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Oxygen/fuel gas blowpipes (cutting machine type) with cylindrical barrels — General specifications and test methods

Chalumeaux oxy-gaz combustible (type machine d'oxycoupage) à corps cylindrique — Spécifications générales et méthodes d'essai

Reference number
ISO 5186:1995(E)

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 5186 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

Annexes A and B of this International Standard are for information only.

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Oxygen/fuel gas blowpipes (cutting machine type) with cylindrical barrels — General specifications and test methods

1 Scope

This International Standard specifies the characteristics of machine cutting blowpipes and gives specifications and corresponding tests.

This International Standard applies to machine cutting blowpipes which are fitted to a gas cutting machine and which have cylindrical barrels where the nozzle centre is coaxial with the barrel, the blowpipe operates with oxygen and fuel gas and has a cutting range from 3 mm to 300 mm cutting thickness.

NOTE 1 In addition to terms used in two official ISO languages (English and French), this International Standard gives the equivalent terms (and definitions) in the German language; these are published under the responsibility of the member body for Germany (DIN). However, only the terms given in the official languages can be considered as ISO terms.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3:1973, *Preferred numbers — Series of preferred numbers.*

ISO 3253:1975, *Hose connections for equipment for welding, cutting and related processes.*

ISO 5175:1987, *Equipment used in gas welding, cutting and allied processes — Safety devices for fuel gases and oxygen or compressed air — General specifications, requirements and tests.*

ISO 9090:1989, *Gas tightness of equipment for gas welding and allied processes.*

ISO 9539:1988, *Materials for equipment used in gas welding, cutting and allied processes.*

3 Definitions

Terminology concerning machine cutting blowpipes is given in annex B. The design details of the blowpipes are left to the discretion of the manufacturer; the illustrations in this International Standard are solely to clarify the terms.

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

3.1 Common types of mixing systems

3.1.1 injector-mixer: Mixing system in which the fuel gas and the oxidizing gas are mixed by the action of the latter which, being discharged from the orifice of the injector, reduces the pressure, thus entraining the fuel gas.

Accordingly, when the valve in the fuel gas channel is closed while the oxidizing gas is normally discharged, the pressure in this channel is below atmospheric pressure. If, at the same time, the fuel gas hose connecting nipple is exposed to the atmosphere, air will be entrained (fuel gas valve open — see figure 1).

3.1.2 mixer without injector action: Mixing system in which the fuel gas and the oxidizing gas are mixed when the latter is discharged from the orifice and meets the fuel gas which is discharged at nearly identical pressure. When the valve in the fuel gas channel is closed while the oxidizing gas is discharged, the pressure in this channel is higher than the atmospheric pressure. If, at the same time, the fuel gas hose connecting nipple is exposed to the atmosphere, oxidizing gas will be discharged (fuel gas valve open — see figure 2).

NOTE 2 Position of the mixing systems:

The mixing systems according to 3.1.1 and 3.1.2 are usually in the blowpipe or in the nozzle.

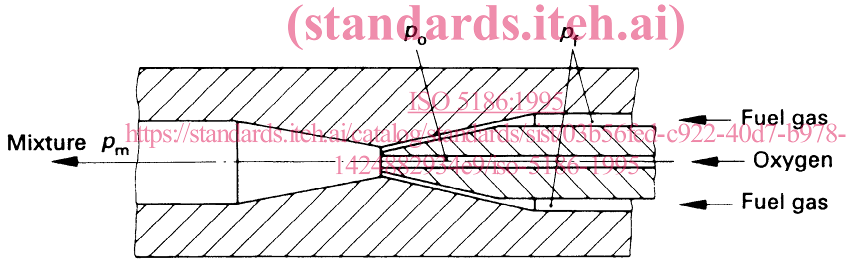
3.2 High-pressure and low-pressure blowpipes

3.2.1 high-pressure blowpipe: A blowpipe in which the pressure of both the fuel gas and the oxidizing gas measured immediately before the point of mixing is higher than the pressure of the gas mixture measured downstream between mixer and nozzle (see figure 2).

3.2.2 low-pressure blowpipe: A blowpipe in which the fuel gas pressure measured immediately before the point of mixing is lower than the pressure of the gas mixture measured downstream between mixer and nozzle (see figure 1).

3.3 Blowpipes classified according to the possibility of varying the flow rate

3.3.1 blowpipe with multiple flow rates: A blowpipe giving a range of flow rates corresponding to a series of nozzles.



p_f = pressure of fuel gas

p_o = pressure of oxygen

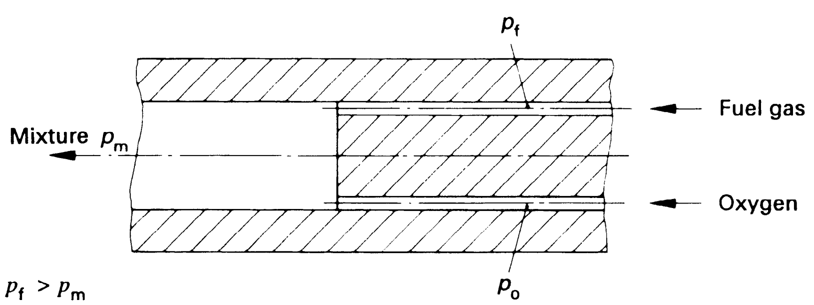
p_m = pressure of mixture

$p_f < p_m$ - low pressure

$p_f > p_m$ - high pressure

$p_o > p_m$

Figure 1 — Injector mixer (low and high pressure)



$p_f > p_m$

$p_o > p_m$

Figure 2 — Mixer without injector action

3.3.1.1 blowpipe with multiple gas flow rates adjusted by means of the injector: A blowpipe with multiple gas flow rates which are varied by means of a device for adjustment of the injector cross-section (blowpipe with variable injector).

3.3.1.2 blowpipe with multiple gas flow rates adjusted by the pressure: A blowpipe with multiple gas flow rates which are varied by adjusting the feed pressures (blowpipe with fixed mixer).

3.3.1.3 blowpipe with multiple gas flow rates adjusted by means of gas control valves: A blowpipe with multiple gas flow rates which are varied by means of the adjustment valves.

3.4 Blowpipes classified according to the mixing position

3.4.1 blowpipe with preliminary mixer: A blowpipe in which the mixture of heating oxygen and fuel gas is ensured by the injector-mixer located before the cutting nozzle.

3.4.2 blowpipe with nozzle mixing: A blowpipe in which the heating oxygen and fuel gas ways are independent in the blowpipe and the head. The gases are mixed in the cutting nozzle (nozzle mixing).

3.5 Backfire, sustained backfire, flashback, backflow

3.5.1 backfire: The return of the flame into the blowpipe with a popping sound, the flame being either extinguished or reignited at the nozzle.

3.5.2 sustained backfire: The return of the flame into the blowpipe with continued burning within the neck or mixer. (This may be accompanied by an initial popping sound followed by a continuous hissing sound caused by continued burning within the blowpipe.)

3.5.3 flashback: The return of the flame through the blowpipe into the hoses and even the regulators. It may also reach the acetylene cylinder, causing heating and decomposition of the contents.

3.5.4 backflow: Flowing back of the gas at the higher pressure into the hose of the gas at the lower pressure. This can be caused by the nozzle exit becoming blocked or restricted.

4 Dimensions

4.1 Shank diameter

The diameter of the blowpipe cylinder shank (D) is preferably equal to one of the following values:

— 32 mm, 35 mm = usual diameters;

— 28 mm = useful diameter for portable machines and robot equipment;

— 45 mm = used e.g. for automatic internal ignition systems.

Tolerance on shank diameter $^{0}_{-0,2}$ mm.

4.2 Shank length

The shank length (L) is the length on which the blowpipe holder can be fixed.

The shank length will be preferably equal to 50 mm, 100 mm, 160 mm, 250 mm and 400 mm.

If other lengths are to be used, they should comply with the series R 20 (ISO 3).

4.3 Rack

The rack is not mandatory, unless required by the blowpipe fixing and height adjusting device.

If a rack is fitted it shall comply either with type F, S, J or N given in table 1.

A spur tooth rack is characterized by its width, the module and pitch of its teeth and its position on the cylinder shank (dimension E on figure 3).

5 Hose connections

The nipples shall either be permanently fitted to the shank or be detachable. The external profile of the nipples is left to the choice of manufacturer. Where a threaded union connection is used it shall conform to ISO 3253.

6 Material

The material requirements, according to ISO 9539, shall be fulfilled.

Components in contact with oxygen shall be free from oil, grease and other contaminants.

Table 1 — Dimensions of the rack

Spur tooth rack	Type F	Type S	Type N	Type J
Module	1	1,25	0,794	1
Pitch, mm	3,14	3,927	2,49	3,14
Width B, mm	$8\ ^{0}_{-0,2}$	$8\ ^{0}_{-0,2}$	$6{,}22\ ^{0}_{-0,13}$	$6\ ^{0}_{-0,2}$
Dimension E, mm	$D + 7\ ^{0}_{-0,3}$	$D + 7\ ^{0}_{-0,3}$	$D + 6{,}35\ ^{0}_{-0,3}$	$D + 6\ ^{0}_{-0,3}$

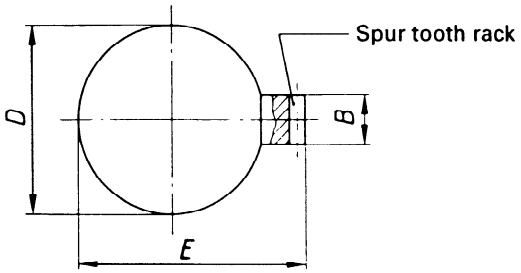


Figure 3 — Main specifications

7 Marking

The marking shall be legible and durable.

7.1 Marking of the blowpipe

The blowpipe shank shall carry the name or registered trade mark of the manufacturer (the term "manufacturer" includes distributors, suppliers or importers) and the reference number of this International Standard. The marking shall be according to 7.5 and 7.6. The connection adjacent to the oxygen inlet of blowpipes with fixed hose connecting nipples shall be identified by the letter "O".

7.2 Marking of oxygen valves

The heating oxygen valves (body or knob) shall be identified by the letter "O" and/or the colour blue.

The cutting oxygen valve shall be identified if similarly designed.

7.3 Marking of nozzles

All nozzles shall be marked with the name, registered trade mark or identifying mark of the manufacturer, the symbol identifying the fuel gas and a code to allow easy reference to the manufacturer's operating data.

7.4 Marking of interchangeable components

Where mismatching of interchangeable components (e.g. mixer and injector) could occur, an identifying code, the manufacturer's trade mark and the symbol identifying the fuel gas shall be marked and shown in the operating data.

7.5 Marking of mixers

The user is advised to refer to the operating instructions provided by the manufacturer (see clause 10). If operating pressures are marked on any part of the blowpipe they shall be indicated in bars.

If the mixing device is symbolically marked, indicating the blowpipe type, the marking should conform to the symbols shown in figures 4 to 6.

Figure 4 — Fuel gas injector mixer

Figure 5 — Mixer without injector action

Figure 6 — Fuel gas injector mixer with backflow resistance according to 8.1.5

7.6 Gases to be used, symbols for gases

The following gases may be used. Where the full name of the gas cannot be imprinted the symbols given in table 2 shall be used.

Table 2 — Designation and symbols of the gases

Designations	Symbols
Oxygen	O
Acetylene	A
Propane, Butane or LPG (Liquefied petroleum gas)	P
Natural gas, Methane	M
Hydrogen	H
MPS (Methylacetylene-propadiene mixtures) and other fuel gas mixtures	Y
Coal gas	C

For blowpipes, nozzles and interchangeable components capable of use with more than one fuel gas the abreviation F shall be used. Operating data shall give details on fuel gases for which these components are suitable.

8 Safety and operational requirements

8.1 Safety requirements

8.1.1 Gas tightness

The blowpipe shall comply with the requirements of ISO 9090 when tested as to the methods specified in it. The test, according to ISO 9090, shall be carried out on new blowpipes and after the valve endurance test in 9.3, after the sustained backfire tests and the overheating tests according to 9.2.1.

8.1.2 Strength requirements

The blowpipes shall be robust and suitable for the purpose intended. They shall be able to resist maltreatment due to incorrect operation and handling, for example backfire and shock.

8.1.3 Valve design

Each gas line shall be separately closed with a valve. Valve elements shall remain captive in all positions.

8.1.4 Blowpipes' resistance to sustained backfire

8.1.4.1 Resistance to overheating

The blowpipe shall not sustain a backfire in the mixer or injector without a warning period of 2 s from the beginning of successive backfires (machine-gunning) when tested in accordance with 9.2.

8.1.4.2 Resistance to occlusion

The blowpipe and nozzle shall be resistant to sustained backfire when the nozzle outlet(s) is or are partially or totally closed. Test conditions are according to 8.2.4 and to 9.2.

8.1.5 Protection against backflow

If a non-return valve is incorporated in the blowpipe it shall conform to ISO 5175.

For mixers with marking as that shown in figure 6, backflow shall not occur at 0,5 to 2 times the nominal gas operating pressures (see 9.4 for test conditions).

8.2 Operational requirements

8.2.1 General

The following operational requirements shall be fulfilled when the gases are supplied to the blowpipe at the nominal pressures specified by the manufacturer.

8.2.2 Flow rate

Flow rates in accordance with the manufacturer's data shall be fulfilled.

It shall be possible to obtain the stated nominal flow of oxygen and fuel gas for all sizes of nozzle.

8.2.3 Adjustment of flame

It shall be possible to adjust the flame continuously from its reducing state to oxidizing state around the stated nominal flow for each nozzle size.

8.2.4 Turn-down ratio

It shall be possible to obtain a stable neutral flame at flow rates which are 25 % below the stated nominal flow rates.

9 Test and acceptance requirements

The accuracy of the measuring and test equipment used shall be stated in the test results.

9.1 Leak test

The tests shall be carried out in accordance with ISO 9090.

9.2 Sustained backfire test

The tests shall be carried out for each combination of nozzle/blowpipe from the manufacturer's product range.

9.2.1 Overheating test

No sustained backfire shall occur in the mixing chamber and/or injector within a minimum period of one minute and a warning period of 2 s from the beginning of successive backfires (i.e. machine-gunning).

9.2.1.1 Procedure

Adjust the blowpipe fitted with its nozzle, to the nominal feed pressures stated by the manufacturer.

Close the cutting oxygen control valve or device.

Adjust the nominal gas flow rates by actuating the valves to produce a neutral (normal for LPG) flame.

After an ignition time of approximately 1 min in atmosphere, position the nozzle inside a 90° angle of thick steel as shown in figure 7.

The maximum test duration shall be 3 min.

During the tests it shall be possible to adjust the heating flame and maintain it neutral by actuating the fuel gas valve only.

The test assembly is immersed in water to keep its temperature under 100 °C.

9.2.1.2 Acceptance requirements

See figure 8.

No backfire shall occur in the first minute of the test.

After the first minute

— return of flame without preliminary backfire is indicative of failure;

— return of flame occurs after successive backfires,

a) if the return of flame occurs less than 2 s after the first backfire, then the test shall have to be repeated;

b) if the return of flame occurs more than 2 s after the first backfire, the test shall be deemed acceptable;

c) if no backfire and sustained backfire occur within 3 min, the test shall be deemed acceptable.

When the test has to be carried out again, two other tests shall be conducted. They shall be both acceptable on the same blowpipe fitted with its nozzle. Prior to each test the blowpipe and nozzle shall be cooled.

9.2.2 Sustained backfire test with orifices successively closed partially or totally

9.2.2.1 Blowpipes with flat nozzle end face

The blowpipe, fitted with its nozzles, shall be resistant to sustained backfire when the heating orifices are temporally closed, either completely or partially.

9.2.2.1.1 Test conditions

The blowpipe shall be fitted with a nozzle from the manufacturer's range. Tests at two pressure conditions shall be carried out for each nozzle according to case 1 or case 2 given below and in table 3.

A neutral flame shall be adjusted for each test at the nominal flow rates specified in the manufacturer's operating data.

The position of the heating oxygen valve of the blowpipe shall be marked. It shall not be modified afterwards. If necessary, adjustment of the neutral flame shall be maintained by means of the fuel gas valve only.

Case 1:

The manufacturer specifies a range of pressures for any one or both gases.

The first test shall be carried out with the higher oxygen and fuel gas pressures.

The second test shall be carried out with the lower oxygen and fuel gas pressures.

Case 2:

The manufacturer only specifies one oxygen pressure and only one fuel gas pressure.

The first test shall be carried out with both oxygen pressure and fuel gas pressure increased by 15 %.

The second test shall be carried out with both oxygen pressure and fuel gas pressure decreased by 15 %.

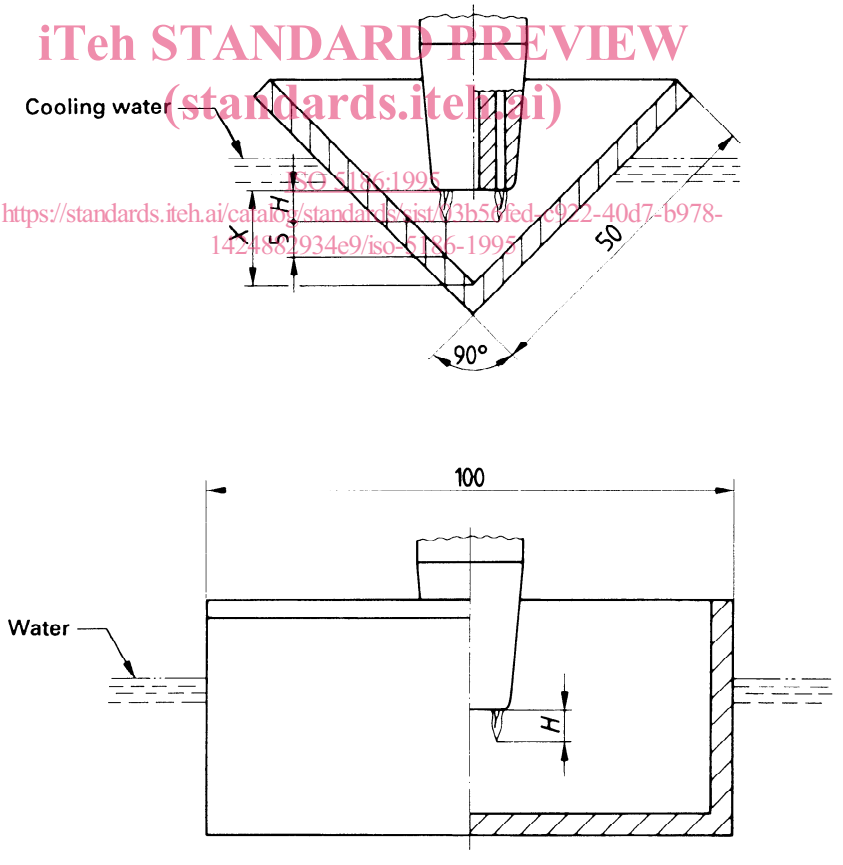
Table 3 — Test conditions

Case	Test No.	Pressure	
		p_{ox} 1)	p_c 2)
1	1	max.	max.
	2	min.	min.
2	1	+ 15 %	+ 15 %
	2	– 15 %	– 15 %

1) p_{ox} is the oxygen pressure specified in manufacturer's operating data (bars).

2) p_c is the fuel gas pressure specified in manufacturer's operation data (bars).

Dimensions in millimetres



H = length of neutral flame inner cones

$X = H + 5 + \frac{d_2}{2}$ (d_2, see figure 10)

Figure 7 — Overheating test

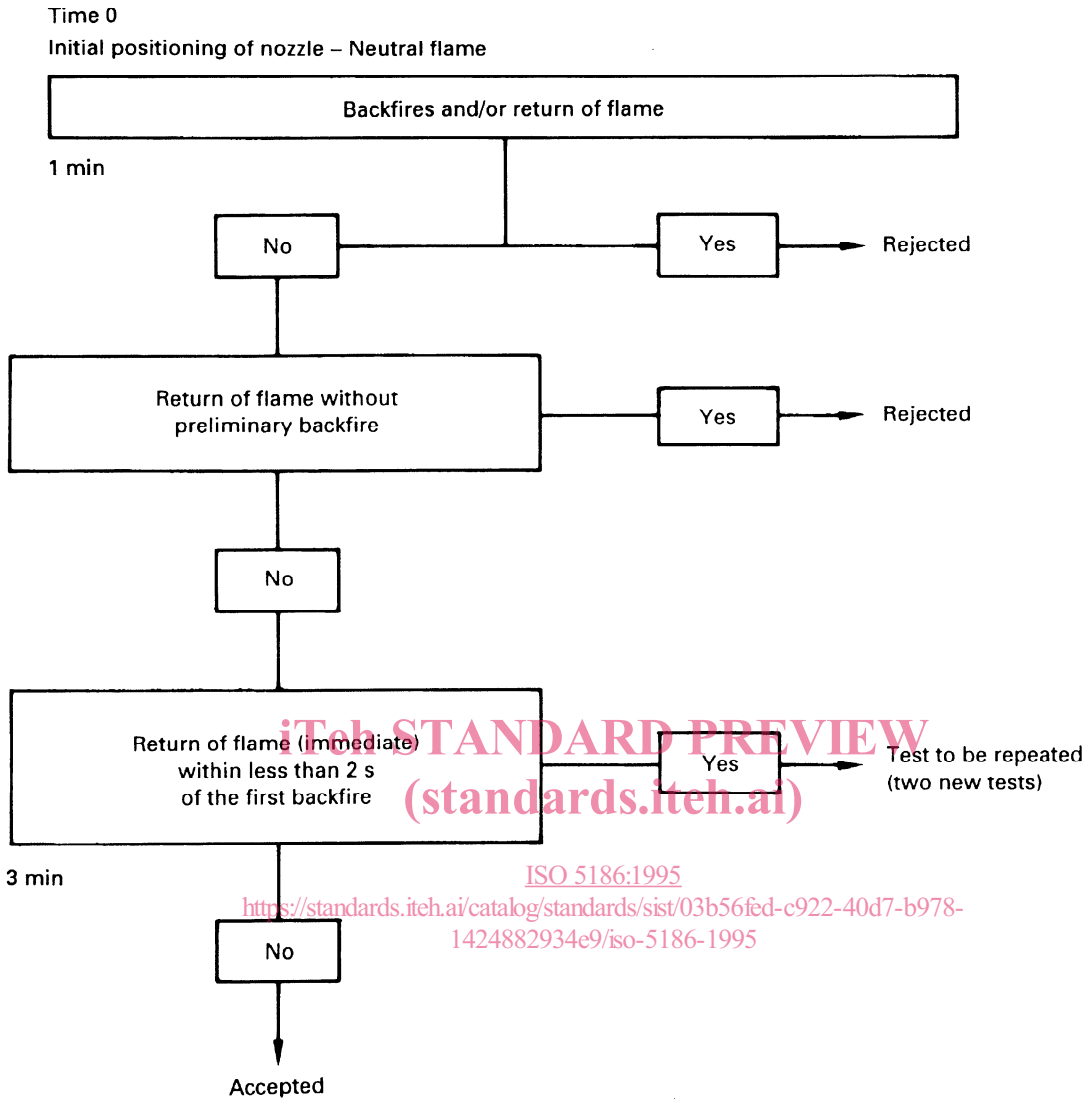


Figure 8 — Acceptance requirements

9.2.2.1.2 Procedure

Set the nozzle axis in the vertical position.

Set the plane of the upper surface of the test segment in the horizontal position.

Ignite the heating flame and stabilize it in atmosphere at the adjustment level selected for the test, for a minimum duration of 30 s.

Carry out tests with the heating flame only. Close the cutting oxygen circuit by means of the valve or closing device. Maintain the heating flame at neutral.

Bring the flat or recessed front end of the nozzle into sliding contact with the surface of a conventional test segment, so that the heating orifices are completely closed five (5) times separated by four (4) times partially closed.

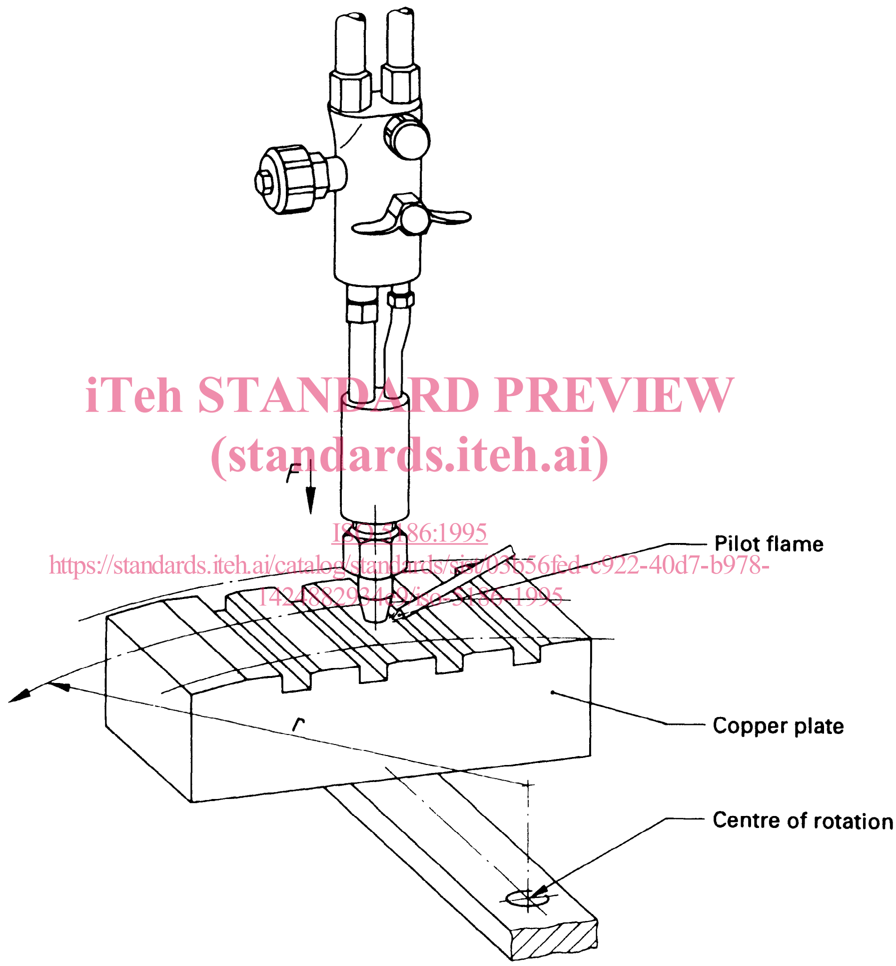
The test shall include five series of complete orifice closures (i.e. $5 \times 5 = 25$) and partial orifice closures (i.e. $4 \times 5 = 20$) within 1 min.

The test segment shall pass five times in one minute (60 s) under the nozzle for one test. Each time the nozzle has passed over the test segment, it shall then remain in atmosphere for a period eleven times longer than that spent over the segment.

In the case of an unsuccessful test cool and clean the blowpipe and nozzle. Two consecutive, identical tests shall be necessary for acceptance (twice five passages of the test segment under the ignited nozzle).

The vertical contact pressure between the copper plate and the nozzle shall be $F = 5$ N. Rotational frequency of the copper plate: $n = 5 \text{ min}^{-1}$.

The test assembly is shown in figure 9.



Test radius: $r = 165$ mm.

Figure 9 — Assembly for closing flat nozzle end faces