INTERNATIONAL STANDARD

ISO 2685

First edition
1992-07-15

Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones

Aéronautique — Conditions et méthodes d'essai en environnement des équipements embarqués — Résistance au feu dans les zones désignées comme "zones de feu"

Reference number
ISO 2685:1992(E)

Contents

		Page
1	Scope	1
2	Definitions	1
3	Requirements	1
4	Test equipment	1
4.1	Large standard burner	1
4.2	Small standard burner	1
4.3	Alternative burners	2
5	Test requirements	2
5.1	Test conditions	2
5.2	Test acceptance criteria	2
6	Acceptance by analogy	2

Annexes

A	Examples of standard burners	3
B	Calibration procedure for standard burners	13
C	Test conditions for fluid systems components	18
D	Test conditions for electrical cables and connectors	20
E	Test conditions for structural components	26
F	Conversion factors	27
G	Bibliography	29

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

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.

International Standard ISO 2685 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Sub-Committee SC 5, *Environmental and operational conditions for aircraft equipment*.

It cancels and replaces ISO Technical Report TR 2685:1984, of which it constitutes a technical revision.

Annexes A, B, C, D and E form an integral part of this International Standard. Annexes F and G are for information only.

Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones

WARNING — Precautions shall be taken to safeguard the health of personnel conducting tests against the risk of fire, inhalation of smoke and/or toxic products of combustion.

1 Scope

This International Standard specifies requirements for all components, equipment and structure contained in designated fire zones and which are constructed to provide a level of resistance to fire not less than the specified minimum.

Two grades of resistance to fire applicable to components, equipment and structure are stated; annexes A to E give details of the types of standard burners and how they shall be used.

This International Standard does not relate to the resistance to fire outside designated fire zones, nor to flammability requirements, nor to those conditions which may exist when combustion chamber burn-through occurs.

NOTE 1 The physical quantities and dimensions given in this International Standard are, wherever practicable, expressed in SI units but are based upon experience of tests conducted with equipment designed to alternative units.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 designated fire zone: Region of an aircraft, for example compartments containing main engines and auxiliary power units, designated as such by the aircraft designer in accordance with the requirements of the approving authority.

2.2 standard flame: Flame having the following characteristics:

— temperature: 1 100 °C ± 80 °C

— heat flux density: 116 kW/m^2 ± 10 kW/m^2

2.3 fire resistant: Grade designating components, equipment and structure capable of withstanding the application of heat by a standard flame for 5 min.

2.4 fireproof: Grade designating components, equipment and structure capable of withstanding the application of heat by a standard flame for 15 min.

3 Requirements

Components, equipment and structure installed in designated fire zones shall, where appropriate, conform to the requirements of one of the grades of resistance to fire (see 2.3 and 2.4). The relevant specification shall state the required grade. Test conditions and acceptance criteria shall be as specified in 5.1 and 5.2.

4 Test equipment

4.1 Large standard burner

The large standard burner shall produce a standard flame and a flame cross-sectional area of not less than 0,018 m^2.

Details of acceptable burners (gas or liquid fuel) are given in annex A.

4.2 Small standard burner

The small standard burner shall produce a standard flame and a flame size of not less than 19 mm diameter.

Details of a small burner are given in annex A.

4.3 Alternative burners

Burners other than those shown in annex A are permitted provided it has been demonstrated that they meet the requirements of 4.1 or 4.2. A burner having a higher heat flux density than a standard burner may be used if agreed by the approving authority.

5 Test requirements

5.1 Test conditions

The following general conditions shall apply to fire tests. Particular conditions to be applied during the fire tests are given in annexes C to E. Any other particular conditions shall be detailed in the specification for the equipment under consideration.

5.1.1 Mounting of specimen

The component, equipment or structure shall be installed on a test rig in a manner that is not less critical than in the aircraft installation, for example in the simulation of heat sink characteristics.

5.1.2 Choice of burner

The type and number of burners shall be chosen so that, during the fire test, the critical parts of the components or items of equipment are enveloped in the test flame(s) from the appropriate direction(s). Generally, a large burner will be required but, for small components, one or more small burners may be used. The nominal axial distance between the burner nozzle(s) and the face of the item under test shall be as defined in annex A.

5.1.3 Calibration of burner

The burner shall be calibrated in accordance with annex B.

5.1.4 Specimen conditioning

For non-metallic components, unless evidence is shown that exposure to aircraft fluids will not adversely affect the resistance to fire characteristics, the specimen shall be conditioned prior to test. Conditioning can be accomplished by immersing the specimen in the fluid for 24 h at ambient temperature.

5.1.5 Test period

The component or item of equipment to be tested shall be subjected to the standard flame for a duration corresponding to the grade of resistance to fire, i.e.

— 5 min for a classification of fire resistant (see 2.3);

— 15 min for a classification of fireproof (see 2.4).

5.2 Test acceptance criteria

The criteria of acceptance shall be that the item is capable of withstanding the appropriate fire test in accordance with the applicable requirements and/or the detailed specification for the component or item of equipment.

Acceptance criteria appropriate to components of fluid systems, electrical systems and structures are given in annexes C to E respectively, or with the particular specification under consideration, where relevant.

6 Acceptance by analogy

If the applicable requirements permit acceptance by analogy, tests to demonstrate compliance with the standard grades of resistance to fire may not be necessary if similarity can be shown either

a) on the evidence from previous testing of similar components, or

b) on the basis of analysis of the design and construction of a component with respect to its inherent resistance to fire.

NOTE 2 The following materials (in the thicknesses given) are considered fireproof:

— stainless steel sheet, 0,38 mm thick;

— mild steel sheet protected against corrosion, 0,46 mm thick;

— titanium sheet, 0,46 mm thick;

— aluminium sheet, 1 mm thick, provided there is

a) an airflow of 41 m/s on the non-flame side of the sheet,
b) zero pressure difference across the sheet, and
c) no significant structural loading of the sheet.

Annex A
(normative)

Examples of standard burners

A.1 Standard large gas burner

A.1.1 Equipment

A.1.1.1 Supply of propane gas with standard regulator valves

The calorific value of the gas shall normally be 93 000 kJ/m^3 (at room temperature and pressure).

CAUTION — The supply bottle(s) shall be kept well away from the burner and test specimen.

A.1.1.2 Supply of low-pressure compressed air

The actual pressure requirement will depend on the user's arrangement of equipment but a low-pressure (for example 35 kPa) supply with a free air flow of 25 m^3/h is usually sufficient. Alternatively, a tapping from a higher pressure supply through a regulator is acceptable.

A.1.1.3 Ways of controlling and measuring gas and air supplies

Ways of controlling and measuring gas and air supplies include manual valves, flow measuring and pressure read-out for gas and air downstream of the valves, and may also feature valve upstream pressure monitoring. For flow measurement, suitable flow-meters may be used; information on flow measurement using differential pressures across an orifice is also included in figure A.3.

NOTE 3 AS401B and BS 3G 100 part 2, section 3, subsection 3.13:1983 show flow-measuring devices mounted with the burner head, but it has been established that they can be used satisfactorily at a console up to 4 m away if connected to the burner by pipes of minimum bore diameter 10 mm.

A.1.2 Details of the burner

The design of the burner is shown in figures A.1, A.2 and A.3 and a photograph of the burner is shown in figure A.4. Important features include:

a) the means of mixing the gas and the air for combustion at the "mixing base";

b) the design of the flame head;

c) the means of introducing cooling air within the structure of the flame head.

A.1.2.1 Mixing base

Air and gas are introduced and mixed in a small chamber. From this chamber, the mixed gas and air enters a relatively large plenum chamber before reaching the flame head.

A.1.2.2 Flame head

The flame head has to act as a flame stabilizer and prevent flashback into the plenum chamber containing a combustible mixture. This is done by using 373 copper tubes cooled by air flowing around them. The cooling air is discharged through 332 holes onto the flame head; it is needed there to keep the burner temperature down at the level required for the test.

A.1.2.3 Cooling air

The cooling air shall be well distributed within the structure of the flame head for the purpose described in A.1.2.2. The top plate and tubing details given on figure A.1 are intended to produce the correct overall effect.

A.1.3 Setting up of the flame

A.1.3.1 Light-up

It is easier to light the burner at reduced gas flow but gas-rich. The following procedure is recommended.

Turn on the gas at a flow rate of about 0,5 m^3/h (12 mm differential water pressure).

Ignite the gas.

If ignition does not occur within a few seconds, turn off the gas and purge the burner with mixing air and wait for low-lying gas near the burner to disperse.

When ignition occurs, introduce mixing and cooling air and then increase the gas flow rates and air flow rates to the intended level without delay.

In order that heating conditions may be stabilized, the apparatus shall be allowed to run for at least

5 min before calibrating the burner or starting the test.

A.1.3.2 Establishing the gas and air flows

Table A.1 gives typical flows of gas and air needed to achieve the characteristics of the standard flame.

Table A.1 — Typical settings for fire integrity testing

	Gas	Mixing air	Cooling air
Flow rate	1 m^3/h	8,9 m^3/h	12,7 m^3/h
Differential pressure	45 mmH_2O	435 mmH_2O	300 mmH_2O
NOTE — The above values may need adjusting to achieve the characteristics of the standard flame (see 2.2).			

A.1.3.3 Calibration

The burner shall be calibrated in accordance with annex B and shall meet the requirements for the standard flame (see 2.2).

A.1.3.4 Distance between burner and test specimen

The nominal axial distance between the burner nozzle and the face of the test specimen shall be 75 mm for vertical and horizontal applications.

A.1.3.5 Shut-down

After the test, the gas shall be turned off first. The air flow shall be turned off only when the burner has cooled sufficiently.

A.2 Standard large liquid fuel burner

A.2.1 General

The details of the standard large liquid fuel burner specified in this annex are equivalent to those found in FAA Powerplant Engineering Report No. 3A. A typical liquid fuel burner complying with the requirements of this annex is shown in figure A.5.

A.2.2 Details of the burner

The liquid fuel burner shall

a) be of a modified gun type;

b) have an 80° spray angle nozzle, nominally rated at 8,5 l/h (assuming a typical fuel calorific value of $42{,}8 \times 10^3$ kJ/kg);

c) have a 318 mm burner extension fixed at the end of the tube, with an opening 152 mm high and 280 mm wide, as shown in figures A.6 and A.7; and

d) have a burner fuel pressure regulator that is capable of adjusting the fuel flow to achieve the characteristics of the standard flame (see 2.2).

A.2.3 Setting up the flame

The burner shall be lit and set up in accordance with the manufacturer's instructions. The flame shall be allowed to stabilize for at least 5 min before calibration or testing.

A.2.4 Calibration

The burner shall be calibrated for temperature and heat flux density in accordance with annex B and shall meet the requirements for the standard flame (see 2.2).

A.2.5 Distance between burner and test specimen

The nominal distance between the end of the burner extension and the component or item of equipment under test shall be 100 mm.

A.3 Standard small gas burner

A.3.1 General

Measurements have shown that the heat flux density of a standard small gas burner can exceed that specified for the standard flame. However, the use of this burner type is acceptable if agreed to by the approving authority.

A.3.2 Details of the burner

Figure A.8 shows only the essential details of the burner assembly. It comprises a gas injector complete with venturi and a jet, steel burner tube and gauze filter.

As received, the jet assembly in the body of the gas injector is normally fitted with fibre washers. These washers should be removed and new light alloy washers fitted in their place. These washers shall be bedded in carefully on both sides to form gas-tight joints. The jet shall be checked to ensure that it is clean and that it is firmly tightened in its holder, by means of the jet-key supplied with the jet.

The following items will be required for use in conjunction with the burner assembly:

a) a cylinder of propane gas;

b) a gas pressure regulator;

c) a pressure gauge of suitable range;

d) copper and flexible tubing, together with the necessary couplings.

A.3.3 Setting up the flame

The gas pressure shall be set at 24 kPa (gauge) with the torch alight and with the air-adjusting nut set to give clearly defined blue cones in the flame, with the tips of the cones almost level with the end of the burner tubes. The best setting is usually that at which the conical bore in the rear end of the adjusting nut is in line with the tip of the jet (see figure A.8).

After the burner has been ignited, the flame stabilized and the torch adjusted, a blue inner cone will extend up 20 mm from the plane of the nozzle. The total length of the flame will then be of the order of 200 mm.

When the torch is satisfactorily adjusted, the flame shall be allowed to stabilize for at least 5 min before calibration or testing.

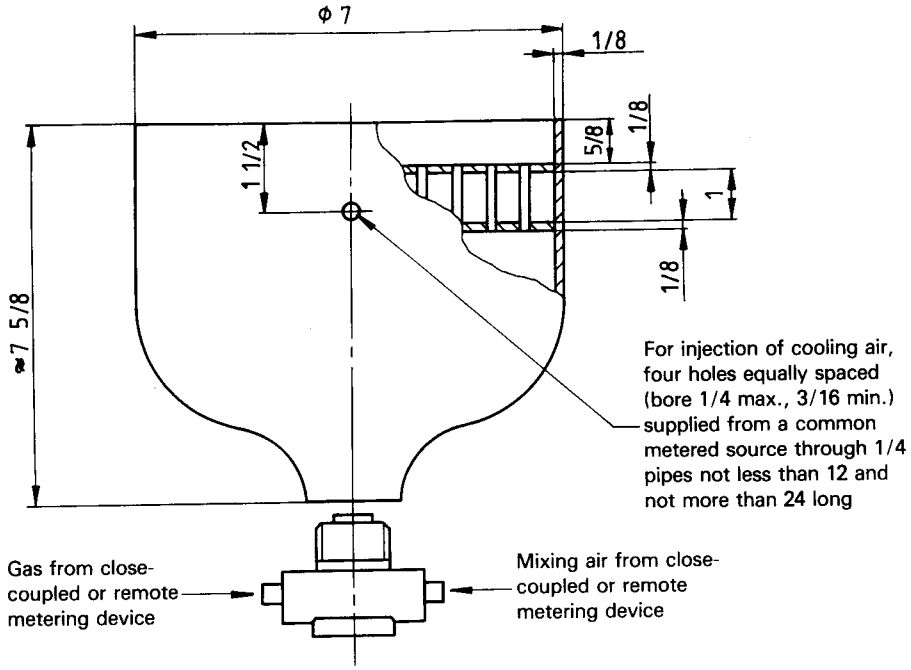
A.3.4 Calibration

The burner shall be calibrated in accordance with annex B and shall meet the requirements for the standard flame (see 2.2). If the measured heat flux density exceeds the requirements for the standard flame, the actual value measured shall be noted.

A.3.5 Distance between burner and test specimen

The nominal axial distance between the burner nozzle and the face of the specimen under test shall be that at which the standard flame conditions are achieved (approximately 50 mm).

Dimensions in inches



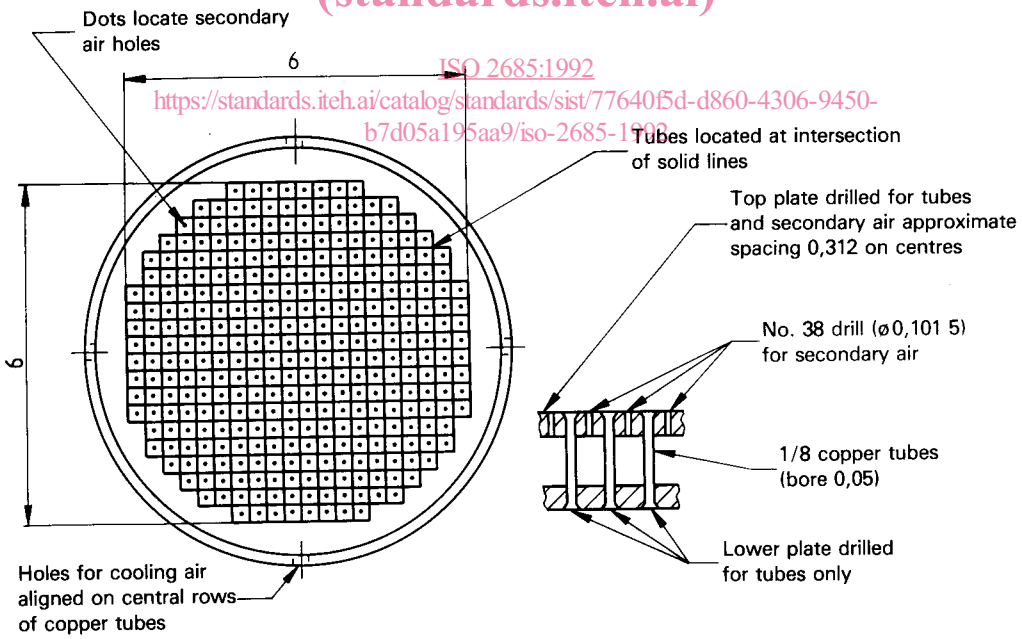
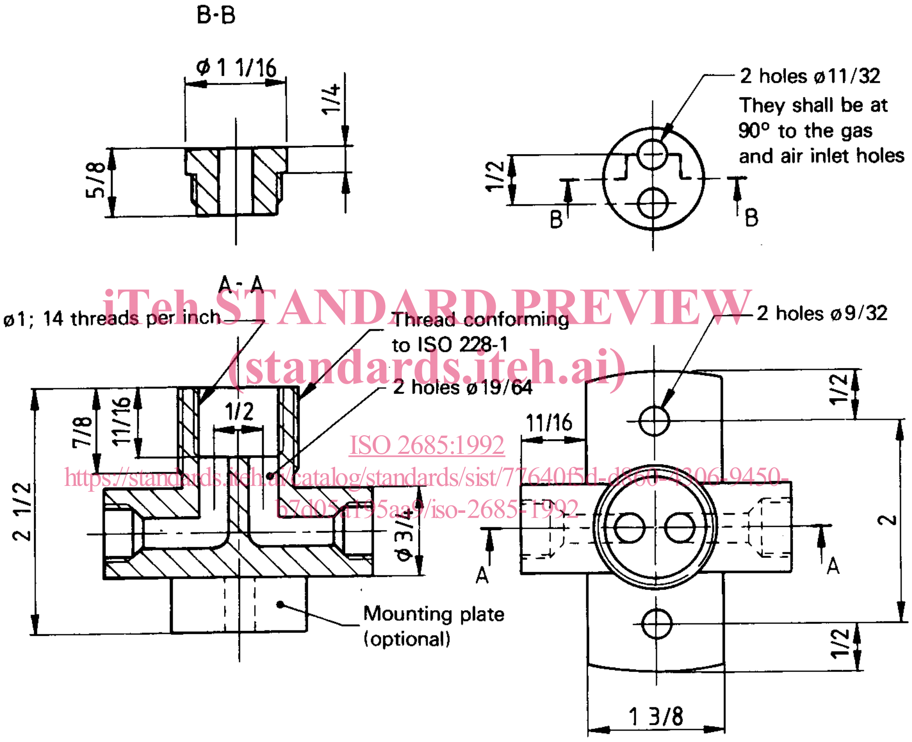


Figure A.1 — Large gas burner

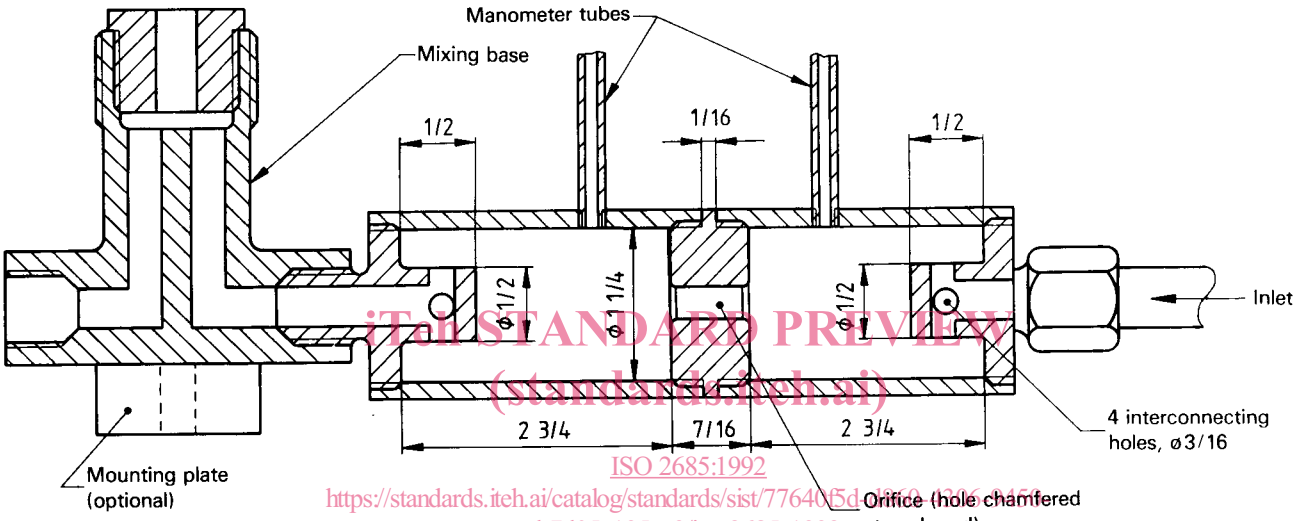
Dimensions in inches

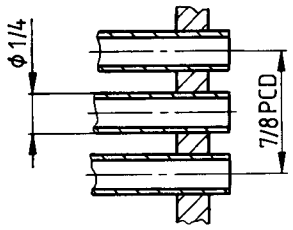


NOTE — AS401B gives additional constructional details.

Figure A.2 — Large gas burner — Mixing base

Dimensions in inches





4 pipes for cooling air

Metering end for cooling air

Orifice sizes

Gas	5/32
Mixing air	1/4
Cooling air	5/16

NOTES

1 Commercially available gas and air flow-meters may be used.

2 When differential values are stated for setting gas and air flows, these relate to a metering device. (See table A.1.)

3 The equipment may be close-coupled to the burner, or may be remote if a different end-fitting with an air manifold for the cooling air connections is used.

Figure A.3 — Large gas burner — Metering device