

Australian Standard[®]

Fire detection and alarm systems

Part 20: Aspirating smoke detectors



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 - Security Providers Association of Australia
 - Society of Fire Safety
-

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Australian Standard[®]

Fire detection and alarm systems

Part 20: Aspirating smoke detectors

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PREFACE

This Standard was prepared by the Standards Australia Committee FP-002, Fire Detection, Warning, Control and Intercom Systems.

The objective of this Standard is to provide the requirements and methods of test for aspirating smoke detectors in fire detection and fire alarm systems in and around buildings. The Standard does not cover aspirating smoke detectors that are intrinsically safe for use in hazardous conditions.

This Standard is identical with, and has been reproduced from ISO 7240-20:2010, *Fire detection and alarm systems—Part 20: Aspirating smoke detectors*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (b) In the source text ‘this part of ISO 7240’ should read ‘this Australian Standard’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>	<i>Australian Standard</i>
ISO 7240 Fire detection and alarm systems (series, as applicable)	AS 7240 Fire detection and alarm systems (series, as applicable)
IEC 60068 Environmental testing (series, as applicable)	60068 Environmental testing (series, as applicable)

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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INTRODUCTION

This part of ISO 7240 is based on a European Standard EN 54-20:2006, prepared by the European Committee for Standardization CEN/TC 72 “*Fire detection and fire alarm systems*”. It has been reviewed and revised by ISO/TC 21/SC 3/WG 21.

Aspirating smoke detectors differ from point-type smoke detectors (see ISO 7240-7) in that air is drawn into the smoke-sensing chamber, rather than relying on convection.

This part of ISO 7240 is not intended to place any other restriction on the design and construction of such detectors.

NOTES

AUSTRALIAN STANDARD

Fire detection and alarm systems**Part 20:
Aspirating smoke detectors**

WARNING — Certain types of detectors contain radioactive materials. National requirements for radiation protection differ from country to country and they are not, therefore, specified in this part of ISO 7240.

1 Scope

This part of ISO 7240 specifies the requirements, test methods and performance criteria for aspirating smoke detectors for use in fire detection and alarm systems installed in buildings.

Aspirating smoke detectors developed for the protection of specific risks that incorporate special characteristics (including additional features or enhanced functionality for which this part of ISO 7240 does not define a test or assessment method) are also covered by this part of ISO 7240. The performance requirements for any special characteristics are beyond the scope of this part of ISO 7240.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7240-1, *Fire detection and alarm systems — Part 1: General and definitions*

ISO 7240-4, *Fire detection and alarm systems — Part 4: Power supply equipment*

ISO 7240-7:2003, *Fire detection and fire alarm systems — Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

EN 50130-4:1995 + Amendment 1:1998 + Amendment 2:2003, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-42, *Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-75, *Environmental testing — Part 2-75: Tests — Test Eh: Hammer tests*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

IEC 61386-1:2008, *Conduit systems for cable management — Part 1: General requirements*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7240-1 and the following apply.

3.1.1

aspirating smoke detector

smoke detector, in which air and aerosols are drawn through a sampling device and carried to one or more smoke-sensing elements by an integral aspirator (e.g. fan or pump)

NOTE Each smoke sensing element may contain more than one sensor exposed to the same smoke sample.

3.1.2

response threshold value

measure of the aerosol concentration in the proximity of the smoke sensing element at the moment that the specimen generates an alarm signal, when it is tested as described in 5.1.5

3.1.3

sampling device

component or series of components or a dedicated device (e.g. a pipe network, dedicated duct, probe or hood) which forms part of the a.s.d. and transfers samples of air to the smoke sensing element(s)

NOTE The sampling device may be supplied separately.

3.1.4

sampling point

any point at which an air sample is drawn into the sampling device

3.1.5

transport time

time for aerosols to transfer from a sampling point to the smoke sensing element

3.2 Abbreviated terms

For the purposes of this document, the following abbreviations apply.

a.s.d.	aspirating smoke detector
c.i.e.	control and indicating equipment
c.p.c.	condensation particle counter
EMC	electromagnetic compatibility
MIC	measuring ionization chamber
r.t.v.	response threshold value

4 Requirements

4.1 Compliance

To comply with this part of ISO 7240, the detector shall meet the requirements of Clause 4, which shall be verified by inspection and engineering assessment, and when tested in accordance with the tests described in Clause 5, shall meet the requirements of the tests.

4.2 Classification

The manufacturer shall clearly state, in accordance with the data presented in 4.13, to which class or classes the aspirating smoke detector is designed. To demonstrate compliance with a specific class, the aspirating smoke detector shall be subjected to the appropriate fire sensitivity test as defined in 5.15.

NOTE Due to the differences and many variations in the design of sampling devices, aspirating smoke detectors are generally intended for use in many varied and often rather specialized applications. Therefore, it might not be practical to conduct type tests that define acceptance criteria for all of these applications. However, in recognition of the diversity of application, three classes are defined to enable system designers and installers to select the most appropriate sensitivity.

Table 1 identifies the classes of detector and the corresponding fire tests used for the classification.

Table 1 — Classification of aspirating smoke detectors

Class	Description	Example application(s)	Test fires
A	Aspirating smoke detector providing very high sensitivity	Very early detection: the detection of very dilute smoke, for example entering air conditioning ducts, to detect the extremely dilute concentrations of smoke that can emanate from equipment in an environmentally controlled area such as a clean room	TF2A, TF3A, TF4 and TF5A
B	Aspirating smoke detector providing enhanced sensitivity	Early detection: for example, special fire detection within or close to particularly valuable, vulnerable or critical items such as computer or electronic equipment cabinets	TF2B, TF3B, TF4 and TF5B
C	Aspirating smoke detector providing normal sensitivity	Standard detection: general fire detection in normal rooms or spaces, giving, for example, at least an equivalent level of detection as a point- or beam-type smoke detection system	TF2, TF3, TF4 and TF5

4.3 Individual visual alarm indication

Each aspirating smoke detector shall be provided with integral red visual indicator(s), visible from outside the aspirating smoke detector, by which the individual smoke-sensing element(s) (see 3.1.1) that released an alarm can be identified until the alarm condition is reset. Where other conditions of the detector can be visually indicated, they shall be clearly distinguishable from the alarm indication.

4.4 Connection of ancillary devices

The detector may provide for connections to ancillary devices (e.g. remote indicators, control relays). Open- or short-circuit failures of these connections shall not prevent the correct operation of the detector.

4.5 Manufacturer's adjustments

It shall not be possible to change the manufacturer's settings except by special means (e.g. the use of a special code or tool) or by breaking or removing a seal.

4.6 On-site adjustment of response behaviour

NOTE 1 The effective response behaviour of an aspirating smoke detector is dependent upon both the sensitivity settings of the smoke sensing element and the design of the sampling device. Many types of aspirating smoke detectors, therefore, have facilities to adjust the smoke-sensing element sensitivity to suit the application and sampling device, etc.

If there is provision for field-adjustment of the sensitivity of the smoke sensing element, then

- a) access to the means of adjustment shall be limited by the requirement for the use of tools or a special code;
- b) it shall be possible to determine what sensitivity settings have been selected and to relate these to documentation that describes the sensitivity settings required for different sampling devices and applications;

NOTE 2 These adjustments may be made at the detector or at the c.i.e.

NOTE 3 Changing sensitivity settings may affect the classification of the installed a.s.d. – see 4.2.

- c) if it is possible to configure the detector (including the sampling device and the sensitivity settings) in such a way that the detector does not comply with this part of ISO 7240, it shall be clearly marked on the detector or in the associated data that, if such configurations are used, the detector does not comply with this part of ISO 7240.

4.7 Response to slowly developing fires

The provision of “drift compensation” (e.g. to compensate for sensor drift due to the build-up of dirt in the detector) and/or the provision of algorithms to match a detector to its environment shall not lead to a significant reduction in the sensitivity of the detector to slowly developing fires.

Because it is not practical to carry out tests with very slow increases in smoke density, an assessment of the response of the detector to slow increases in smoke density shall be made by analysis of the circuit/software, and/or physical tests and simulations.

Where such algorithms are used, the detector shall be deemed to meet the requirements of 4.7 if the documentation and assessment shows

- a) how and why a sensor drifts;
- b) how the compensation technique modifies the detector response to compensate for the drift;
- c) that suitable limits to the compensation are in place to prevent the algorithms/means from being applied outside the known limitations of the sensor and to ensure ongoing compliance with the provisions of this part of ISO 7240;
- d) for any rate of increase in smoke density, R , that is greater than $A/4$ per hour (where A is the initial uncompensated r.t.v. of the a.s.d.), the time for the detector to give an alarm does not exceed $1,6 \times A/R$ by more than 100 s;
- e) that the range of compensation is limited such that, throughout this range, the compensation does not cause the r.t.v. of the detector to exceed its initial value by a factor greater than 1,6.

NOTE Further information about the assessment of requirements d) and e) is given in Annex J.

4.8 Mechanical strength of the pipework

Sampling pipes and fittings shall have adequate mechanical strength and temperature resistance.

Pipes shall either be classified in accordance with IEC 61386-1:2008 to at least class 1131 (for the significance of the digits, see Table 2) or shall be tested in accordance with 5.16.

Table 2 — Mechanical requirements of sampling pipe

Property	Class	Severity
Resistance to compression	1	125 N
Resistance to impact	1	0,5 kg, 100 mm height to fall
Temperature range	31	–15 °C to +60 °C

Where the supplier of the a.s.d. does not supply pipes for the sampling device, the product documentation shall specify that the requirements of this subclause shall be met.

4.9 Hardware components and additional sensing elements in the sampling device

Components, including optional components (box, filter, sensor, valve, etc.), in the sampling device shall be described in the documentation. The a.s.d., including the hardware components listed (i.e. the worst-case combination in accordance with the manufacturer's documentation), shall meet the requirements of this part of ISO 7240.

If the component incorporates a sensing element that participates in the signal output of the a.s.d. (e.g. for localization information), then the performance of the a.s.d., including these sensing elements, shall meet the requirements of this part of ISO 7240.

4.10 Airflow monitoring

4.10.1 The airflow through the aspirating smoke detector shall be monitored to detect leakage or obstruction of the sampling device or sampling point(s).

4.10.2 A fault signal shall be given when the airflow is outside the operational limits as specified by the manufacturer's data.

A fault signal shall be given for the following:

- a) when any leakage or obstruction results in an increase or decrease in the volumetric airflow of 20 % and greater through an aspirating smoke detector; or
- b) when, for aspirating smoke detectors that incorporate technology that provides for constant (or nearly constant) volumetric flow rate, which is largely independent of the sampling device (e.g. incorporates speed control of the fan or uses a positive displacement pump), there is a loss of 50 % or more of sampling points.

In either case, the fault signal shall be released within not more than 300 s of the fault occurring.

NOTE This time is independent of any delay times between signalling the fault and its indication at the c.i.e. and compensates for spurious, short-term flow variations that would otherwise result in an unwanted fault signal.

4.10.3 Where an a.s.d. has a facility to memorize the “normal” flow rate (present when the detector is installed or serviced) and, thereafter, monitor for deviations from this normal flow, the action of setting the memorized “normal” flow shall be a voluntary action at access level 3 (see ISO 7240-2).

4.10.4 Power cycling of the a.s.d. (turning it off and on) shall not result in a change to the memorized “normal” flow rate.

4.11 Power supply

The power for the aspirating detector shall be supplied by power supply equipment in accordance with ISO 7240-4. This power supply equipment may be common to the c.i.e.

4.12 Marking

Each detector shall be clearly marked with the following information:

- a) number of this part of ISO 7240, e.g. “This product conforms to ISO 7240-20”;
- b) name or trademark of the manufacturer or supplier;
- c) model designation (type or number);
- d) wiring terminal designations;
- e) some mark(s) or code(s) (e.g. a serial number or batch code) by which the manufacturer can identify at least the date or batch and place of manufacture, and the version number(s) of any software contained within the detector.

Where the sensitivity class (see 4.2) is marked on the detector, additional information shall be provided to clearly indicate the means by which the classification of any used configuration can be determined.

This additional information may be a cross-reference to a separate document or may be a summary of the worst-case configuration tested under each class.

Where any marking on the device uses symbols or abbreviations not in common use, these shall be explained in the data supplied with the device.

The markings shall be visible during installation and shall be accessible during maintenance.

The markings shall not be placed on screws or other easily removable parts.

4.13 Data

Either an aspirating smoke detector shall be supplied with sufficient technical, installation and maintenance data to enable its correct installation, sensitivity setting and operation or, if all of these data are not supplied with each a.s.d., reference to the appropriate data sheet(s) shall be given on, or with, each aspirating smoke detector.

The manufacturer shall declare in these data the classification of each sampling device configuration and associated sensitivity settings. If the number of configurations is undetermined, the manufacturer shall provide the necessary means to determine the classification of any configuration used.

These data shall also be available on the commercial datasheets to enable the correct design of an installation prior to delivery of the hardware.

These data shall be referred to in the test report and shall be used to describe and determine the worst-case configuration(s) that are used in the fire tests (see 5.15) and the transport time for the sampling point(s) in the fire test room.

The transport time should not include any processing time and is specifically limited to the time required to transport aerosols from the sampling point (in the fire test room) to the sensing element.

The method used for determining the classification shall be clearly stated. This is likely to take into account the following parameters:

- a) sizes and number of sampling points (maximum and minimum) and any limitations on their position along the sampling device;
- b) sensitivity settings for the detector and how this parameter should be adjusted;
- c) details of permitted sampling device arrangement (e.g. single pipe, branch, “H”-configurations);

- d) maximum length of the sampling device (e.g. the maximum pipe length and branch length);
- e) aspirator setting (if adjustable).

4.14 Additional requirements for software controlled detectors

4.14.1 General

For detectors that rely on software control to fulfil the requirements of this part of ISO 7240, the requirements of 4.14.2, 4.14.3 and 4.14.4 shall be met.

4.14.2 Software documentation

4.14.2.1 The manufacturer shall submit documentation to the testing authority that gives an overview of the software design. This documentation shall be in sufficient detail to allow inspection of the design for compliance with this part of ISO 7240 and shall include at least the following:

- a) functional description of the main program flow (e.g. as a flow diagram or structogram), including
 - 1) a brief description of the modules and the functions that they perform,
 - 2) the manner in which the modules interact,
 - 3) the overall hierarchy of the program,
 - 4) the manner in which the software interacts with the hardware of the detector,
 - 5) the manner in which the modules are called, including any interrupt processing;
- b) description of which areas of memory are used for the various purposes (e.g. the program, site-specific data and running data);
- c) designation by which the software and its version can be uniquely identified.

4.14.2.2 The manufacturer shall prepare and maintain detailed design documentation. This shall be available for inspection in a manner that respects the manufacturer's rights of confidentiality. It shall comprise at least the following:

- a) overview of the whole system configuration, including all software and hardware components;
- b) description of each module of the program, containing at least
 - 1) the name of the module,
 - 2) a description of the tasks performed,
 - 3) a description of the interfaces, including the type of data transfer, the valid data range and the checking for valid data;
- c) full source code listings, as hard copy or in a machine-readable form (e.g. ASCII-code), including global and local variables, constants and labels used, and sufficient comment to recognize the program flow;
- d) details of any software tools used in the design and implementation phase (e.g. CASE-Tools, Compilers).

This detailed design documentation may be reviewed at the manufacturer's premises.

4.14.3 Software design

To ensure the reliability of the detector, the following requirements for software design shall apply.

- a) Design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation.
- b) The software shall be designed to avoid the occurrence of deadlock of the program flow.

4.14.4 The storage of programs and data

The program necessary to comply with this part of ISO 7240 and any pre-set data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall be possible only by the use of some special tool or code and shall not be possible during normal operation of the detector.

Site-specific data shall be held in memory that can retain data for at least two weeks without external power to the detector, unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

Unless otherwise specified in a test procedure, the testing shall be carried out after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing described in IEC 60068-1 as follows:

- temperature: (15 to 35) °C;
- relative humidity: (25 to 75) %;
- air pressure: (86 to 106) kPa.

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

5.1.2 Operating conditions for tests

If a test method requires that a specimen be operational, then the specimen shall be connected to suitable supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value or the mean of the specified range.

Where an a.s.d. has multiple sensitivity settings, the sensitivity of the specimen during all tests in Table 3 (with the exception of the fire sensitivity test in 5.15) shall be set at the highest sensitivity setting used during the fire sensitivity test(s).

NOTE It is not intended that the environmental tests be conducted at all possible sensitivity settings, only at the highest used during the fire sensitivity test. This is particularly relevant where multiple classes and/or multiple configurations are submitted.

To allow a check of the flow monitoring function as required before, during and/or after environmental tests, the sampling device may be simulated by a simpler sampling device [e.g. stub pipe with appropriate orifice(s)] to provide a typical airflow through the detector.

During the dry heat, damp heat and cold tests, a sufficient length of pipe shall be installed in the chamber to allow the temperature of the test aerosol entering the specimen to stabilize at the test temperature.

The details of the supply and monitoring equipment and the alarm criteria used shall be given in the test report; see Clause 6.

5.1.3 Mounting arrangements

When necessary, the specimen shall be mounted by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, then the method considered as the most unfavourable shall be chosen for each test.

5.1.4 Tolerances

Unless otherwise specified, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test (i.e. the relevant parts of IEC 60068-2).

If a specific tolerance or deviation limit is not specified in a requirement or test procedure, then a deviation limit of $\pm 5\%$ shall be applied.

5.1.5 Measurement of response threshold value

5.1.5.1 General

There are a number of different a.s.d. operating principles, which have different ranges of sensitivity. Accordingly, various methods can be used to measure the r.t.v. The object of any method chosen shall be to determine a measure of the aerosol concentration that, when passing through the detector, just causes the release of an alarm. This can generally be achieved by introducing smoke or an aerosol into the sampled air stream so that the detector is subjected to a slowly increasing concentration, and recording the concentration at the moment when an alarm is released. The r.t.v. is used only as a relative measurement; therefore, various parameters to measure the aerosol concentration may be used, providing that the chosen parameter is essentially proportional to the particle-number concentration (i.e. a linear relationship) for the particular test aerosol. Further information is provided in Annex A.

5.1.5.2 Typical r.t.v. measurement procedure

Connect the specimen to measuring apparatus as recommended in Annex A. Control the airflow through the detector at a typical rate within the manufacturer's specification.

Connect the specimen to the supply and monitoring equipment in accordance with 5.1.2 and allow it to stabilize for at least 15 min unless otherwise specified by the manufacturer.

Before commencing each measurement, purge the measuring apparatus and specimen sufficiently to ensure that the result is not affected by the previous measurements.

Increase the aerosol concentration at an appropriate rate, depending upon the sensitivity of the specimen. The rate of increase in aerosol density shall be similar for all measurements on a particular a.s.d. type. It is recommended that the alarm signal be released at between 2 min and 10 min after the start of the test.

NOTE Preliminary testing can be necessary to determine the appropriate rate for a particular detector type.

The r.t.v. N shall be taken as the aerosol concentration at the moment when the specimen releases an alarm signal. The particular measuring unit for the aerosol concentration depends on the measuring apparatus used.

5.1.6 Test of the airflow monitoring facility

In accordance with the requirements in 4.10, the airflow monitoring facility shall be tested as follows.

- a) Where the volumetric flow is not maintained at a constant, verify the increase and decrease in flow as follows.
 - 1) Determine the normal volumetric airflow, F_n , expressed in litres per minute, from the sampling configuration used for the fire tests using suitable instrumentation.
 - 2) For testing the airflow monitoring, set the test flow rate, F_t , at the specimen to $F_n \pm 10\%$. If the specimen has a memorized normal flow, enter F_t into the memory in accordance with the normal operating instructions. This shall be done only once at the start of each environmental test and shall not be done during or after conditioning.
 - 3) For decreased flow, decrease the volumetric airflow from F_t by 20 % ($F_t - 20\%$).
 - 4) For increased flow, increase the volumetric airflow from F_t by 20 % ($F_t + 20\%$).

An example of a possible practical arrangement to achieve this test is given in Annex K.

- b) Where the tests of a) cannot be applied (e.g. where the volumetric flow is maintained at a constant), verify the flow monitoring facility by the loss of a maximum of 50 % of the sampling points by disabling the furthest sampling points from the sensing element on the worst-case sampling device used in the fire sensitivity test(s). Test for loss of the points separately as follows.
 - 1) Disable (i.e. close or block off) a total of 50 % of the sampling points furthest from the sensing element.
 - 2) Break the sampling device such that the same points are disabled by the breakage.

5.1.7 Provision for tests

Eight specimen a.s.d. shall be provided to conduct the tests in the test schedule (see 5.1.8), together with sufficient sampling pipes and fittings to set up the various sampling device configuration required by the tests.

The specimens submitted shall be representative of the manufacturer's normal production with regard to their construction and calibration.

This implies that the mean r.t.v. of the eight specimens, found in the reproducibility test, should also represent the production mean, and that the limits specified in the reproducibility test should also be applicable to the manufacturer's production.

5.1.8 Test schedule

The specimens shall be tested according to the test schedule in Table 3. The specimens shall be numbered arbitrarily, with the exception of specimen No. 8.

Table 3 — Test schedule

Test	Subclause	Specimen No. ^a
Repeatability	5.2	1
Reproducibility	5.3	1 to 8 ^b
Variation in supply parameters	5.4	1
Dry heat (operational)	5.5	1
Cold (operational)	5.6	1
Damp heat, steady state (operational)	5.7	1
Damp heat, steady state (endurance)	5.8	2
SO ₂ corrosion (endurance)	5.9	3
Shock (operational)	5.10	4
Impact (operational)	5.11	4
Vibration, sinusoidal (operational)	5.12	5
Vibration, sinusoidal (endurance)	5.13	5
Electromagnetic compatibility (EMC) immunity tests	5.14	6 and 7
Fire sensitivity	5.15	8

^a The schedule shows the specimen numbers recommended for each test. Other arrangements may be used to improve the efficiency or cost of testing, or to reduce the number of specimens damaged by the testing. However, the reproducibility of the sensitivity of at least eight smoke-sensitive parts shall be measured in the reproducibility test. If fewer specimens are being used for the rest of the tests, then it is necessary to consider the possible damaging effects of subjecting a specimen to a number of tests, especially endurance tests.

^b The least sensitive specimen shall be designated specimen No. 8 and used in the fire sensitivity tests.

5.2 Repeatability

5.2.1 Object

The object of this test is to show that the detector has stable behaviour with respect to its sensitivity, even after a number of alarm conditions.

5.2.2 Test procedure

Measure the r.t.v. of the specimen six times in accordance with 5.1.5.

Designate the maximum r.t.v. as $N_{\max}$ and the minimum as $N_{\min}$.

5.2.3 Requirements

The ratio $N_{\max} : N_{\min}$ shall not be greater than 1,6.

5.3 Reproducibility

5.3.1 Object

The object of this test is to show that the sensitivity of the detector does not vary unduly from specimen to specimen.

5.3.2 Test procedure

Test the function of the airflow monitoring facility on each specimen, in accordance with 5.1.6.

Measure the r.t.v. of each of the test specimens in accordance with 5.1.5.

Calculate the mean r.t.v., $\bar{N}$.

Designate the maximum r.t.v. as $N_{\max}$ and the minimum as $N_{\min}$.

5.3.3 Requirements

The correct fault signals, in accordance with 4.10, shall be given during the airflow monitoring facility test.

The ratio $N_{\max} : \bar{N}$ shall not be greater than 1,33.

The ratio $\bar{N} : N_{\min}$ shall not be greater than 1,5.

5.4 Variation in supply parameters

5.4.1 Object

The object of this test is to show that within the specified range(s) of the supply parameters (e.g. voltage), the sensitivity of the specimen is not unduly dependent on these parameters.

This may be demonstrated by testing in accordance with 5.4.2.1 or by consideration of the electronic design of a.s.d. and appropriate testing in accordance with 5.4.3.

5.4.2 Standard test procedure

5.4.2.1 Test procedure

Measure the r.t.v. of the specimen in accordance with 5.1.5.

Test the airflow monitoring facility in accordance with 5.1.6 under the nominal and extremes of the specified supply conditions (e.g. nominal, maximum and minimum supply voltage).

Designate the maximum r.t.v. as $N_{\max}$ and the minimum as $N_{\min}$.

5.4.2.2 Requirements

The correct fault signals, in accordance with 4.10, shall be given during the airflow monitoring facility test.

The ratio $N_{\max} : N_{\min}$ shall not be greater than 1,6.

5.4.3 Alternative test procedure

Where it can be shown by design examination that the sensitivity of the detector and speed of the airflow are independent of the supply voltage, then appropriate measurements (e.g. of internal voltages and flow rate) may be used to determine whether the specimen fulfills this requirement.

The appropriate measurements should be chosen by discussion between the testing laboratory and the manufacture.