INTERNATIONAL STANDARD

ISO 10294-4

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Fire resistance tests — Fire dampers for air distribution systems —

Part 4:
Test of thermal release mechanism

Essai de résistance au feu — Clapets résistant au feu pour systèmes de distribution d'air —

Partie 4: Méthode d'essai du mécanisme de déclenchement thermique

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10294 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10294-4 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*. A test method was needed to evaluate the correct operation of damper-operating mechanisms.

ISO 10294 consists of the following parts, under the general title *Fire resistance tests — Fire dampers for air distribution systems*:

— *Part 1: Test method*

— *Part 2: Classification, criteria and field of application of test results*

— *Part 3: Guidance on the test method*

— *Part 4: Test of thermal release mechanism*

Annexes A and B of this part of ISO 10294 are for information only.

Fire resistance tests — Fire dampers for air distribution systems —

Part 4: Test of thermal release mechanism

WARNING — In order that suitable precautions may be taken to safeguard health, the attention of all concerned in fire testing is drawn to the possibility that toxic or harmful gases may be evolved during the conduct of this test.

1 Scope

This part of ISO 10294 specifies the test requirements related to thermal release mechanisms used in fire dampers tested in accordance with ISO 10294-1. Only the thermal release mechanism is subjected to the tests described. The test methods are designed to ensure that under fire conditions the thermal release mechanism complies with the expected functions so that the damper will close completely so as to prevent the spread of fire.

This part of ISO 10294 also includes a method for ensuring that the thermal release mechanism does not close the damper in non-fire conditions. The effect of corrosion on the operational reliability of the release mechanism is also evaluated.

This method is only applicable to thermal release mechanisms installed within the damper or duct. It does not cover thermal release mechanisms that are located outside the ventilation duct.

The test can provide information on comparative performance between one thermal release mechanism and another and thus provides for the testing of thermal release mechanisms that have not been included in the damper assembly that was tested in accordance with ISO 10294-1.

The method specified in this part of ISO 10294 will determine whether the thermal activation system for the closing device of a fire damper system

— is suitable for a fire damper assembly to be tested according to ISO 10294-1,

— is suitable for a fire damper already qualified according to ISO 10294-1 with an alternative system of the same class (temperature-load),

— is capable of maintaining its performance after the reliability tests.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10294. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10294 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 10294-1:1996, *Fire resistance tests — Fire dampers for air distribution systems — Part 1: Test method*.

ISO/IEC 13943:2000, *Fire safety — Vocabulary*.

3 Terms and definitions

For the purposes of this part of ISO 10294, the terms and definitions given in ISO/IEC 13943 and the following apply.

3.1
fire dampers
mobile closure within a duct which is operated automatically or manually and is designed to prevent the passage of fire

3.2
thermal release mechanisms
system which evaluates the parameters of temperature in the airflow of the ventilation duct and initiates the closing of the fire damper before a predicted threshold limit is reached

NOTE The sensing element may be, for example, a fusible link, memory metal, frangible bulb or electrical sensor.

3.3
threshold limit
temperature before which the thermal release mechanism must have operated

4 Requirements

4.1 Thermal release

The thermal release mechanism is installed in the centreline of the cross section of the test duct, which is part of the test arrangement according to Figure 1 or Figure 2. The test arrangement shall include a heating arrangement that can expose the thermal release mechanism to the conditions specified in 4.2, also a fan and velocity measuring equipment. A suitable method of controlling the air temperature and velocity shall be provided.

The position in which the thermal release mechanism is installed shall be chosen such that the airflow conditions near the heat-sensitive element are in accordance with the practical conditions. If the test specimens are not absolutely symmetrical, the test of response behaviour described in 4.2 and the test of faulty set-off described in 4.3 shall be performed in both possible directions of airflow.

4.2 Response behaviour

Starting at an initial temperature of (25 ± 2) °C, the specimen shall be exposed to an increasing air temperature such that it follows the relationship (see Figure 3):

$$T = (25 + 20t) \pm 2$$

where

T is the temperature, in degrees Celsius;

t is the time from the start of the test period, in minutes.

The response threshold of the thermal release mechanism shall not exceed an 80 °C rise above the starting temperature. A 25 °C initial temperature and 80 °C maximum temperature rise means that the maximum temperature of activation (threshold limit) will be 105 °C. This means that the thermal release mechanism shall operate within 4 min. This test may be applied to other operating temperatures and guidance is given annex B.

The mean air velocity at the start of this test shall be (1 ± 0,1) m/s. The test shall be performed three times for each orientation and location of the thermal release mechanism. The thermal release mechanism shall operate before the threshold limit is exceeded on each of the samples tested.

4.3 Faulty set-off

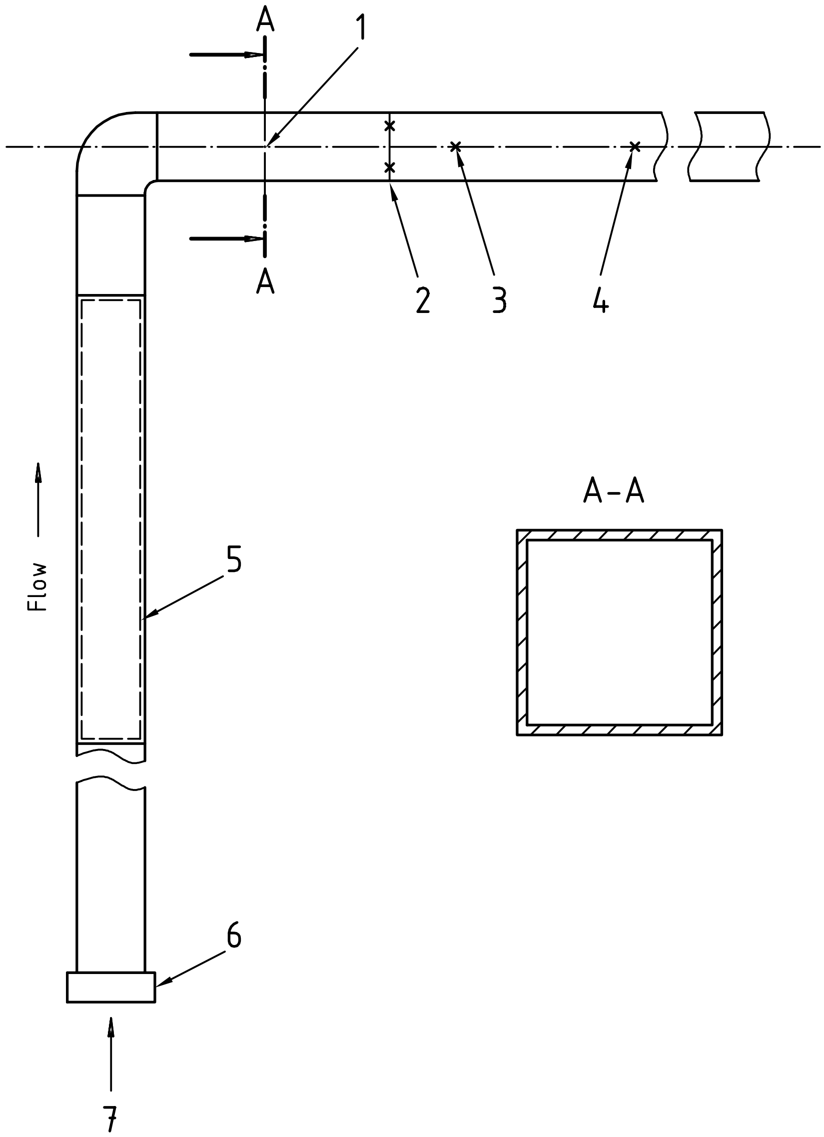
For 1 h the specimen shall be exposed to an air temperature of (60 ± 2) °C. The thermal release mechanism shall be under the same loading as would be applied under normal service conditions. The mean airflow velocity (mass flow) for this test shall be (1 ± 0,1) m/s. The test shall be performed once for each orientation and location of the thermal release mechanism.

The thermal release mechanism shall not release in any of the samples tested.

Where other operating temperatures are to be used, a different limit for temperature shall be selected. Guidance is given in annex B.

5 Test apparatus

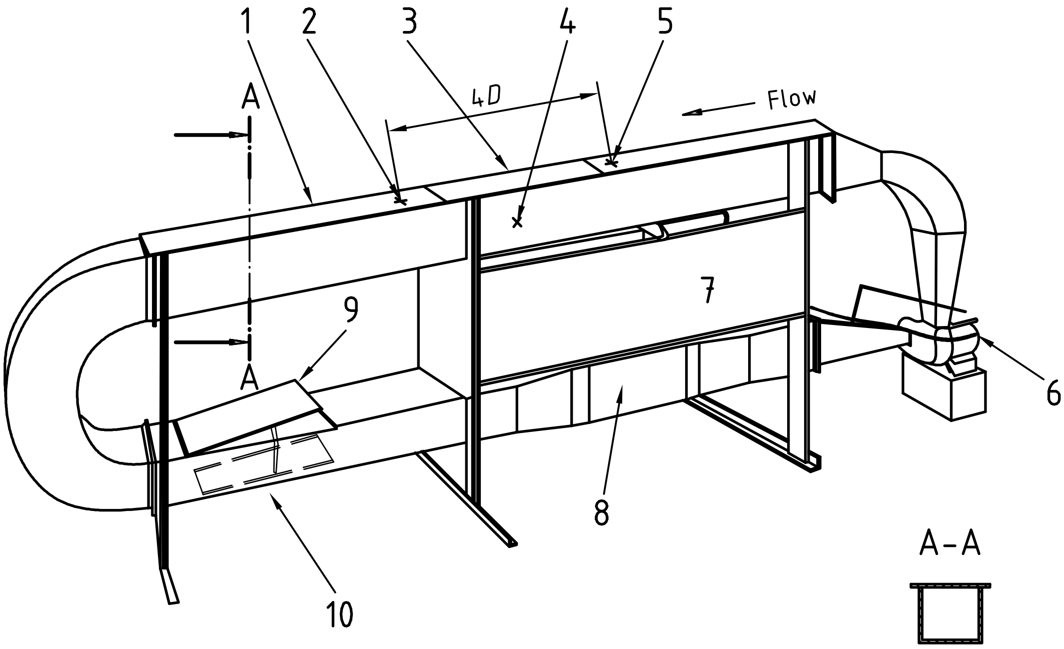
The recommended types of devices with opened and closed airflow are shown in Figure 1 and Figure 2. Larger and smaller cross sections may be used provided the requirements for the air temperature and the airflow velocity are met.



Key

1 Baffles for airflow
2 Thermocouples
3 Thermal release mechanism
4 Anemometer, distance 4 D from the fan
5 Heating zone
6 Fan
7 Ingress of air

Figure 1 — Test arrangement



Key

1 Removable cover
2 Anemometer, distance 4 D from the ventilation duct used in the test
3 Cover for the release mechanism-testing zone
4 Thermal release mechanism and location of observation window
5 Thermocouple
6 Fan
7 Control panel
8 Heating zone
9 Damper for the egress of air
10 Damper for the ingress of air

Figure 2 — Alternative test arrangement

5.1 Ducting

The length of ducting shown in Figure 1 or Figure 2 may be changed provided the requirements for the air temperature and the airflow velocity are met. Each shall be provided with suitable access for installing the thermal release mechanism. The airflow shall be straight. An observation window shall be located as shown in Figure 1 or Figure 2.

A means of providing and controlling the ingress of air shall also be provided.

5.2 Fan, capable of providing the air velocities specified.

5.3 Heater, located within the duct system, having suitable means of control and capacity to achieve the heating conditions specified in 4.2.

5.4 Air-velocity measuring equipment, suitable to meet the criteria of 4.2 and 4.3.

5.5 Instrumentation

The air temperature shall be measured by means of a sheathed thermocouple of diameter (0,25 ± 0,025) mm. The thermocouple shall be situated in the same distance from the top of the ventilation duct used in the test as the part of the thermal release mechanism that is sensitive to heat. The horizontal distance shall be approximately 230 mm from the thermal release mechanism.

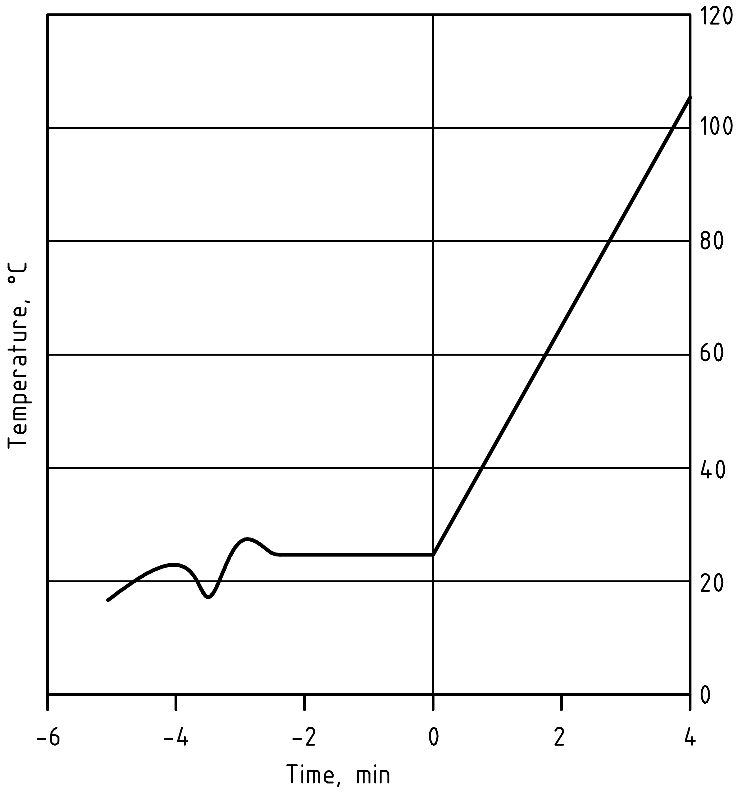


Figure 3 — Time/temperature rise for response behaviour test

6 Test procedure

6.1 Installation of thermal release mechanism

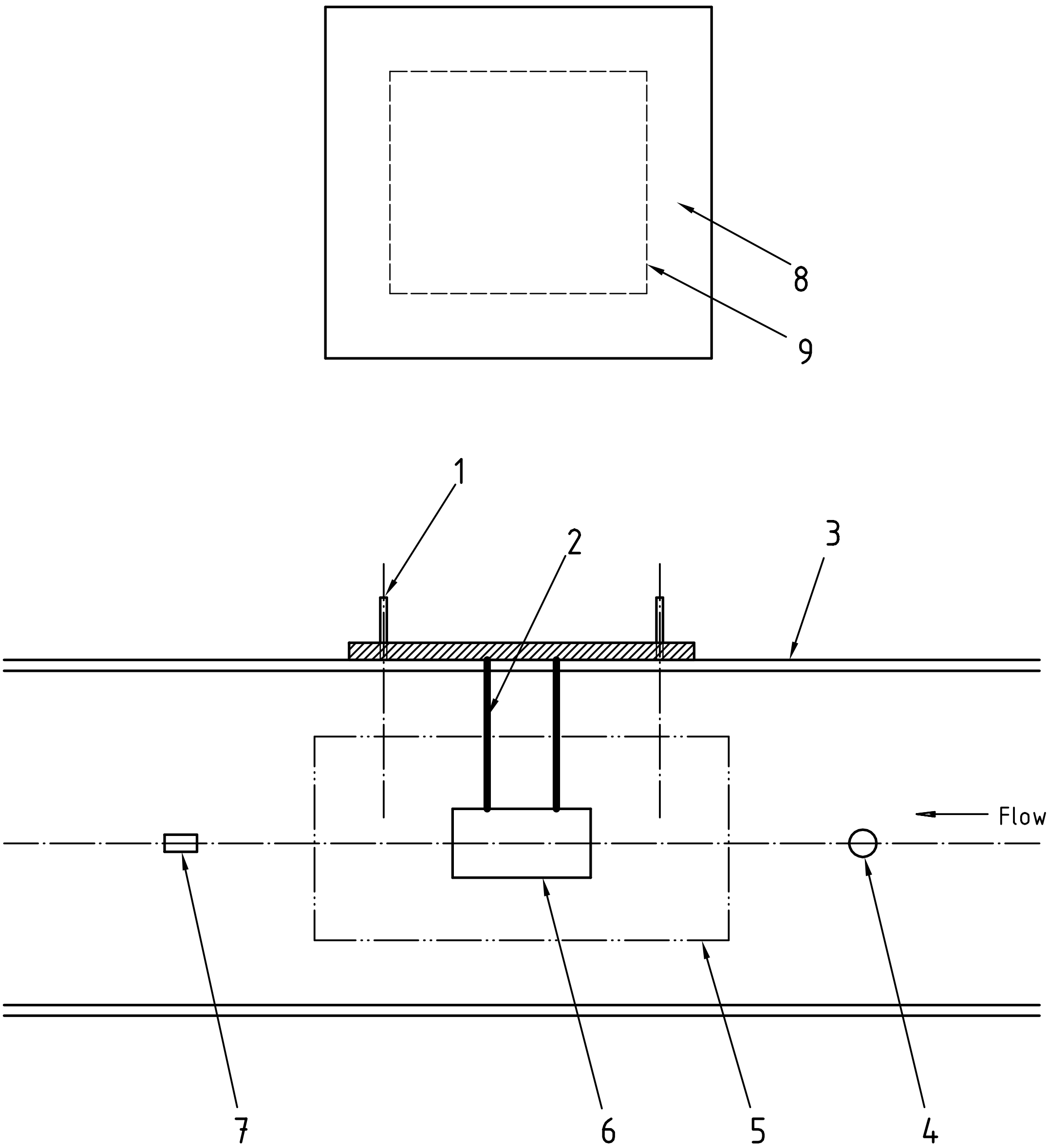
The thermal release mechanism shall be suspended from a plate in its normal orientation on a plate dimensioned as shown in Figure 4, which forms part of the top of the working area of the ventilation duct used in the test, such that the thermal release mechanism is positioned symmetrically to the sides and on the centreline of the ventilation duct used in the test. If the thermal release mechanism is not absolutely symmetrical, then both sides shall be tested. For the testing of faulty set-off, the thermal release mechanism shall be loaded as specified in 4.3.

6.2 Control of test conditions

6.2.1 Testing of response behaviour

Before each test, the temperature of the airflow, as measured by the thermocouple (5.5), shall be at (25 ± 2) °C. Remove the thermal release mechanism from a conditioning chamber set at a temperature of (25 ± 2) °C, and locate the mechanism in the test duct. Wait at least 5 min for the temperature to stabilize.

The control of the temperature within the ventilation duct used in the test shall be adjustable, with sufficient control and spare capacity so that the temperature can be controlled over a range of 1 °C/min to 30 °C/min, with a maximum nominal value deviation of ± 2 °C.



Key

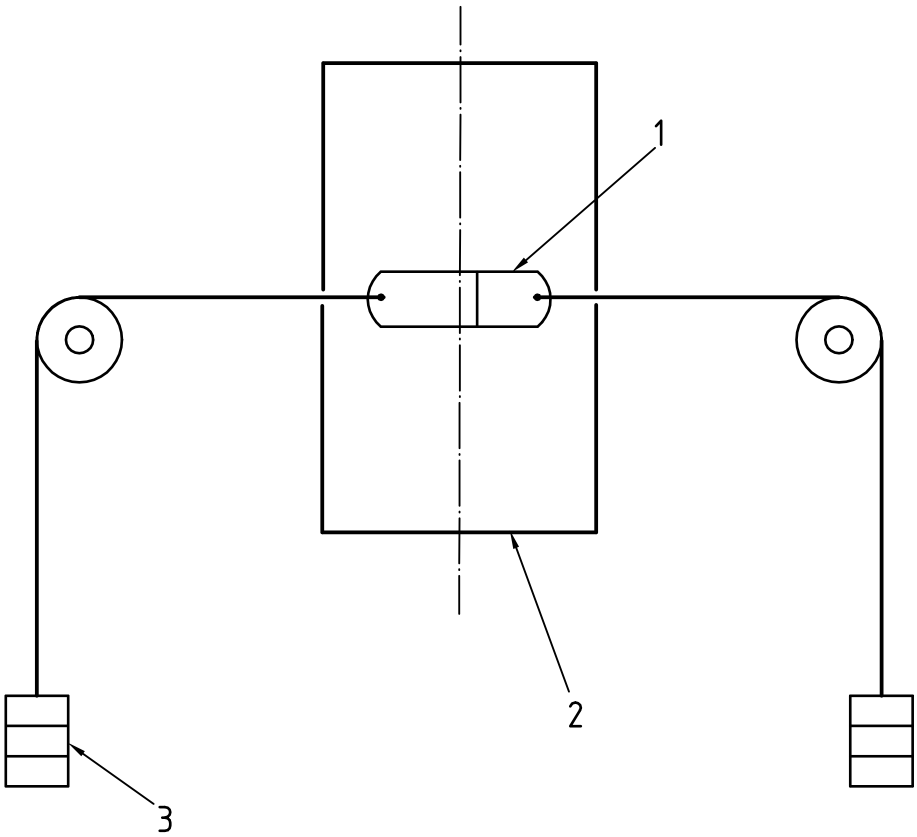
1 Locating studs
2 Stiff suspension wire
3 Test duct
4 Thermocouple
5 Observation window
6 Thermal release mechanism
7 Temperature compensated anemometer
8 Mounting plate
9 Hole cut in test duct

Figure 4 — Installation of thermal release mechanism

6.2.2 Testing of faulty set-off

Before each test, apply a load in the direction of the release movement which is equal to the load under normal service conditions. The temperature of the airflow and of the thermal release mechanism shall be prestabilized at 60 °C ± 2 °C then the test may be started.

Where the device cannot be tested together with the operating springs, the laboratory shall provide a means of applying the load specified by the manufacturer. An example is shown in Figure 5.



Key

1 Thermal release mechanism
2 Cross section of test duct
3 Loading system

Figure 5 — Example of loading means

7 Test report

The fulfilment of the requirements given in 4.2 and 4.3 shall be verified and detailed in the test report. Information relating to the corrosion tests shall also be included if carried out.

The test report shall also contain at least the following information:

a) name and address of the testing laboratory and the location where the test has taken place, if the latter is not the same as the address of the testing laboratory;

b) unmistakable indication of the report (e.g. serial numbers) and of each page of the report, as well as specification of the total number of pages of the report;

c) name and address of the sponsor;

d) description and name of the tested item;

e) date of receipt of the tested item and date (dates) of the test;

f) test specification or description of the test method or testing instructions, including value of load applied;

g) if necessary, description of the sampling method;

h) all deviations, additions or limitations compared with the test specification as well as other information that is important for the specific test;

i) data concerning all used and non-standardized test methods or instructions;

j) result of measurements, examinations and interpolated results; if necessary, complementary tables, graphs, sketches and photos;

k) indications concerning the accuracy of measurement (if relevant);

l) signature and title or corresponding indication of the persons who are responsible for the technical content of the test report as well as the date of issue;

m) indication that the test results refer only to the tested items;

n) notice that without permission of the testing laboratory the report may not be duplicated in extracts.

Annex A
(informative)

Reliability tests

A.1 General

The tests described in this annex are optional.

The reliability tests consist of subjecting a group of thermal release mechanisms to a simulated environmental exposure for a period of 5 days, after which the response behaviours of the thermal release mechanisms are measured.

The tests consist of exposure to

a) a salt spray fog,

b) a moist hydrogen sulfide/air mixture, and

c) a moist carbon dioxide/sulfur dioxide/air mixture. A group of thermal release mechanisms consist of the five samples. One sample group is exposed to the salt spray fog; a second sample group is subjected to the moist hydrogen sulfide/air mixture; and a third sample group is subjected to the moist carbon dioxide/sulfur dioxide air mixture.

Not less than 4 days or more than 7 days after the exposure, subject each thermal release mechanism to the procedures given in 6.2.1 and 6.2.2. Observe each thermal release mechanism to determine if operation occurs within the time specified in 4.2 and 4.3.

WARNING — These tests use hydrogen sulfide and sulfur dioxide, which are both poisonous gases. Hydrogen sulfide gas is also flammable. Because of these hazards, these gases must be stored, transferred and used only in gas-type systems. Adequate ventilation must also be provided to handle any accidental leakage. Due their unpleasant odour and irritating effects, these gases give a warning of their presence.

A.2 Salt spray fog test

The salt spray fog test is intended to demonstrate the performance of the thermal release mechanism after it has acquired an accumulation of particulate matter. It is recommend that all galvanized steel parts of the thermal release mechanism be painted to inhibit corrosion by the salt spray fog.

The thermal release mechanisms shall be exposed to a salt spray within a fog chamber. The salt solution in the chamber shall be a 20 % solution (by mass) of sodium chloride in distilled water. The pH shall be between 6,5 and 7,2 and the density between 1,126 g/ml and 1,157 g/ml when atomized at 35 °C. Suitable means of controlling the atmosphere in the chamber shall be provided. The thermal release mechanisms shall be supported in their normal operating position and exposed to the salt spray (fog) in a chamber having a volume of at least 0,43 m^3, in which the exposure zone shall be maintained at a temperature of (35 ± 2) °C. The temperature shall be recorded at least once per day, at least 7 h apart (except weekends and holidays when the chamber normally would not be opened). Salt solution shall be supplied for a recirculating reservoir through air-aspirating nozzles, at a pressure between 0,7 bar (0,07 MPa) and 1,7 bar (0,17 MPa). Salt solution runoff from exposed samples shall be collected and shall not be returned to the reservoir for recirculation. The thermal release mechanisms shall be shielded from condensate drippage.

Fog shall be collected from at least two points in the exposure zone to determine the rate of application and salt concentration. The fog shall be such that for each 80 cm^2 of collection area, 1 ml to 2 ml of solution shall be collected per hour over a 16 h period and the salt concentration shall be (20 ± 1) % by mass.

The thermal release mechanisms be exposured to the salt spray for a period of 5 days. After this period, the thermal release mechanisms shall be removed from the fog chamber and allowed to dry for 4 days to 7 days at a temperature not exceeding (20 ± 5) °C in an atmosphere having a relative humidity not greater than 70 %.

After the drying period, the thermal release mechanisms shall be subjected to the tests described in 6.2.1 and 6.2.2.

A.3 Moist hydrogen sulfide/air mixture test

Exposure to a moist hydrogen sulfide/air mixture is intended to demonstrate the ability of the thermal release mechanism to resist a corrosive atmosphere. The thermal release mechanisms shall be supported vertically and exposed to a moist hydrogen sulfide/air mixture in a closed glass chamber having openings for gas inlet and outlet. On 5 days out of every 7 days, an amount of hydrogen sulfide equivalent to 1,0 % of the volume of the chamber shall be introduced into the chamber from a commercial gas cylinder, the volume required being measured with a flowmeter and timer. Prior to each introduction of gas, the remaining gas/air mixture from the previous day shall be thoroughly purged from the chamber. On the 2 days out of every 7 days that this does occur, the chamber shall remain closed and no purging or introduction of gas shall be provided. During the exposure, the gas/air mixture shall be gently stirred by means of a small fan located in the upper middle portion of the chamber. A small amount of water (10 ml per 0,003 m^3 of chamber volume) shall be maintained at the bottom of the chamber for humidity. Specimens shall be shielded from condensate drippage.

The thermal release mechanisms shall be exposed to the moist hydrogen sulfide mixture for a period of 5 days. After this period, the thermal release mechanisms shall be removed from the chamber and allowed to dry for 4 days to 7 days at a temperature not exceeding (20 ± 5) °C in an atmosphere having a relative humidity not greater than 70 %.

After the drying period, the thermal release mechanisms shall be subjected to the tests described in 6.2.1 and 6.2.2.

A.4 Moist carbon dioxide/sulfur dioxide/air mixture test

Exposure to a moist carbon dioxide/sulfur dioxide/air mixture is intended to demonstrate the ability of the thermal release mechanism to resist a corrosive atmosphere.

The thermal release mechanisms shall be supported vertically and exposed to a moist carbon dioxide/sulfur dioxide/air mixture in a closed glass chamber having openings for gas inlet and outlet. On 5 days out of every 7 days, an amount of carbon dioxide equivalent to 1,0 % of the volume of the chamber, plus an amount of sulfur dioxide equivalent to 1,0 % of the volume of the chamber shall be introduced. Prior to each introduction of gas, the remaining gas/air mixture from the previous day shall be thoroughly purged from the chamber. On the 2 days out of every 7 days that this does not occur, the chamber shall remain closed and no purging or introduction of gas shall be provided. A small amount of water (10 ml per 0,003 m^3 of chamber volume) shall be maintained at the bottom of the chamber for humidity. Specimens shall be shielded from condensate drippage.

The thermal release mechanisms shall be exposed to the moist carbon dioxide/sulfur dioxide/air mixture for a period of 5 days. After this period, the thermal release mechanisms shall be removed from the chamber and allowed to dry for 4 days to 7 days at a temperature not exceeding (20 ± 5) °C in an atmosphere having a relative humidity not greater than 70 %.

After the drying period, the thermal release mechanisms shall be subjected to the tests described in 6.2.1 and 6.2.2

Annex B
(informative)

Thermal release mechanisms for higher operating temperatures

B.1 General

The basic test method described in this part of ISO 10294 is intended to cover standard operating conditions. However, the test methods may be adapted to cover situations where the thermal release mechanism is intended to be operated at either lower or higher temperatures, for example dampers used in cold climates or those installed in warm air ducts. For the example given below, the requirement specified is that the response threshold does not exceed 140 °C and does not operate at 90 °C. However, the procedure may be adopted for any threshold limit that thermal release mechanisms are designed for. Except for the temperatures/threshold limits, all other conditions specified in this part of ISO 10294 shall be complied with.

Other threshold limits such as 50 °C (cold countries), 120 °C, 180 °C or 350 °C may be used.

B.2 Test of response behaviour

The mean airflow for this test shall be as given in 4.2. Starting at an initial temperature of 25 °C, the specimen shall be exposed to the temperature rise specified in 4.2. The response threshold of the release mechanism shall not exceed 140 °C.

An initial temperature of 25 °C and a maximum temperature rise of 115 °C means that 140 °C is the maximum temperature of activation (threshold limit).

The test shall be undertaken three times for symmetrical and six times for non-symmetrical thermal release mechanisms.

B.3 Test of faulty set-off

The specimen shall be exposed to an air temperature of 90 °C ± 2 °C for 1 h. The mean airflow for this test shall be as given in 4.3. The specimen shall be loaded as given in 6.2.2.

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