BRITISH STANDARD

BS 7346-1:
1990

Incorporating Amendment No. 1

Components for smoke and heat control systems —

Part 1: Specification for natural smoke and heat exhaust ventilators

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Fire Standards Policy Committee (FSM/-) to Technical Committee FSM/14, upon which the following bodies were represented:

Association of Metropolitan Authorities
British Fire Services' Association
British Gas plc
British Retailers' Association
Building Employers' Confederation
Chartered Institution of Building Services Engineers
Chief and Assistant Chief Fire Officers' Association
Consumer Policy Committee of BSI
Department of Education and Science
Department of Health
Department of the Environment (Building Research Establishment)
Department of the Environment (Construction Industries Directorate)
Department of the Environment (Property Services Agency)
Department of the Environment for Northern Ireland
Electricity Supply Industry in England and Wales
Fire Brigades Union
Health and Safety Executive
Home Office
Incorporated Association of Architects and Surveyors
Institute of Building Control
Institution of Fire Engineers
Institution of Gas Engineers
Institution of Structural Engineers
London Fire and Civil Defence Authority
Loss Prevention Council
National Council of Building Material Producers
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Scottish Development Department
Timber Research and Development Association

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Access Committee for England
Association of Consulting Engineers
Association of Rooflights Manufacturers (Arms)
British Automatic Sprinkler Association
British Council of Shopping Centres
British Fire Protection Systems Association Ltd.
British Property Federation
Building Services Research and Information Association
Flat Glass Manufacturers' Association
Intumescent Fire Seals Association
London District Surveyors Association
Smoke Ventilation Association
Society of Fire Safety Engineers
Warrington Fire Research Centre

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Contents

Foreword

This Part of BS 7346 has been prepared under the direction of the Fire Standards Policy Committee and is based on a draft prepared by the Smoke Ventilation Association. It is one of a series of specifications for components of smoke and heat control systems. The other Parts are as follows:

— *Part 2: Specification for powered heat and smoke exhaust ventilators;*

— *Part 3: Specification for smoke curtains.*

The use of smoke and heat exhaust ventilators has become widespread and their value in assisting in the evacuation of people from buildings, reducing fire damage and financial loss by preventing smoke logging, facilitating fire fighting, reducing roof temperatures and retarding the lateral spread of fire is firmly established. For these benefits to be obtained it is essential that smoke and heat exhaust ventilators operate fully and reliably whenever called upon to do so during their installed life.

A heat and smoke ventilation installation is intended to perform a positive role in a fire emergency. Smoke and heat exhaust ventilators should be installed as part of a properly designed smoke and heat exhaust scheme.

Assessed capability. Users of this British Standard are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 7346 specifies performance requirements for natural smoke and heat exhaust ventilators that are intended to be installed in buildings to release the products of combustion in the event of a fire.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this standard the following definitions apply.

2.1
automatic smoke and heat exhaust ventilator

a ventilator that is installed into a building and is designed to open automatically after the outbreak of fire if called upon to do so, to allow smoke and hot gases to escape

NOTE Such ventilators are sometimes referred to as fire vents.

2.2
dual purpose ventilator

a smoke and heat exhaust ventilator which has provision to allow its use for comfort ventilation

2.3
natural ventilation

ventilation that is caused by buoyancy forces due to difference in density of the air because of the effects of temperature differences

2.4
measured free area

the actual measured throat area of the natural heat and smoke exhaust ventilator

NOTE This is normally the smallest clear opening between the drainage channels; no reduction is made for controls, louvres or other obstructions.

2.5
aerodynamic free area

the measured free area (**2.4**) above multiplied by the coefficient of discharge

2.6
coefficient of discharge (C_D)

the ratio of actual flow rate to theoretical flow rate through the ventilator

NOTE The theoretical flow rate (see Appendix A) is calculated for an opening with the same area. The actual flow rate is measured over a range of pressure differences across the ventilator in a suitable wind tunnel. The coefficient is normally constant over the range of pressure differences, and takes into account any obstructions in the ventilator such as controls, louvres, dampers, or other obstructions.

2.7
thermal link

a heat sensitive mechanical linkage which parts when its temperature exceeds a specified limit

NOTE Thermal links can also be specified by time constant, so that they operate in a predetermined period.

3 Construction

3.1 General

3.1.1 The smoke and heat exhaust ventilator shall be constructed so that when correctly installed and in use there is no possibility of flames or hot gases emerging from the ventilator being deflected directly onto an adjacent structure.

3.1.2 The design of the ventilator shall ensure that when in use none of the component parts reduce the ventilation opening if the ventilator disintegrates or collapses due to the effects of fire.

3.1.3 The materials used shall have a class 1 surface spread of flame rating when tested in accordance with BS 476-7.

NOTE The materials used in the construction of the heat and smoke ventilator should not add to the fire risk of the building, nor contribute significantly to a fire during use.

3.1.4 The design of all moving parts, bearings, sliding surfaces, fastenings and other components of the operating mechanisms and the materials from which they are constructed, shall ensure satisfactory operation of the heat and smoke exhaust ventilator during its expected lifetime, which shall be not less than 10 years.

3.1.5 Each heat and smoke exhaust ventilator shall be fitted with a means of automatically opening to vent hot smoke or air. This may take one of the following forms.

a) *Thermal link.* The thermal link shall be mounted within the throat of the ventilator; with flap type ventilators there shall be a single link, so that the parting of the link will release the opening flaps or louvres. It shall be fitted into the ventilator control system in such a way that the load on the thermal link does not exceed the load stamped on the link or the manufacturer's recommendations.

NOTE These links normally fuse at approximately 68 °C to 74 °C.

b) *Multiple control of several ventilators via a frangible bulb activated valve or fusible plug.* The valve or plug shall be positioned at high level and shall release compressed air from pressurized pipework. Unless an alternative temperature is specified, the frangible bulb shall break at 68 °C. Loss of pressure in the pipework shall automatically result in the opening of the ventilators.

c) *Automatic smoke detection system.* The ventilator shall open following an alarm condition initiated by an automatic smoke detection system complying with BS 5839-1.

3.1.6 The ventilator shall be so designed that it will always fail to the fully open position under fire conditions.

3.1.7 When the ventilator has a life safety (i.e. means of escape) application it shall be activated in accordance with **3.1.5** c).

3.1.8 Manual overriding controls shall be provided as part of the control system.

3.1.9 It shall be possible to test the ventilator, remotely open and closed, from working level in the building.

3.2 Resistance to corrosion

The ventilators and control system shall be constructed from materials resistant to natural atmospheric corrosion and sunlight, and shall be selected so as to prevent the possibility of galvanic corrosion between adjacent components.

3.3 Springs

All springs shall be of stainless steel complying with grade 316S31 of BS 970-1 or equivalent.

NOTE Other types of device, such as gas springs, may also be used in place of tension and compression springs.

3.4 Bearings

All pivot points/bearings shall be designed to ensure free movement at all times.

4 Heat and coefficient of performance testing of smoke and heat exhaust ventilators

4.1 A standard production ventilator with a nominal throat size of 1.5 m wide by 2.5 m long shall be submitted to the test schedule described in **4.2** to **4.7**. If the size range is less than the specified size above, then the largest ventilator in the range shall be tested. Ventilator designs for use in the vertical and horizontal positions shall be tested in both planes.

NOTE A test on one size of ventilator will allow an appraisal of other similar ventilators in the range even with different aspect ratios except for coefficients of performance (see **4.3**).
Ventilators of larger area or with unusual aspect ratios may need to be tested on an ad hoc basis.

4.2 The ventilator shall be inspected to ensure that it complies with the published performance data.

4.3 The coefficient of discharge of the ventilator shall be determined in accordance with Appendix A.

4.4 The ventilator shall be mounted either horizontally or vertically on a suitable test rig, depending on whether it is intended for roof or wall application, to check its response to heat and to determine the effects of differential expansion, in accordance with **4.5**, **4.6** and **4.7**.

4.5 The ventilator shall be subjected to a slow rate of temperature rise in accordance with **B.4.1**. The ventilator shall open smoothly to the fully open position, and it shall remain in this position without reduction in the ventilation area. Even if the gas struts fail the ventilator shall be maintained in the open position.

4.6 The ventilator shall be subjected to a fast rate of temperature rise in accordance with **B.4.3**. The ventilator shall open smoothly to the fully open position, and it shall remain in this position without reduction in the ventilation area. Even if the gas struts fail the ventilator shall be maintained in the open position.

4.7 The ventilator shall open as follows:

a) for both slow and rapid rate of rise of temperature tests, smoothly and swiftly to a fully open position so that there is no obstruction of passage of air through the ventilator at any time during test;

NOTE If the ventilator opens prematurely it is not deemed to have failed the tests.

b) for the slow rate of rise of temperature test, within 3 min of the air temperature reaching the stated operating temperature of the heat detector/operating mechanism;

c) for the rapid rate of rise of temperature test, within 90 s of the air temperature reaching the stated operating temperature of the heat detector/operating mechanism.

4.8 The ventilator shall open and close as intended, without failure of any of the components necessary for operation, when the smoke and heat exhaust ventilator is operated 2 000 times, unless it is a dual purpose ventilator, in which case it shall be operated 30 000 times.

4.9 When tested in accordance with Appendix C, the ventilation opening shall remain clear from obstruction throughout the test.

A similar ventilator of a smaller size may be used: the ventilator shall have a minimum measured throat area of 1.2 m × 1.2 m or the largest in the range if smaller than this. If gas struts are used in the ventilator these should be carefully examined for failure.

NOTE 1 If the gas struts fail the ventilator should be maintained in the open position.

NOTE 2 If a range of gas struts is available for the ventilator, it is to be tested with the highest pressure struts fitted.

A ventilator shall have failed the test if one of the following apply:

a) it failed to open;

b) it failed to open fully;

c) when open, the ventilator, because of its design:

1) disturbed the free flow of smoke and hot gases from the rig;

2) deflected smoke and/or hot air onto the surface of the rig;

d) having opened, it reclosed or partially closed subsequently;

e) the ventilator area became blocked or partially blocked after the ventilator had opened.

NOTE 3 If the ventilator failed the test because of d) or e), the manufacturer has the right to retest the ventilator to determine the partially closed/blocked coefficient. Two further ventilators should then be fully tested in accordance with **C.4**. These also should be tested as described in Appendix A, and the lowest coefficient of discharge of all three ventilators can be used in the manufacturer's published literature. Under these conditions the ventilator will be said to have a "qualified" pass.

5 Climatic performance and testing of smoke and heat exhaust ventilators

5.1 A standard production ventilator with a nominal throat size of 1.5 m wide by 2.5 m long shall be submitted to the test schedule described in **5.2** to **5.6**. If the size range is less than the specified size above, then the largest ventilator in the range shall be tested. Ventilator designs for use in the vertical and horizontal positions shall be tested in both planes.

NOTE A test on one size of ventilator will allow an appraisal of other similar ventilators in the range.

5.2 The ventilator shall be inspected to ensure that it complies with the published performance data and is a production sample.

5.3 When tested in accordance with Appendix D, rain shall not visibly penetrate within the ventilator boundary.

5.4 The ventilator shall be designed to withstand a minimum wind load of 2.4 kN/m^2 suction and pressure, or higher where such wind loads are likely to be imposed on the ventilator (see CP3:Chapter V-2).

The ventilator shall be mounted on a suitable test rig and tested to the design wind load. Loads shall be applied as specified in CP 118, BS 449 or BS 5950.

5.5 Uninsulated roof mounted ventilators shall be designed to withstand a snow load of 125 N/m^2 and shall be capable of opening with the snow load applied. Insulated roof mounted ventilators shall be designed to withstand and operate with a snow load of 300 N/m^2. With roof angles α of between 30° and 60° the load shall be modified by a correction factor of $(60 - \alpha)/30$. If the roof angle exceeds 60° then the snow load shall be nil. If higher snow loads are required these shall be calculated in accordance with BS 6399-3.

5.6 The ventilator shall be designed to open and withstand a side wind of 18 m/s (Beaufort Force 8) when in the open position without flaps or louvres closing.

6 Certification of performance data

The manufacturer of the ventilator shall be able to supply a Certificate of conformity to the requirements set out in clause **4**. This certificate shall list the performance criteria and state where the tests were carried out.

All instruments used shall carry a current calibration certificate, traceable to a recognized standard.

7 Servicing

The suppliers of the equipment shall be able to provide a regular maintenance contract and/or to recommend one or more servicing companies.

NOTE It is recommended that after installation the ventilator should be serviced at least once per year. The frequency may have to be increased if the application is in a particularly sensitive or dirty environment, i.e. such occupancies as bleach works and electroplating shops. The minimum recommended annual service is shown in Appendix E.
For life safety (i.e. means of escape) applications the smoke ventilation system should be tested once per week.

Appendix A Coefficient of discharge test

A.1 Principle

The ventilator is mounted in a wind tunnel, and the air flow and pressure across the ventilator is measured over a range of values. The average coefficient of discharge is calculated by comparison with the theoretical air flow through an equivalent opening, so that the aerodynamic free area can be calculated.

A.2 Scope

This test can be used for all natural smoke and heat ventilators.

A.3 Apparatus

A.3.1 *A suitable wind tunnel,* with the facility to cater for a range of air flow rates and pressures (see Figure 1). The face of the tunnel shall be large enough to accommodate the test ventilator.

A.3.2 *A suitable manometer,* to measure the static pressures inside the tunnel.

A.3.3 *A calibrated orifice plate or pitot tube scan,* or other suitable method, to measure accurately the air flows through the ventilator.

A.4 Test procedure

A.4.1 Mount the open ventilator into the face of the tunnel as shown in Figure 1.

NOTE The minimum of 0.2 of the throat width at each side and the minimum of 0.2 of the throat length at the top and bottom is to ensure that the static pressure tappings inside the tunnel are not disturbed by the air flow.

The air flow shall be in the correct direction.

There shall be a clear space in front of the tunnel equal to 1.5 times the largest throat dimension of the ventilator.

A.4.2 Operate the fan driving the tunnel to produce a range of different airflows through the ventilator. Record the static pressure, barometer pressure, airflow and ambient temperature for each flow rate. Take six sets of readings between 10 N/m^2 and the highest pressure difference available. Calculate the coefficient of discharge of the ventilator from these readings.

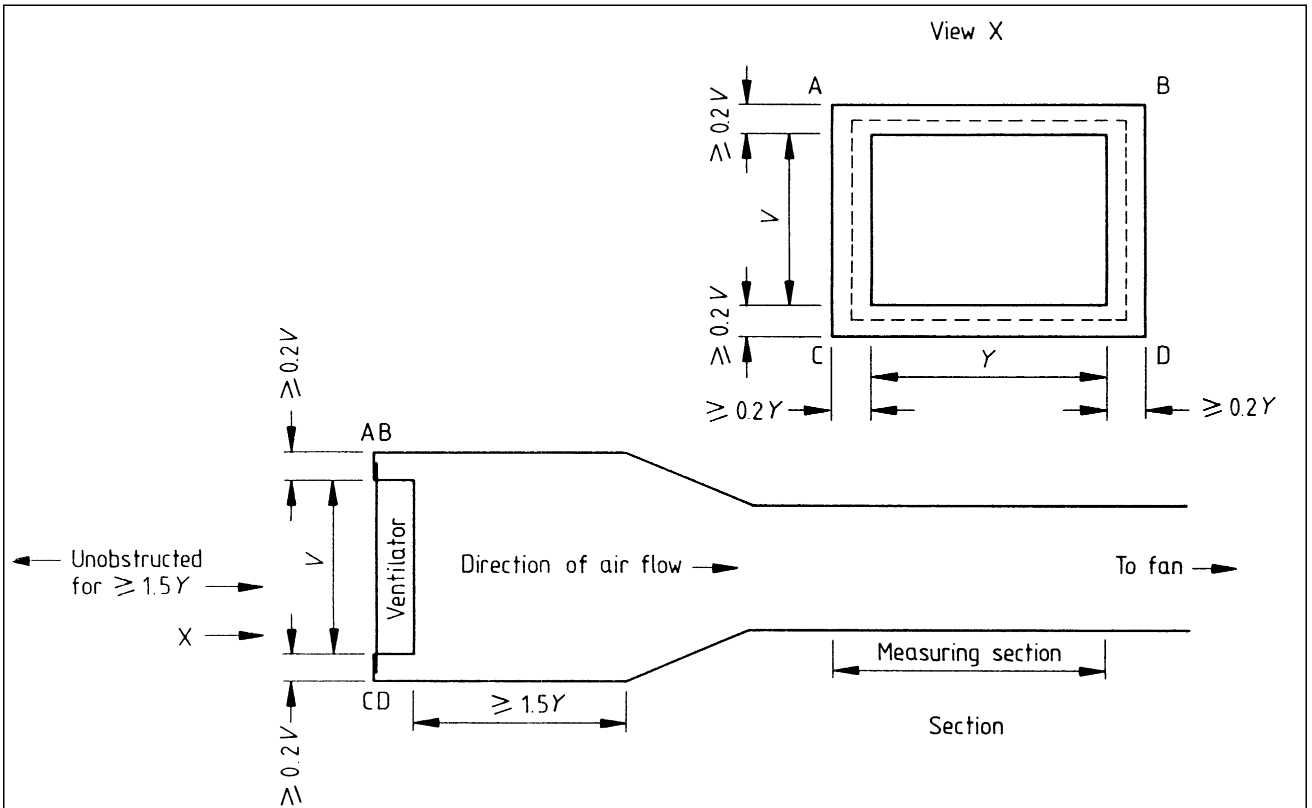

Figure 1 — Wind tunnel

A.5 Calculations

By graphical or calculation methods, determine the best straight line through the plotted points of Q_n^2 against differential pressure, and passing through zero, where Q_n is the air flow through the ventilator in m^3/s. If all the points lie within ± 5 % differential pressure of the best line, then values from any point on the line may be used in the calculation of C_D as the derived value of C_D will be independent of flow rate throughout the range tested.

If isolated points fall outside the ± 5 % band, then tests shall be repeated at the relevant flow rates to check the validity of the data.

If groups of points fall outside the ± 5 % band indicating that the test results do not follow a linear relationship between Q_n^2 and differential pressure, then calculate C_D for each of the test points and plot C_D against Q_n and determine the best line (curve) through the points. If the points fall within ± 5 % of C_D of the best line, then values from points on the line may be used in the interpolation of C_D. Derived data shall include at least the values of C_D at the minimum, median and maximum test flow rates.

Flow measurements shall be in accordance with BS 1042 (air flow measurement accuracy ± 2.5 %, pressure difference accuracy ± 0.25 %), using instruments that carry a current calibration certificate, traceable to a defined national standard.

Calculate the air density from the equation

$$\rho = \frac{346.8 \times P}{1000(273 + t)}$$

where

P is the barometric pressure (in mbar[a]);

t is the ambient air temperature (in °C).

[a] 1 mbar = 10^2 N/m^2 = 10^2 Pa.

Calculate the theoretical flow, Q_t (in m^3/s), from the equation

$$Q_t = A\sqrt{\frac{2\Delta P_s}{\rho}}$$

where

A is the ventilator throat area (in m^2);

ΔP_s is the static pressure difference at the test flow rate (in Pa);

ρ is the air density (in kg/m^3).

Calculate the coefficient of the ventilator from the aerodynamic tests using the equation

$$C_D = \frac{Q_n}{Q_t}$$

where

Q_n is actual flow determined by test.

A.6 Results

Record full details of the ventilator under test, including details of the size and type, the measurements recorded during the tests, and the calculations to determine the coefficient of discharge.

A.7 Determination of leakage coefficient

Use the procedure given in **A.4** with the ventilator closed to determine the leakage coefficient.

Appendix B Temperature rise and expansion test

B.1 Principle

This test simulates the rise in temperature above a developing fire and tests the response of the heat sensitive detecting element of the ventilator to this rise in temperature, and the effects of expansion on the operation of the ventilator. Two sets of conditions are simulated:

a) a slowly developing fire producing a slow rate of rise of temperature;

b) a rapidly developing fire producing a rapid rate of rise of temperature.

B.2 Scope

This test is applicable to ventilators having an integral heat sensitive detection element similar to that described in **3.1.5** a). It can also be used for ventilators without a heat sensitive device by the use of a manual actuator which can be operated after a specified time period.

B.3 Temperature rise test rig

B.3.1 The rig shall consist of an open top box constructed from materials that would be classified as non-combustible if tested to BS 476-4.

B.3.2 A horizontal ventilator to be tested shall form part of the lid of the box. Any gaps between the ventilator and the rig shall be sealed with suitable heat resistant materials.

B.3.3 A vertical ventilator shall be mounted in a specially constructed enclosure forming the lid of the box.

The enclosure shall have walls and roof constructed of non-combustible materials and all gaps between the ventilator and the enclosure, and the enclosure and the rig, shall be sealed with suitable heat resistant materials.

B.3.4 The rig shall be provided with a means of controlling the air temperature within the rig and the rate of rise of this temperature. The temperature control of the rig shall be such that:

a) the air temperature can be raised at 3 °C/min with the air temperature in the rig being at all times within ± 5 °C of that required by the set rate of change of temperature;

b) the air temperature can be raised at 60 °C/min with either:

1) the air temperature in the rig being at all times within ± 10 °C of that required by the set rate of change of temperature; or

2) the area under the temperature/time curve being at all times within ± 15 % of the area under the temperature/time curve resulting from the test described in **B.4.3**. The tolerance shall be calculated in accordance with **3.1.2** of BS 476-20:1987.

It shall be possible to control the rate of rise of temperature as described at least over the range 20 °C to 200 °C.

B.3.5 The air temperature in the rig shall be measured by temperature measuring equipment, e.g. thermocouples, having a time constant not greater than 2 s. The temperature measuring device(s) shall be situated as close as possible to the heat detector/operating mechanism, i.e. fusible link, of the ventilator where fitted.

B.3.6 As well as controlling the temperature in the rig via a temperature controller, the temperature measured by the temperature measuring device(s) shall also be continuously recorded against time.

B.4 Test procedure

B.4.1 With the ventilator in position, and the chart recorder running, raise the air temperature in the rig from ambient (25 °C maximum) at 3 °C/min until 65 °C is reached. It shall be held at this temperature for 1 h and then increased by 3 °C/min until the heat sensitive device operates. Ventilators without a heat sensitive device shall be actuated manually 3 min after the initiation of the increase in temperature after the 1 h period. Note both the air temperature and the time at which the ventilator opens. In addition note any distortion of defect which impairs the operation of the ventilator. If gas struts are used in the ventilator these should be carefully examined for failure.

B.4.2 When the ventilator has operated, switch off the heating elements or burners. Allow the rig to cool to 25 °C or less and fit a new heat detector/operating mechanism to the ventilator where necessary.

B.4.3 Repeat the test as in **B.4.1** but raise the air temperature at a rate of 60 °C/min until the heat sensitive device parts. Ventilators without a heat sensitive device shall be manually actuated 3 min after the start of the test. Do not allow a 1 h dwell period in this test.

B.5 Results

B.5.1 Record full details of the ventilator under test, including details of the heat detector operating mechanism, e.g. fusible link, and its temperature rating.

B.5.2 The report shall state:

a) the air temperature at which the ventilator operated;

b) the time since the beginning of the test when the ventilator operated;

c) the time since the beginning of the test at which the air temperature reached the stated operating temperature of the heat detector/operating mechanism, or the temperature reached at the time of manual actuation.

Record a) to c) for both the slow and the rapid rate of rise of temperature tests.

B.5.3 Record any distortion or defect which impaired the operation of the detector.

Appendix C Fire/heat test

C.1 Principle

The ventilator is tested to destruction to ensure that the ventilator opens under fire/extreme heat conditions and to ensure that the ventilator throat area does not reduce the available airway for smoke release.

C.2 Scope

The test can be used for ventilators incorporating any of the detectors and operating mechanisms described in **3.1.5**. However, if the detector mechanism is not integral with the ventilator [as in **3.1.5** b) and **3.1.5** c)] it is not practical for the detector mechanism to be incorporated into the test. In such cases operation of the ventilator can be manually initiated provided this is done in a similar way to operation under fire conditions, e.g. air may be released from a compressed air line to simulate the breaking of a frangible bulb, or an electric signal may be used to simulate the operation of an electric heat or smoke detection system. Nevertheless, any test and subsequent appraisal of a ventilator with a non-integral detection mechanism is not an appraisal of that detection mechanism.

C.3 Apparatus

C.3.1 *Suitable rig,* constructed of non-combustible materials and large enough to accommodate the test ventilator. The rig design shall ensure that adequate air for combustion is always available.

NOTE The furnace described in BS 476-20 is suitable.

C.3.2 *A means of combustion* fitted to the rig.

NOTE This will normally be gas or oil fired burners; other means of combustion may also be used.

C.3.3 *A multi-channel pen recorder,* in conjunction with thermocouples to monitor temperatures as required, to measure the following temperatures:

a) the air temperature immediately below or behind the ventilator. In the case of a vertically mounted ventilator, air temperatures shall be monitored in line with the top and bottom of the ventilator;

b) where applicable, the temperature as close to the heat detecting/operating mechanism as possible.

C.4 Test procedure

C.4.1 Set up the ventilator in the rig in either a horizontal or vertical position depending on its intended use when installed in a building.

C.4.2 Position the thermocouples, connect them to the chart recorder, and start the chart recorder.

C.4.3 Start the burners or other means of combustion. Adjust the burning rate to provide the time/temperature curve specified in BS 476-20. The test shall be for a minimum period of 10 min.

C.4.4 If the opening of the ventilator is to be initiated manually as described in **C.2** this shall be done when the air temperature reaches 100 °C.

C.4.5 Observe the ventilator throughout the test and note anything that may affect the successful operation of the ventilator (see **4.9**).

C.4.6 On completion of the test allow the ventilator to cool and then examine it to ensure that the fire/heat has not caused any blockage of the airway, thus reducing its efficiency in the release of smoke and hot gases.

C.5 Test report

The test report shall state the following:

a) full details of the ventilator under test, including details of the heat sensitive/detector mechanism, i.e. fusible link, and its rating; if opening of the ventilator was initiated manually as described in **C.2**, this shall be clearly stated, including details of the exact method used;

b) the time, after ignition, that the ventilator opened, and any other observations, with the relevant times, noted during the course of the test;

c) a graph of time against air temperature and, if required, graphs of any other temperatures measured; the temperature at which the ventilator opened shall be noted in the report;

d) any structural damage to the ventilator and whether or not this influenced the release of smoke;

e) whether the ventilator passed or failed the test.

Appendix D Rain testing of natural ventilators

D.1 Principle

The weatherproof characteristics of natural ventilators in the closed position are tested at a variety of angles by driving rain at them.

D.2 Scope

D.2.1 This test procedure is intended for the testing of natural ventilators.

D.2.2 Weather conditions/roof angles which are to be simulated in this test are as follows:

a) wind and rain straight on to the ventilator, rain test rig angles 0°, 15°, 45° and 90° to the horizontal;

b) wind and rain at 45° to the ventilator, rain test rig angles 0°, 45° and 90° to the horizontal;

c) wind and rain at 90°, i.e. across the ventilator, rain test rig angles 0°, 45° and 90° to the horizontal.

NOTE Before testing any ventilator reference should be made to its normal applications; in particular any limitations on roof angles, maximum or minimum, should be observed and testing modified to suit.

D.3 Apparatus

NOTE The test apparatus is shown in Figure 2.

D.3.1 *Variable angle rain test rig*

D.3.2 *Rain nozzle boom*

D.3.3 *Wind machine.*

D.3.4 127 mm (5 inch) *rain gauge and* 250 mL *measuring cylinder.*

D.3.5 *Anemometer*

D.4 Test procedure

D.4.1 Fix the ventilator in the closed position securely to the top of the test rig using either bolts or clamps.

D.4.2 Fill any open area around the ventilator with suitable sheeting and seal with waterproof material, so as to minimize extraneous water leaks and hence make it easier to observe any water entry on the test ventilator.

D.4.3 The rainfall rate shall be 75 mm/h. Set and measure the rainfall rate as follows.

a) Position the rain nozzle boom to give a good "rain" covering.

NOTE One or more nozzles may be used depending on the ventilator size.

b) To measure the rainfall rate, proceed as follows.

1) Place the rain gauge in front of the test rig within the spread of the nozzle.

2) Turn on the nozzle or nozzles to be used having first covered the rain gauge to prevent premature collection.

3) When the water emitted from the nozzles has settled to an even flow rate uncover the rain gauge and collect the water for 15 min.

4) Calculate the rainfall. Adjust the water flow rate and repeat 1) to 3) until a rainfall of 75 mm/h is established.

D.4.4 Wind speed shall be 13 m/s.

Position the anemometer directly in front of the rain test rig.

D.4.5 The test rig and ventilator shall be set at the required angle as given in **D.2.2**.

D.4.6 Turn the "rain" on and leave for 5 min before turning on the "wind". Leave the system under test for a further 15 min. During this time examine the ventilator closely from below to determine if any leaks are present and where they go.

D.4.7 After a further 15 min terminate the test and position the ventilator for the next part of the test.

D.5 Results

D.5.1 Record full details of the ventilator under test.

D.5.2 Note the wind speed and rainfall.

D.5.3 Note any leaks through the ventilator including where the leak originates and where it travels.

Appendix E Service schedule

E.1 Principle

Where smoke and heat exhaust systems are installed it is essential that they are serviced regularly and maintained in good working condition. This service schedule sets the minimum annual service requirements which shall be undertaken.

E.2 Scope

This service schedule applies to equipment used in natural smoke and heat exhaust ventilation systems, i.e. ventilators, compressors, controls and interconnections.

E.3 Service schedule

E.3.1 Check ventilator fixing and weathering, and clean off all dirt with a stiff (not wire) brush from internal and external weathering channels and surfaces of the ventilator.

Check operation of the louvres, flaps and/or dampers, clean bearings and lubricate as necessary.

Check operation of ventilators to ensure they open and close correctly. Replace any failed, distorted, or badly worn components or repair as necessary.

E.3.2 Fully service compressors once per year in accordance with the manufacturer's recommendations and instructions by an approved agent. Leave the compressor operating at the specified pressure. In addition to this annual service the client should ensure that on a weekly basis the oil level is checked and topped up as necessary, the filter is cleaned, and condensate is drained if an automatic drain is not fitted.

NOTE The electrical supply to the compressor should be on automatic reset after loss of power.

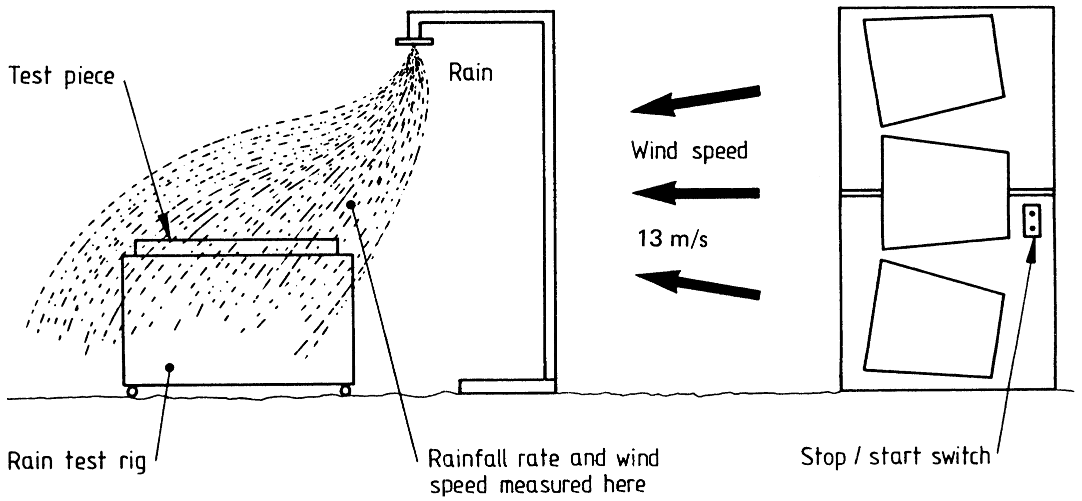

Figure 2 — Apparatus for rain testing

E.3.3 Check the operation of each control panel and override controls. Check the integrity of all internal connections and tighten/remake as necessary. Where components are found to be faulty replace these. Check any remote sensors or detectors to ensure they are operating correctly.

E.3.4 Check all interconnecting pneumatic pipework and electrical systems to ensure the system functions correctly.

E.3.5 It is recommended that after installation the ventilator should be serviced at least once per year. The frequency may have to be increased if the application is in a particularly sensitive or dirty environment, i.e. such occupancies as bleach works and electroplating shops.

E.4 Testing

E.4.1 After carrying out the service detailed in **E.3**, the whole system should be tested to ensure that it operates in accordance with the manufacturer's specification.

E.4.2 A certificate (see **E.5**) should be issued to the user which details the service work and the tests which have been carried out. Any repairs or modifications should be reported.

E.4.3 For life safety (i.e. means of escape) applications the user should test the smoke ventilation system on a weekly basis and maintain a record of testing (see **E.6**).

NOTE To comply with the requirements of the Health and Safety at Work etc. Act 1974 and the IEE Regulations, it will be necessary for the service work to be carried out by a suitably qualified technician.

E.5 Specimen service certificate for smoke ventilation systems

USER'S NAME . . . . REF. NO. . . . .

ADDRESS . . . .

. . . .

. . . .

SYSTEM COMPRISES:

Number and type of ventilators
Number of control panels and overrides
Number of compressors
Type of system, i.e. pneumatic, electrical, etc.
Mode of actuation, i.e. automatic smoke detection, sprinkler flow switch, manual, fusible link, etc.

SERVICE DETAILS

The system has been serviced in accordance with appendix E of BS 7346 : Part 1 : 1990. In addition the following work was carried out:

REPAIRS AND MODIFICATIONS

The following items were repaired or replaced:

The system was modified by:

TESTING

On completion of the above work the whole system was tested as follows:

The system was fully operational and the service was completed to our satisfaction.

User's Signature . . . . Date . . . .

Position . . . .

Service Engineer's
Signature . . . . Date . . . .

E.6 Specimen test record sheet

DATE	HOW OPERATED	RESULT	DETAILS OF FAILURE	SIGNATURE

blank

Publications referred to

BS 449, *Specification for the use of structural steel in building.*

BS 476, *Fire tests on building materials and structures.*

BS 476-4, *Non-combustibility test for materials.*

BS 476-7, *Method for classification of the surface spread of flame of products.*

BS 476-20, *Method for determination of the fire resistance of elements of construction (general principles).*

BS 970, *Specification for wrought steels for mechanical and allied engineering purposes.*

BS 970-1, *General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

BS 1042, *Measurement of fluid flow in closed conduits.*

BS 5750, *Quality systems*[1].

BS 5839, *Fire detection and alarm systems for buildings.*

BS 5839-1, *Code of practice for system design, installation and servicing.*

BS 5950, *Structural use of steelwork in building.*

BS 6399, *Loading for buildings.*

BS 6399-3, *Code of practice for imposed roof loads.*

CP3, *Code of basic data for the design of buildings.*

CP3:Chapter V, *Loading.*

CP3-2, *Wind loads.*

CP 118, *The structural use of aluminium.*

[1] Referred to in the foreword only.

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