INTERNATIONAL STANDARD

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Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones

Aéronefs — Méthode d'essai en environnement des équipements embarqués — Tenue au feu dans les zones désignées «zones de feu»

Reference number
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Contents

Annexes

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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.

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*.

This second edition cancels and replaces the first edition (ISO 2685:1992), of which it constitutes a technical revision.

Annexes A and B form an integral part of this International Standard. Annexes C to G are for information only.

NOTE — Annexes C, D and E are temporarily maintained for information purposes pending the preparation of standards regarding specific test conditions for the products concerned.

Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones

CAUTION — 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 the tests conditions applied to all components, equipments and structures located in zones designated as "fire zones" and built to satisfy the minimum specified level for resistance to fire.

Two grades of resistance to fire are applicable to components, equipments and structures.

Annexes A and B give details of the types of burners providing the standard flame 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 induced by the flame coming from the combustion chamber.

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 received by the standard apparatus described in B.4.2: (116 ± 10) kW/m^2

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

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

3 Test equipment

The burner shall produce a flame having the characteristics of the standard flame.

Examples of this burner (gas or liquid fuel) are given in annex A.

4 Test requirements

4.1 Test procedure

The following procedure applies to all the fire tests. Particular conditions to be applied during the fire tests shall be detailed in the specification of the equipment under consideration.

4.1.1 Mounting of specimen

The component, equipment or structure shall be installed on a test rig defined in the specification of the equipment under consideration, in conditions at least equivalent to those encountered in the aircraft.

4.1.2 Choice of burner

The type and number of burners shall be chosen such 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).

For that, the following conditions shall be fulfilled:

$$A \leq 2B$$

where

A is the major cross-section of the equipment or specimen, in square metres;

B is the area of the flame at the nozzle of the burner, in square metres.

The nominal axial distance between the burner nose(s) and the surface of the item under test shall be as defined in annex A.

4.1.3 Calibration of burner

The burner shall be calibrated in accordance with annex B.

4.1.4 Test duration

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

– 5 min for a "fire resistant" classification (see 2.3);

– 15 min for a "fireproof" classification (see 2.4).

4.2 Test acceptance conditions

As conditions of acceptance, the item shall be capable of withstanding the fire test corresponding to the appropriate requirements and/or to its detailed specification.

Annex A
(normative)

Examples of burners providing the standard flame

A.1 Gas burner

A.1.1 Equipment

A.1.1.1 Supply of low pressure compressed air

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

A.1.1.2 Means of controlling and setting gas and air supplies

Means of controlling and setting gas and air supplies include manual valves and metering devices to measure differential pressure of gas and air, and, eventually, feature valve upstream pressure monitoring. For flow setting, figure A.3 indicates how to proceed using differential pressure across each orifice.

NOTE — BS 3G 100 part 2, section 3, subsection 3.13 (1983) shows 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 with a minimum bore diameter of 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 gas and 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 larger plenum chamber before reaching the flame head.

A.1.2.2 Burner head

The burner head must act as a flame stabilizer and prevent flashback into the plenum chamber containing the combustible mixture. To do this, the burner is made up of 373 copper tubes which are cooled by air flowing around them. The cooling air is supplied through 332 holes at the flame head, thus maintaining the burner temperature 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, shown in figure A.1, are designed to produce the correct overall effect.

A.1.3 Flame setting

A.1.3.1 Lighting

It is easier to light the burner when the gas flow is reduced, 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, 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, then immediately increase the gas flow rates and air flow rates to the intended level;

– in order for the heating conditions to stabilize, allow the apparatus to run for at least 5 min before calibrating the burner or starting the test.

A.1.3.2 Gas and air differential pressure settings

Table A.1 gives the typical gas and air settings needed to achieve the characteristics of the standard flame according to the metering devices of figure A.3.

Table A.1 — Typical settings for fire testing

	Gas	Mixing air	Cooling air
Differential pressure	440 Pa ($45\ mmH_2O$)	4 265 Pa ($435\ mmH_2O$)	2 940 Pa ($300\ mmH_2O$)
NOTE — The above values may need adjusting to achieve the characteristics of the standard flame (see 2.2) and are established for a calorific value close to 93 000 kJ/m^3.			

A.1.4 Calibration

The burner shall be calibrated in accordance with annex B and shall meet the requirements for the standard flame (see 2.2). The nominal axial distance, *h*, between the burner nose and the surface of calibration equipment in practice is close to 75 mm (see figures A.1, B.2 and B.3).

A.1.5 Distance between burner and test specimen

The nominal axial distance $h \pm 10$ %, between the burner nose and the surface of the test specimen, shall be the one determined by the calibration of the flame.

A.1.6 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 Liquid fuel burner

The details of the 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.2.1 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 x 10^3 kJ/kg);

c) have a 318 mm burner nozzle fixed at the end of the tube, with a 152 mm high and 280 mm wide opening, 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.2.2 Flame setting

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

A.2.3 Calibration

The burner shall be calibrated in accordance with annex B and shall meet the requirements for the standard flame (see 2.2). The nominal axial distance h between the end of the burner nozzle and the calibration equipment in practice is close to 100 mm (see figures A.6, B.2 and B.3).

A.2.4 Distance between burner and test specimen

The nominal axial distance $h \pm 10$ % between the end of the burner nozzle and the test specimen shall be the one determined by the calibration of the flame.

Dimensions in inches,
in millimetres in parentheses

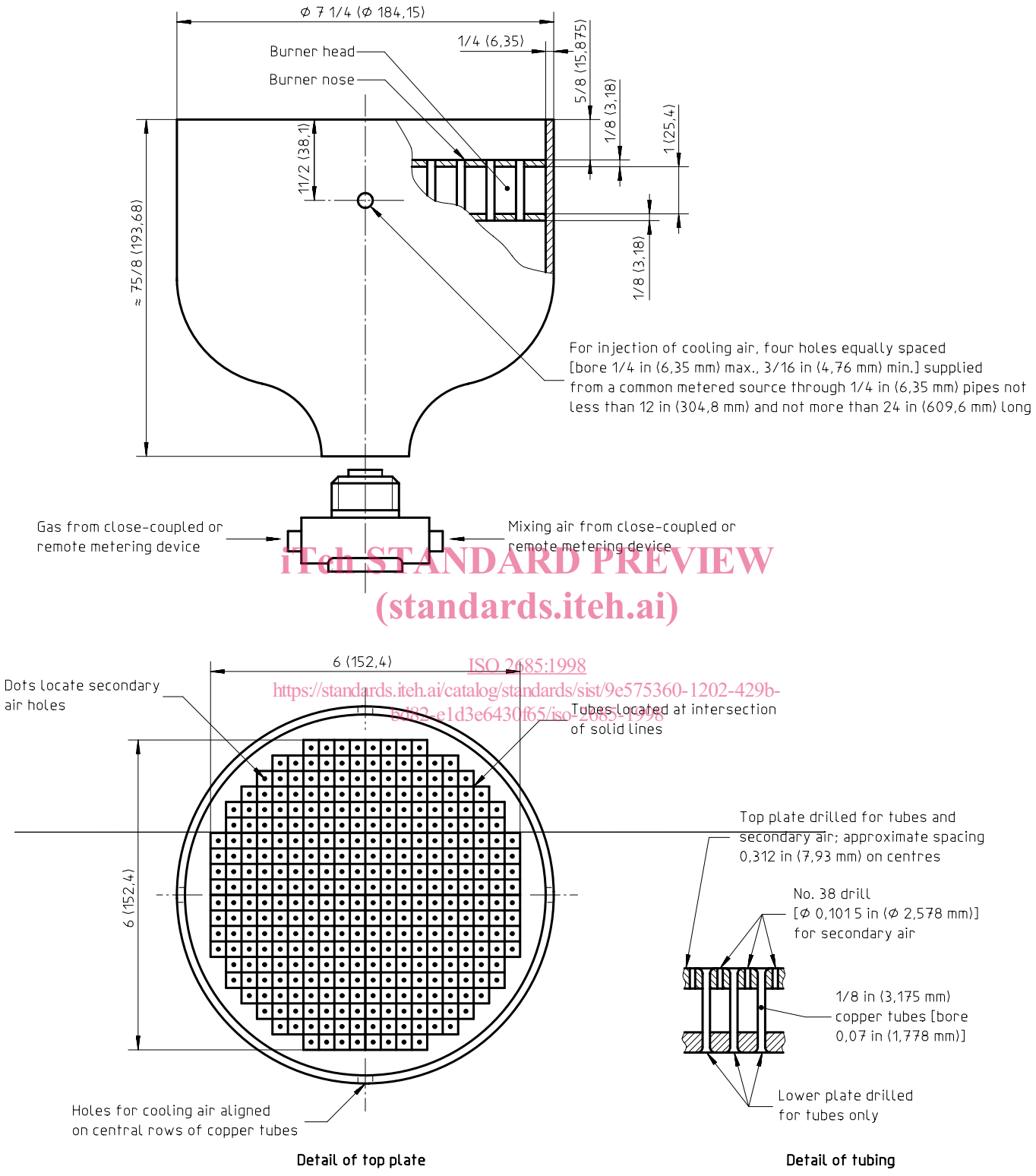
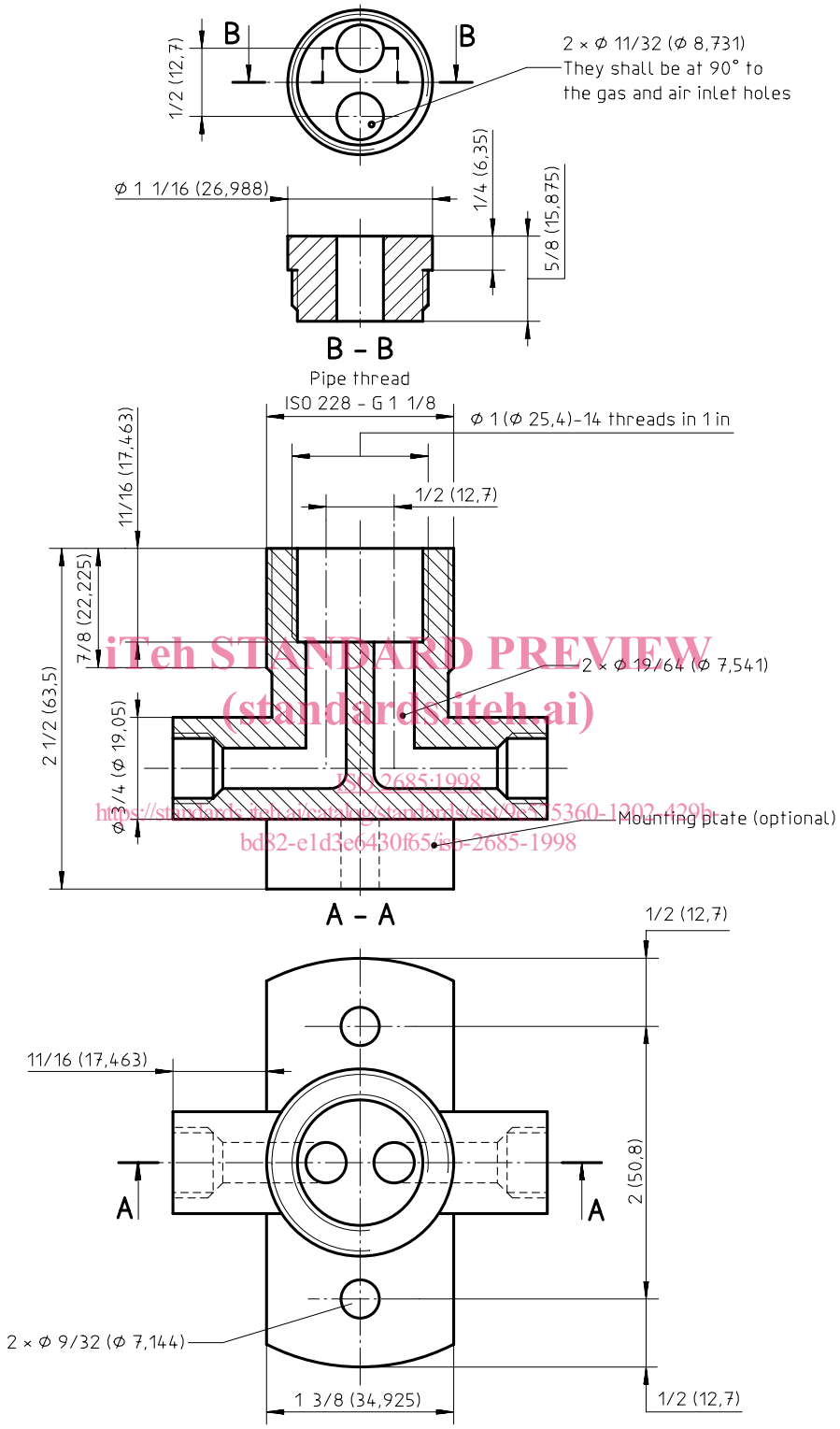


Figure A.1 — Gas burner

Dimensions in inches,
in millimetres in parentheses



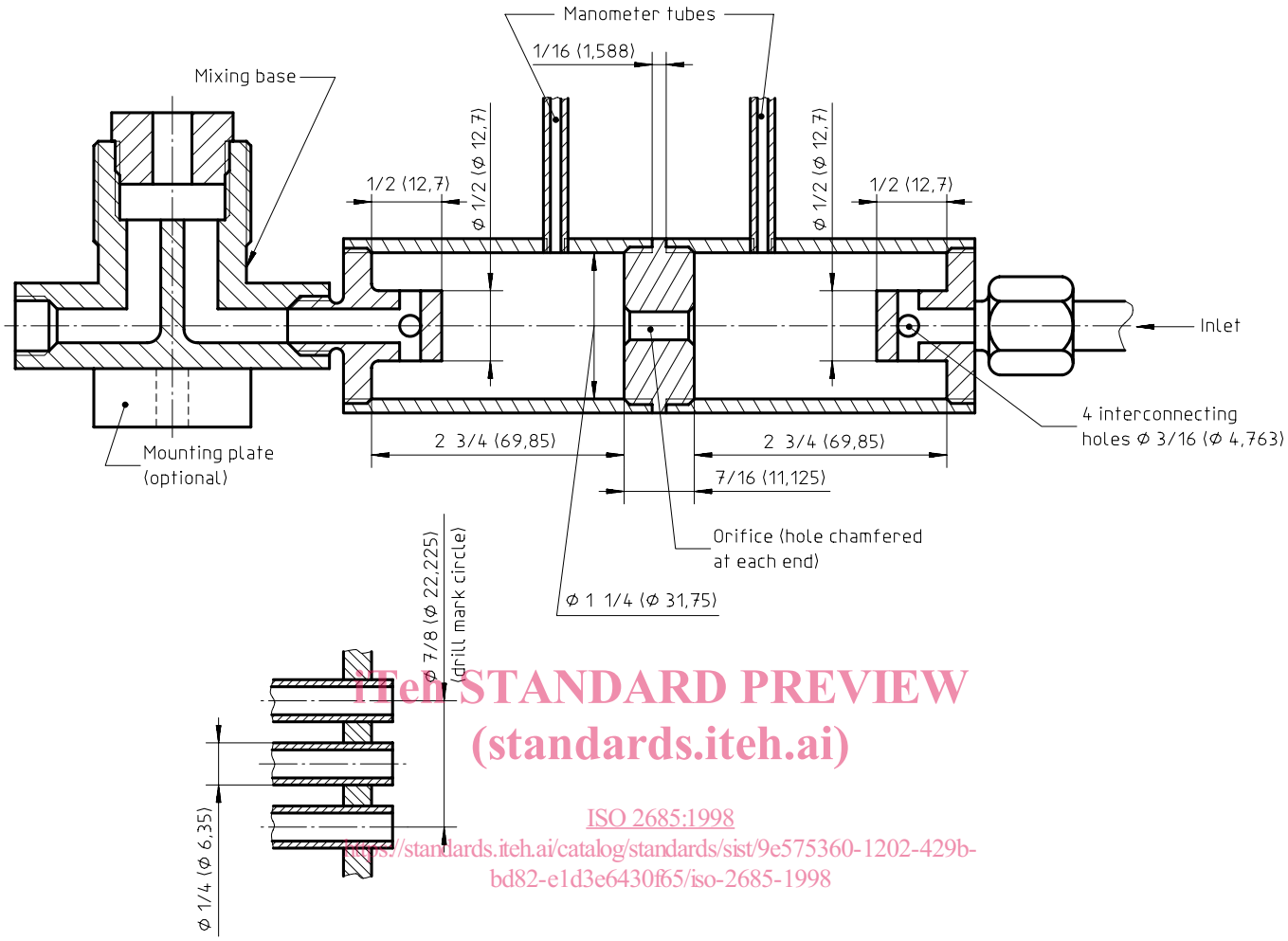
NOTES

1 AS401B gives additional constructional details.

2 The threads shall be sealed during mounting.

Figure A.2 — Gas burner — Mixing base

Dimensions in inches,
in millimetres in parentheses



4 pipes for cooling air

Metering end for cooling air

Orifice sizes

Gas	5/32 (3,969)
Mixing air	1/4 (6,35)
Cooling air	5/16 (7,938)

NOTES

1 When differential pressure values are stated for setting gas and air flows (see table A.1), they relate to the metering device above.

2 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.

3 The threads shall be sealed during mounting.

Figure A.3 — Gas burner — Metering device