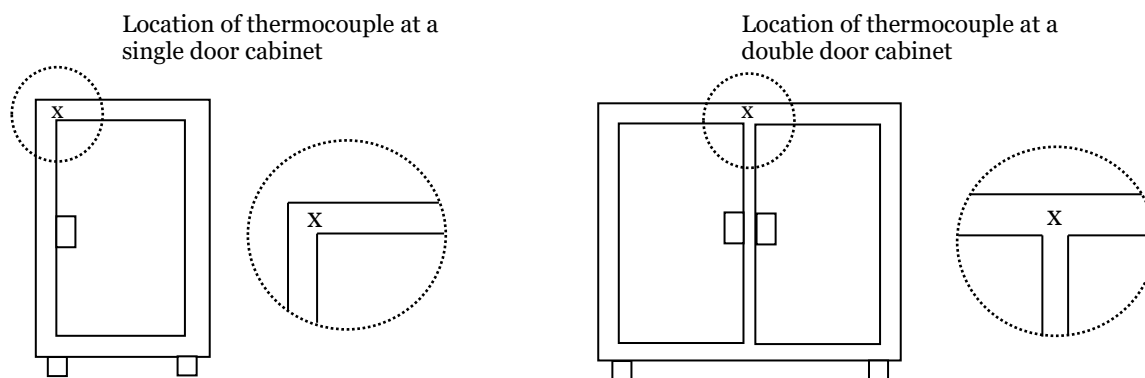


Figure 2 Principal location of thermocouples during "Internal Fire Exposure" testing

The cabinet, after having successfully completed tests described in sections 7.2-7.4, is filled to its storage capacity with inflammable goods, 50 % petroleum products and 50 % watersoluble products (preferably petroleum spirit and ethanol in 1-liter bottles, respectively). The products are spread out such that every other shelf is filled with each respective product: ethanol on the top shelf, petroleum spirit on the next, etc. The temperature of the inflammable goods must be at least 15°C.

The ignition source is a cube manufactured from porous fibreboard measuring 60 mm x 60 mm x 75 mm. After absorbing 120 ml heptane, it is placed in a thin plastic bag. The ignition source is placed on the second from the top shelf (with petroleum spirits) in the centre of the foremost row of bottles.

The cabinet door(s) is/are held open completely. The ignition source is ignited and the fire allowed to develop freely for 60 seconds. Next, the doors are released allowing the door-closing mechanism to function as intended.

The fire in the cabinet is allowed to progress freely for a period of 30 minutes or until it can be clearly established that the fire in the cabinet is out. If the cabinet fails to fulfill its protective function, the test is terminated and the fire manually extinguished.

After the experiment, the cabinet is examined for damage. Documentation is made of the damage both to the cabinet and to the inflammable goods and of the quantity of spillage in the spill tray.

The course of events is recorded and documented visually. Any spillage to the floor during the first 60 seconds when the door was held open is noted but not taken into account in evaluation of the protective function of the cabinet. The experiment shall always be documented with photographs and at least one video camera.

Temperature measurements during the experiment shall be made at the points given below (see Figure 1). Measurement shall continue throughout the whole course of the experiment, with measurements at least every 5 seconds.

- A plate thermometer is placed centrally in the ceiling construction, mounted above the cabinet. Further plate thermometers are mounted in the ceiling if higher temperatures could be expected.
- A plate thermometer, orientated towards the door, is placed inside the cabinet on the front edge of the upper shelf directly over the combustion source.
- Thermocouples, as specified in section 7.1, are welded to the surface of the cabinet's exterior (gables, backside, top). At least one thermocouple must be mounted centrally on each side. Further thermocouples may be mounted if higher temperatures could be expected at other points: for instance, at welding joints or corners. It is not recommended to mount more than five thermocouples per side.

7.6 External Fire Exposure

The experiment is conducted using the same cabinet set-up as for the "Internal Fire Exposure" test. If the damage to the cabinet and its contents after the internal fire is very limited, the same cabinet and inflammable goods contents can be re-used, if the manufacturer so permits. Replacement of individual damaged components or bottles of inflammable goods is permitted.

Two gas burners are placed on the floor 10 cm from the cabinet, as shown in Figure 3. One burner, 60 cm x 35 cm, is placed parallel to one of the cabinet's gabled sides. The other burner, 60 cm x 20 cm, is placed alongside the front and door section of the cabinet. The burners shall be placed such that their short sides are in line with the front and the gable respectively. Both burners shall be 25 cm high.

Table 1. Effect of the gas burner

	0-1 min*	1-2 min**	2-3 min**	3-4 min**	4 min – end of test**
60 x 35 x 25 cm	200 kW	240 kW	280 kW	335 kW	360 kW
60 x 20 x 25 cm	100 kW	140 kW	140 kW	160 kW	160 kW

* - 30 s averaged effect shall be $\pm 50\%$ of the indicated effect.

** - 30 s averaged effect shall be $\pm 10\%$ of the indicated effect. The total averaged effect may not deviate more than $\pm 5\%$.

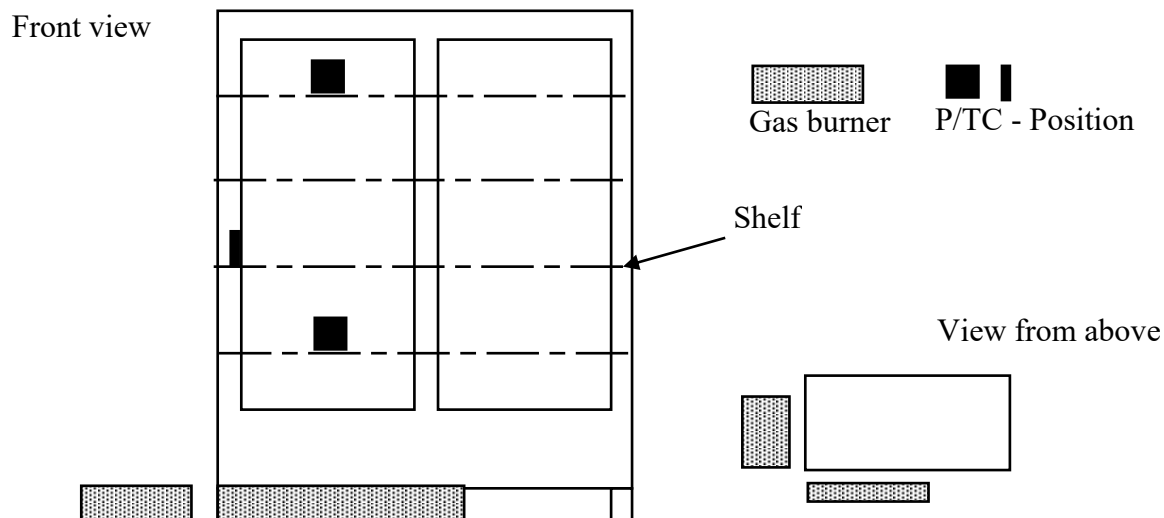


Figure 3 Principal experimental set-up for the "External Fire Exposure" test.

The cabinet door(s) shall be closed and the gas burner ignited. After 15 minutes of fire exposure, the fire at the front of the cabinet shall be extinguished. A total of 30 minutes after the start of the test, the fire beside the cabinet is extinguished. If the protective function of the cabinet is not fulfilled, the test is terminated and the fire manually extinguished.

After the experiment, the cabinet is examined for damage. Documentation is made of the damage to the cabinet, the inflammable goods and the quantity of spillage in the spill tray.

The course of events is recorded and documented visually. The experiment shall always be documented with photographs and at least one video camera.

Temperature measurements during the experiment shall be made at the points given below (see Figure 3). Measurement shall continue throughout the entire course of the experiment, with measurements at least every 5 seconds.

- A plate thermometer, orientated towards the door, is mounted inside the cabinet on the front edge of the top shelf.
- A plate thermometer, orientated towards the door, is mounted inside the cabinet on the front edge of the bottom shelf.
- A plate thermometer, orientated towards the fire-exposed gable is mounted inside the cabinet on the second shelf from the bottom. The distance between the the plate thermometer and the wall of the cabinet should be equivalent to the minimum possible distance between the bottles and the wall.

8 Test Report

The test report shall at least contain the following information:

- Name and address of the experimental institute
- Report number
- Name and address of the commissioning body
- Purpose of the experiment
- Information about the sampling procedure
- Name and address of the cabinet manufacturer
- Type designation for the cabinet and any manufacturing number or the like for the tested cabinet
- Description of the tested cabinet including complete drawings, material descriptions and manufacturer's/supplier's instructions for installation and maintenance
- Date of the cabinet's arrival at the test laboratory and test dates
- Experimental method
- Any conditioning before the tests
- Description of instruments and experimental apparatus
- Exact description of placement and mounting of thermocouples
- Any deviations from the test method
- Description of observations concerning examination according to point 6 and the tests according to point 7.2-7.6. Include relevant diagrams showing measured temperatures as a function of time.
- Include photos of the cabinet before and after the fire test, relevant occurrences during the test and the cabinet's appearance after completion of the test.
- Concluding judgement of whether the cabinet fulfills posted requirements
- Date and signature.