INTERNATIONAL STANDARD

ISO 5172

Second edition
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Manual blowpipes for welding, cutting and heating — Specifications and tests

Chalumeaux manuels pour soudage aux gaz, coupage et chauffage — Spécifications et essais

Reference number
ISO 5172:1995(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 5172 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Gas welding equipment*.

This second edition cancels and replaces the first edition (ISO 5172:1977), which has been technically revised.

Annex A of this International Standard is for information only.

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Manual blowpipes for welding, cutting and heating — Specifications and tests

1 Scope

This International Standard specifies the characteristics of manual blowpipes for gas welding, cutting and heating of metals and gives specifications and corresponding tests.

This International Standard covers manual blowpipes for welding and heating up to 1 800 l/h to 2 500 l/h fuel gas and cutting blowpipes for cutting structural steel up to a thickness of 300 mm.

Air aspirated blowpipes are excluded from this International Standard (see ISO 9012).

NOTE 1 In addition to terms used in two of the three official ISO languages (English and French), this International Standard gives the equivalent terms 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 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications.*

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 9012:1988, *Air-aspirated hand blowpipes — Specifications.*

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

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

Terminology concerning gas welding, cutting and heating blowpipes is given in annex A.

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 the 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 dis-

charged, 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 shank; they may also be between the shank and nozzle 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 a single flow rate: A blowpipe which, due to design, gives a single nominal gas flow rate which can only be varied within narrow limits.

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

3.3.2.1 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).

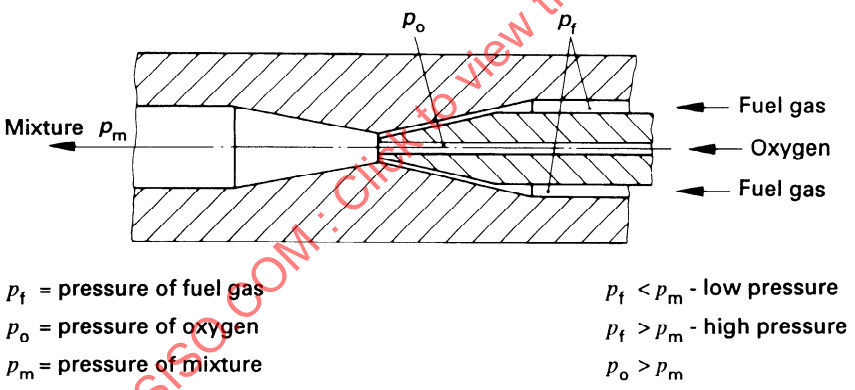


Figure 1 — Injector-mixer (low and high pressure)

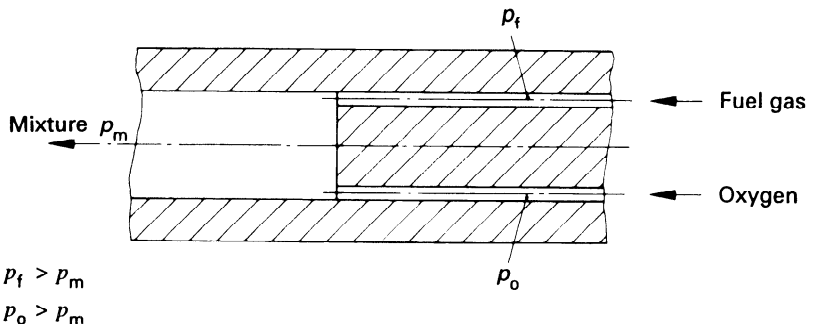


Figure 2 — Mixer without injector action

3.3.2.2 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).

3.3.2.3 blowpipe with multiple gas flow rates adjusted by changing the injector: A blowpipe with multiple gas flow rates which are varied by changing the injector. The latter often forms a single component with the outlet nozzle (blowpipe with interchangeable nozzle).

3.3.2.4 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 Cutting 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 Hose connections

The nipples shall be either permanently fitted to the shank or 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.

5 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.

6 Marking

The marking shall be legible and durable.

6.1 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 should be according to 6.6 and 6.7. The connection adjacent to the oxygen inlet of blowpipes with fixed hose connecting nipples shall be identified by the letter "O".

6.2 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.

6.3 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.

6.4 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.

6.5 Marking of cutting attachment

If it is separable, the cutting attachment shall be marked with the name, the registered trade mark or

the identifying mark of the manufacturer (the term "manufacturer" includes distributors, suppliers or importers).

6.6 Marking of mixers

The user is advised to refer to the operating instructions provided by the manufacturer (see clause 9). If operating pressures are marked on any part of the blowpipe they shall be indicated in bar.

If the mixing device is symbolically marked, indicating the blowpipe type, the marking should conform to the symbols shown in figures 3 to 5.

Figure 3 — Fuel gas injector-mixer

Figure 4 — Mixer without injector action

Figure 5 — Fuel gas injector-mixer with backflow resistance according to 7.1.5

6.7 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 1 shall be used.

Table 1 — Designations and symbols for 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
Compressed air	D

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

7 Safety and operational requirements

7.1 Safety requirements

7.1.1 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 8.4, after the sustained backfire tests 8.2.3 or 8.2.4 and the overheating tests according to 8.2.1 or 8.2.2.

7.1.2 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.

7.1.3 Valve design

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

7.1.4 Blowpipes' resistance to sustained backfire

7.1.4.1 Resistance to sustained backfire due 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 8.2.

7.1.4.2 Resistance to sustained backfire due to occlusion

The blowpipe and nozzle shall be resistant to sustained backfire when the nozzle outlet(s) is or are partially and totally closed. Test conditions are according to 8.2.3 for welding blowpipes and to 8.2.4 for cutting blowpipes.

7.1.5 Protection against backflow

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

For mixers with marking such as that shown in figure 5, backflow shall not occur at 0,5 to 2 times the nominal gas operating pressures (see 8.5 for test conditions).

7.2 Operational requirements

7.2.1 General

The following operational requirements shall be fulfilled for neutral (normal for LPG) mixture when the gases are supplied to the blowpipe at the nominal pressures specified by the manufacturer.

7.2.2 Flow rate

Flow rates according to the manufacturer's operating data shall be fulfilled. It shall be possible to obtain the stated nominal flow of oxygen and fuel gas for all nozzles.

7.2.3 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.

7.2.4 Turn-down ratio — Welding blowpipes

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

7.2.5 Stability in wind

It shall be possible to maintain the flame in a wind transverse to the axis of the emergent gas stream at the orifice. Test conditions are according to 8.3.

8 Test conditions

The accuracy of the measuring and test equipment used shall be stated in the test results. All tests are standard and are not intended to be production tests.

8.1 Leak test

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

8.2 Sustained backfire test

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

8.2.1 Overheating test — Welding blowpipes

The nozzle and blowpipe being tested shall be adjusted to the nominal flow stated by the manufacturer and to neutral flame conditions.

To generate a backfire, external heating shall be applied to the mixing tube and the nozzle by reflected heat from the flame. This reflected heating shall be applied for a minimum period of 2 s after the first backfire.

The test device defined by figure 6 for a single flame shall be used.

If no sustained backfire occurs within 3 min the blowpipe/nozzle is acceptable. If sustained backfire occurs without backfire, or within 2 s of the first backfire, the blowpipe/nozzle is rejected. An initially rejected blowpipe/nozzle shall pass the test twice before being regarded as acceptable. (Cooling and cleaning between tests is permitted.)

8.2.2 Overheating test — Cutting blowpipes

No sustained backfire shall occur in the mixing chamber and/or injector within a minimum period of 1 min and a warning period of 2 s from the beginning of successive backfires (i.e. machine-gunning).

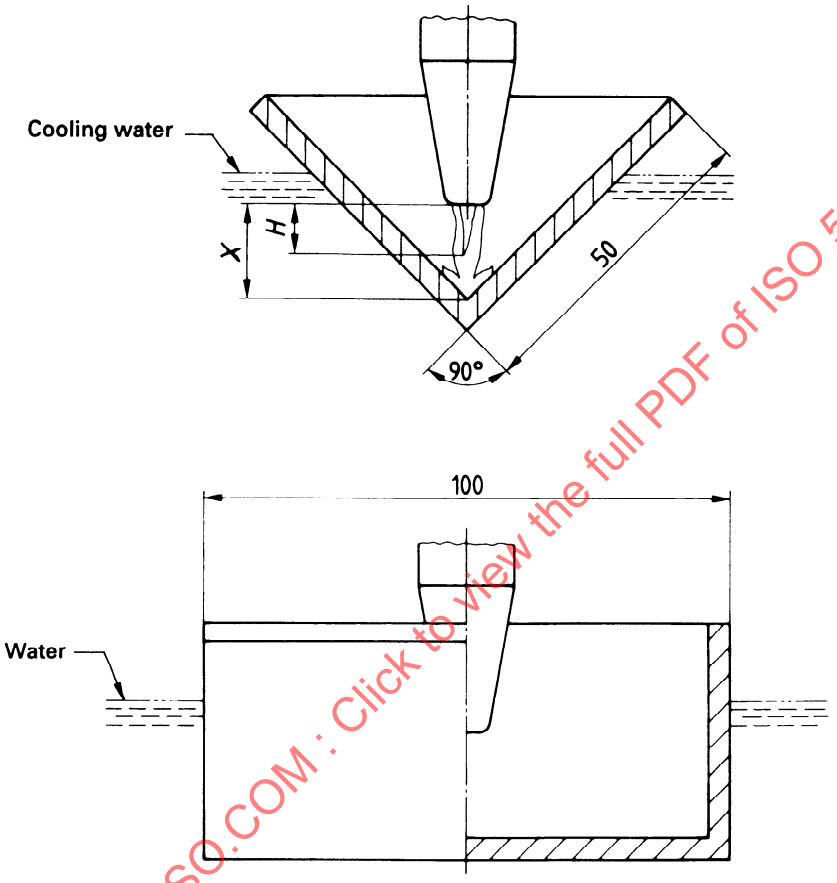
8.2.2.1 Procedure

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.

Dimensions in millimetres



H = length of primary flame inner cones

$X = H + 5$

NOTE — The test assembly is immersed in water to maintain its temperature under 100 °C.

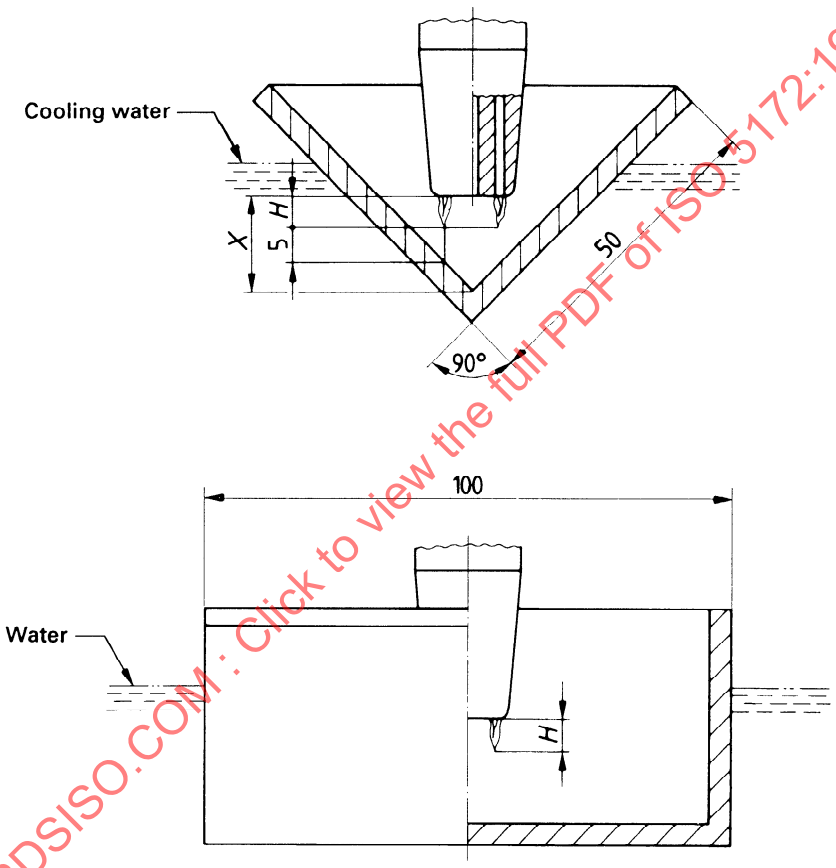
Figure 6 — Overheating test — Welding blowpipes — Single flame

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.

Dimensions in millimetres



H = length of primary flame inner cones

$X = H + 5 + \frac{d_2}{2}$

(d_2, see figure 12)

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

Figure 7 — Overheating test — Cutting blowpipes — Multi heating flame

8.2.2.2 Acceptance requirements

The flow chart for acceptance/rejection is shown in figure 8.

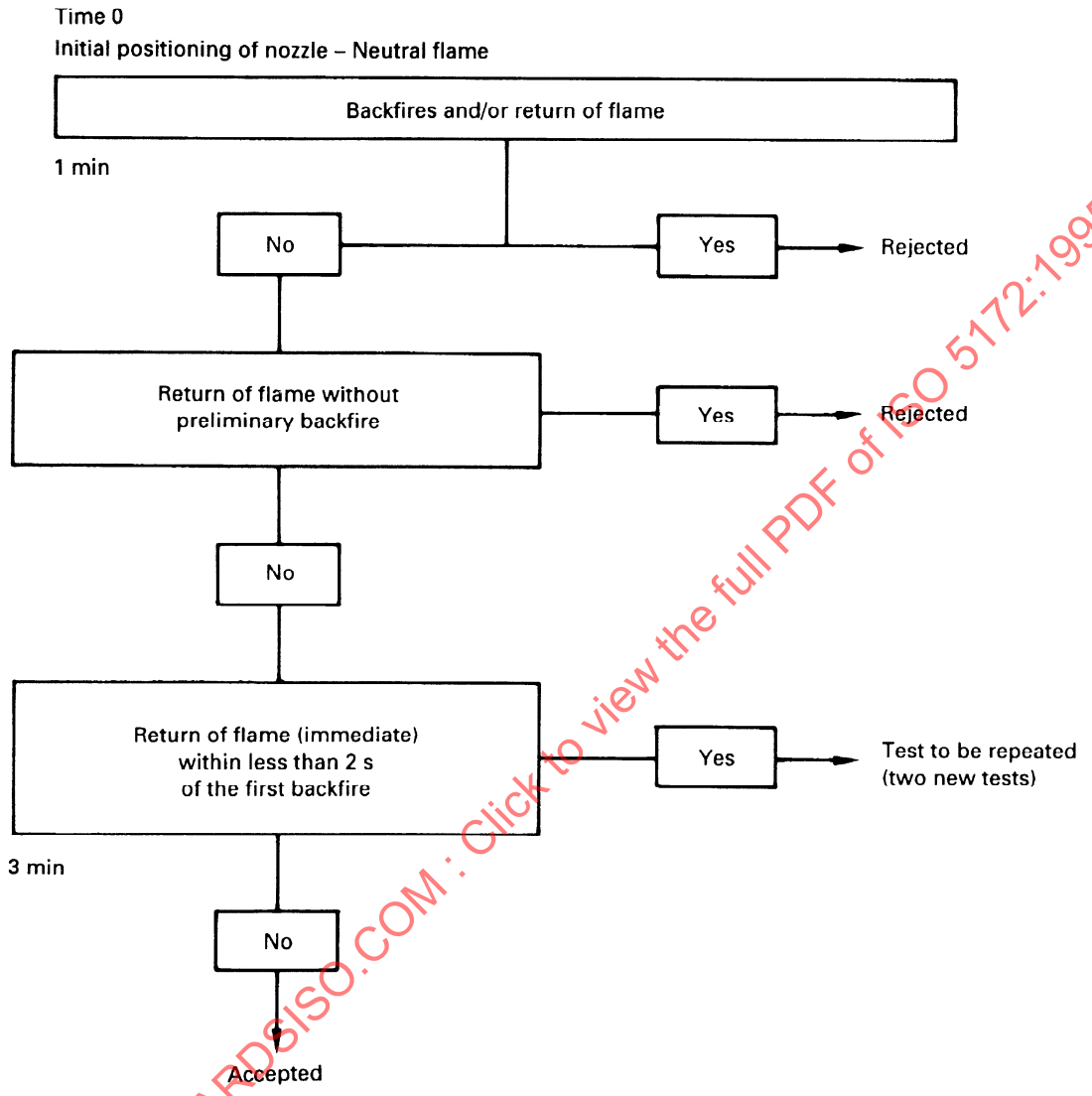


Figure 8 — Acceptance requirements

No backfire should 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 both be acceptable for the same blowpipe fitted with its nozzle. Prior to each test the blowpipe and nozzle shall be cooled.

8.2.3 Sustained backfire test with partially closed orifice — Welding blowpipes

The test assembly is shown in figures 9 and 10.

8.2.3.1 Setting-up conditions

— test radius: $R_t = 100(1 + 0{,}4 \log Q)$ mm

where Q is the nominal flow of fuel gas in litres per hour under the condition defined in ISO 554;

— vertical load between test segment and nozzles: $F = 5$ N;

— rotational frequency of the copper segment: $n = 10\ \text{min}^{-1}$;

— orifice parallel and in contact with the test segment.

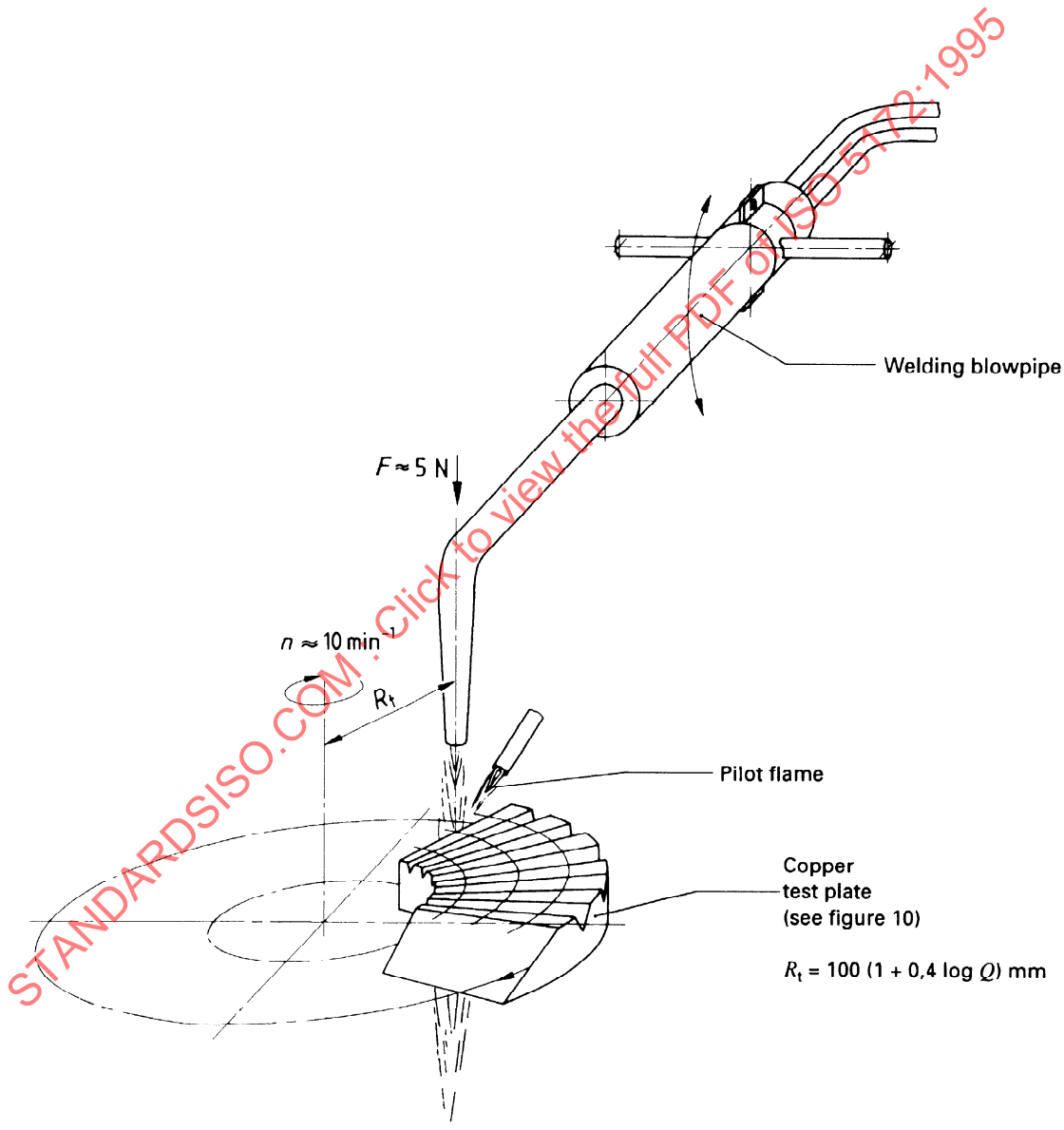


Figure 9 — Assembly for testing blowpipes for resistance to sustained backfire

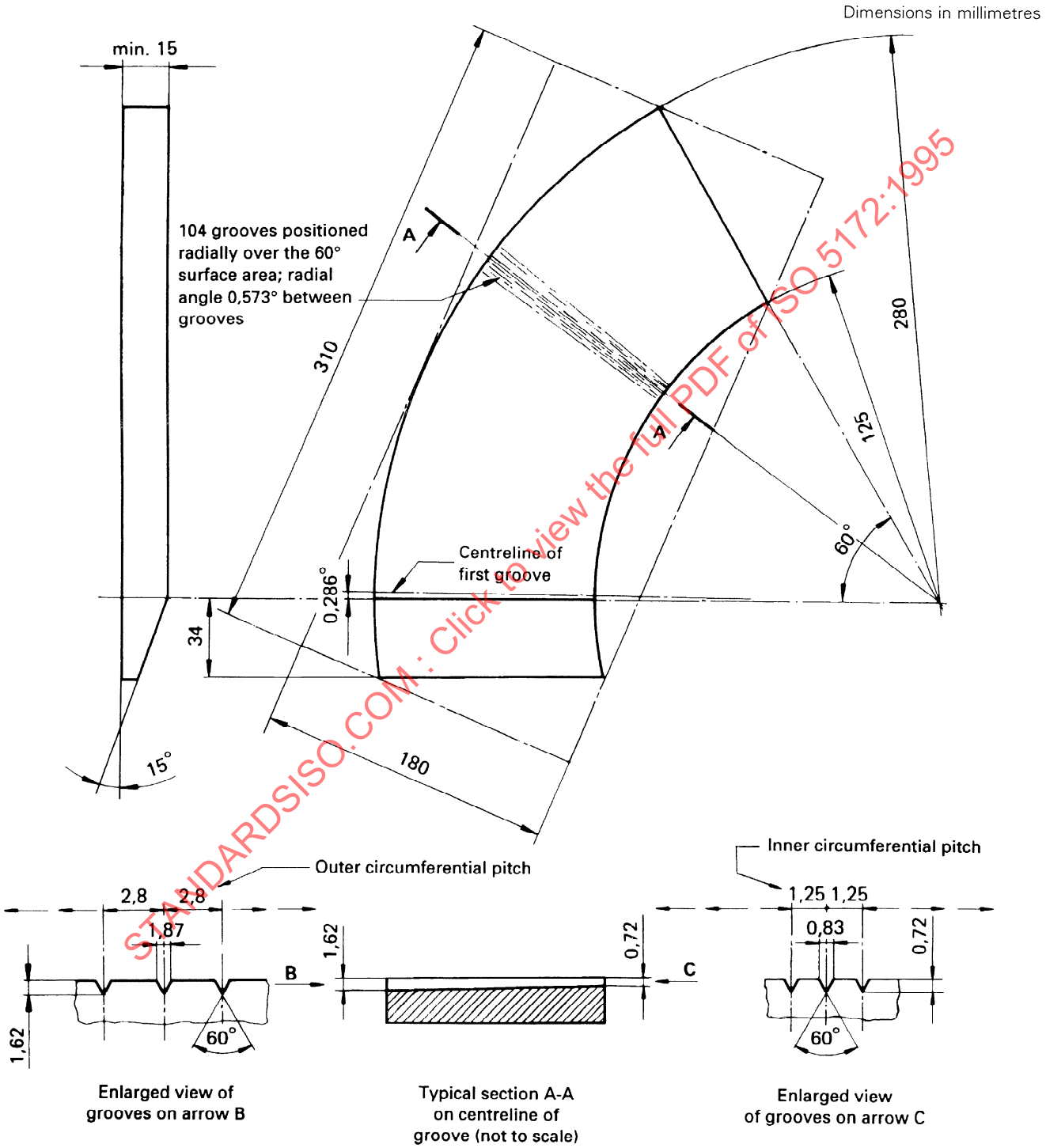


Figure 10 — Drawing for machine-grooved copper test segment

8.2.3.2 Flow setting conditions

The test shall be carried out at two flow conditions:

a) at nominal flow (7.2.2);

b) at reduced flow (7.2.4).

8.2.3.3 Flame setting conditions

The flame shall be neutral.

8.2.3.4 Procedure

Allow the flame to stabilize for 30 s (adjustment to maintain a neutral flame is permissible), prior to rotation. No adjustment to maintain a neutral flame shall be made during rotations.

8.2.3.5 Acceptance requirements

The nozzle/blowpipe is acceptable if, after five complete revolutions, no sustained backfire occurs.

Should a sustained backfire occur, stop the test, cool and clean the blowpipe and nozzle. For acceptance, the test shall be carried out twice without sustained backfire, with cooling after each test of five rotations.

8.2.4 Sustained backfire test with orifices successively closed partially or totally — Cutting blowpipes

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

8.2.4.1 Test principle

The flat or recessed front end of the nozzle is brought 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.

Tests shall be carried out with the heating flame only. The cutting oxygen circuit shall be closed by means of the valve or closing device. The heating flame shall always be maintained neutral.

During the tests backfires shall occur. The heating flame shall be reignited naturally or by the adjacent secondary flame during partial orifice closing, between contacts with the test segment and at the end of the test.

The backfire or backfires shall not cause sustained backfire.

8.2.4.2 Equipment necessary for the test

The major assembly used for tests is shown in figure 11.

The test segment shape can be either a circle sector or a rectangle. Dimensions depend on diameter d_2 circumscribed to heating orifices (figure 12).

The test segment profile is defined in the vertical plane including the nozzle axis.

8.2.4.3 Setting-up conditions

The nozzle axis shall be vertical.

The plane of the upper surface of the test segment shall be horizontal.

The vertical load applied to the nozzle shall be $F = 5$ N.

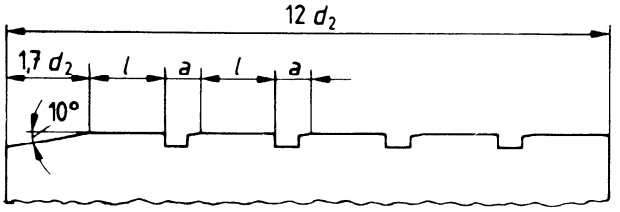
The heating flame shall be ignited and stabilized in atmosphere at the adjustment level selected for the test, for a minimum duration of 30 s.

The assembly shall be set in motion (at uniform speed) and the test segment shall pass five times in 1 min (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, the blowpipe and nozzle shall be cooled and cleaned. Two consecutive, identical tests shall necessarily be acceptable (twice five passages of the test segment under the ignited nozzle).

Testing of a blowpipe and its nozzles shall be carried out with each nozzle.

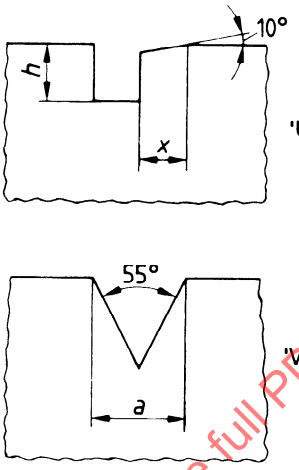
The test may be carried out using rectangular copper test segments or a circle sector (figures 13 and 14).



a) Longitudinal section along nozzle axis

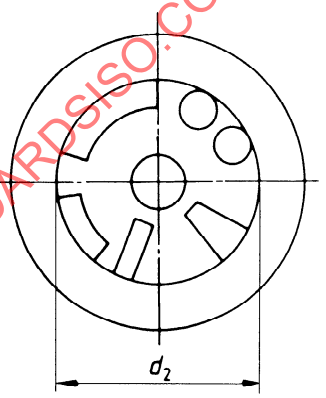
$a = k_1 d_2$, $k_1 = 0{,}7 \pm 0{,}1$
$l = k_2 d_2$, $k_2 = 1{,}5 \pm 0{,}25$
$h = 3$ mm (+0,5; 0)
$\frac{1}{3} a \leqslant x \leqslant \frac{1}{2} a$

4 partial closures
5 total closures



b) Test segment shape

Figure 11 — Test assembly



Example of diameter d_2 according to the shape of heating orifices

Figure 12 — Front end of nozzle

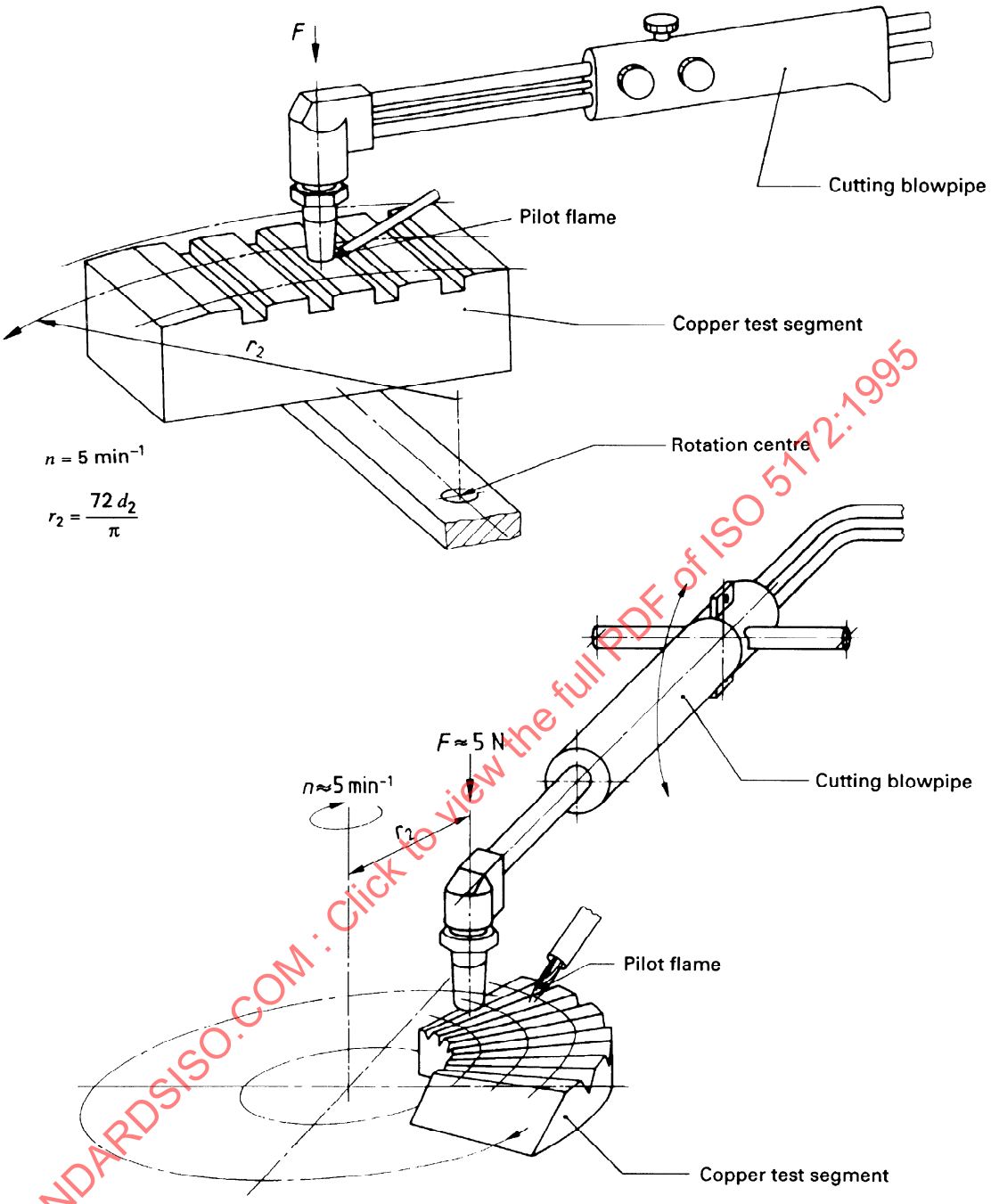


Figure 13 — Assembly for testing cutting blowpipes for resistance to sustained backfire

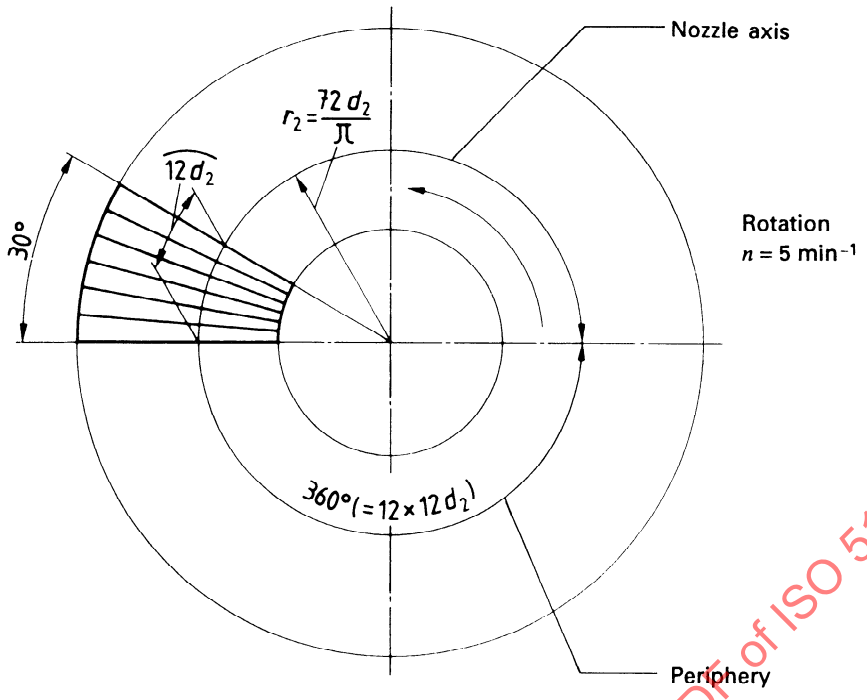


Figure 14 — Copper circular test segment for testing cutting blowpipes

8.2.4.4 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 2.

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 No. 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 with the lower oxygen and fuel gas pressures.

Case No. 2

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

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

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

Table 2 — 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 (bar).

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

8.3 Test for stability in wind

The blowpipe shall be tested using the apparatus shown in figure 15. The flame shall not be ex-

tinguished when the air stream velocity is = 8 m/s for a neutral flame with fuel gas and oxygen at nominal flow conditions specified in the manufacturer's operating data.

8.4 Valve endurance test

The valves shall be subjected to a life cycle test of 5 000 openings and closings. The closing torque used shall be the one given by the manufacturer. After this endurance test, a leak test (see 8.1) shall be carried out.

8.5 Backflow test

For mixers marked according to figure 5.

The resistance to backflow is tested separately for both oxygen and fuel gas lines. The tests are carried out with oil-free compressed air or with nitrogen for all nozzles sizes.

8.5.1 Testing of resistance against backflow of oxygen in the fuel gas line

8.5.1.1 Test conditions

Test conditions and the arrangement are shown in figure 16.

8.5.1.2 Procedure

Test the blowpipe using the following procedure:

— fully open the heating and fuel gas oxygen valve;

— close the cutting oxygen valve;

— adjust pressure on the oxygen side to twice the value of the highest pressure given by the manufacturer for the nozzle size being tested;

— record the pressure on the pressure gauge at the fuel gas side.

8.5.1.3 Assessment

If the recorded pressure is lower than 0,5 times the lowest pressure of fuel gas, given by the manufacturer for the particular nozzle size, then the requirement for resistance against backflow of oxygen is met.

8.5.2 Testing of resistance against backflow of fuel gas in oxygen line

8.5.2.1 Test conditions

Test conditions and the arrangement are shown in figure 17.

Dimensions in millimetres

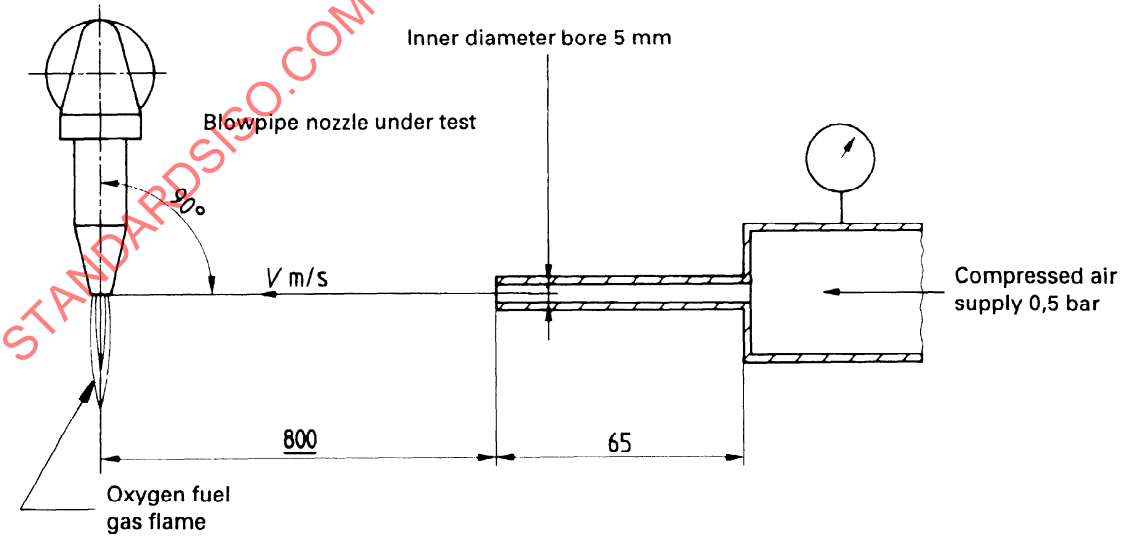


Figure 15 — Apparatus for test for stability in wind

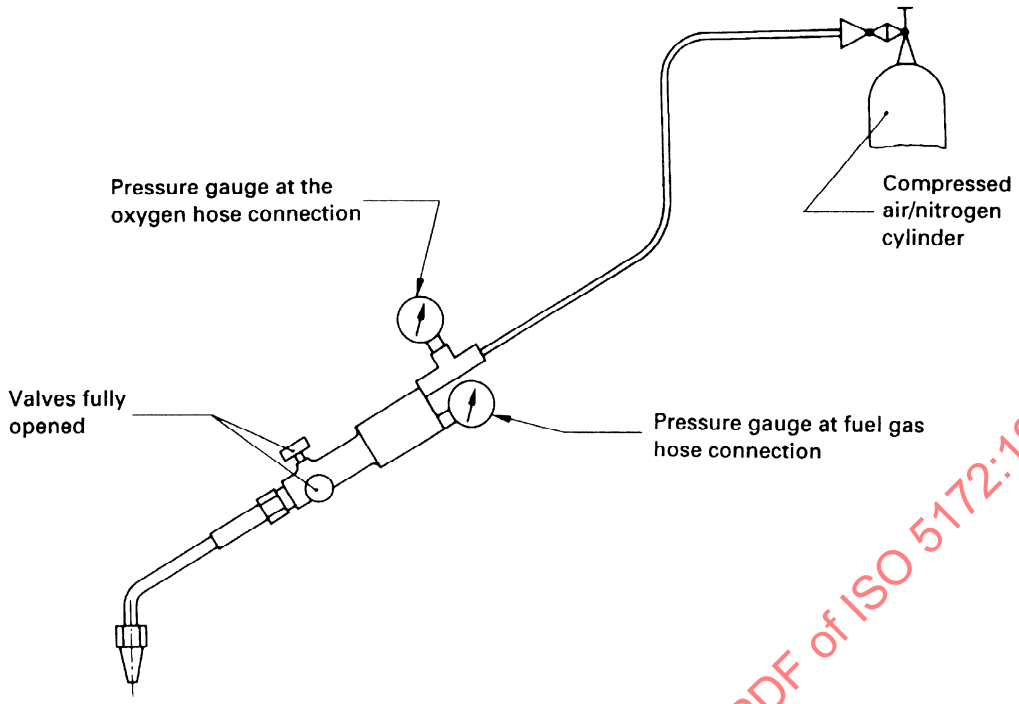


Figure 16 — Assembly for testing the resistance against backflow of oxygen in the fuel gas line

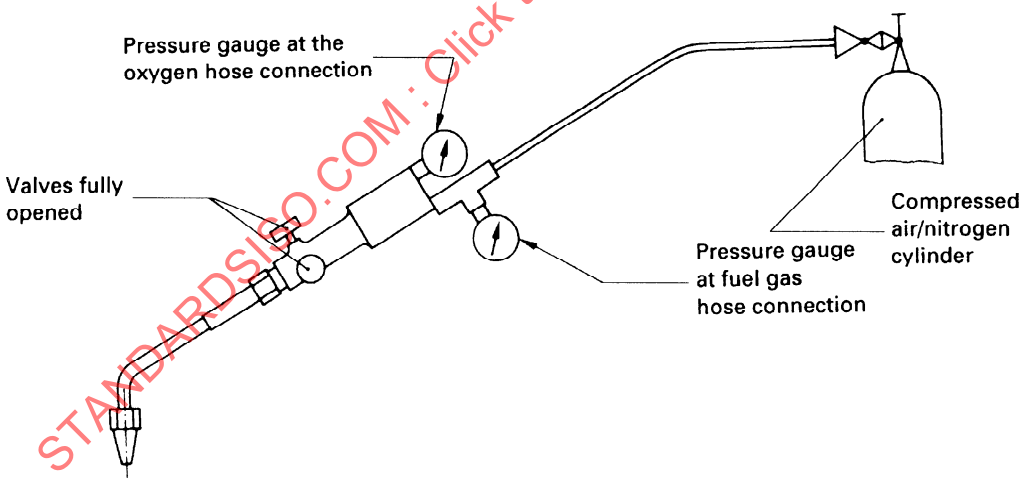


Figure 17 — Assembly for testing the resistance against backflow of fuel gas in the oxygen line

8.5.2.2 Procedure

Test the blowpipe using the following procedure:

— fully open the heating and fuel gas oxygen valve;

— close the cutting oxygen valve;

— adjust pressure on the fuel gas side to twice the value of the highest pressure given by the manufacturer for the nozzle size being tested (for acetylene maximum test pressure 1,5 bar);

— record the pressure on the pressure gauge at the oxygen side.

8.5.2.3 Assessment

If the recorded pressure is lower than 0,5 times the lowest pressure of oxygen given by the manufacturer for the particular nozzle size, then the requirement for resistance against backflow of fuel gas is met.

9 Instructions for use

The appliance shall be accompanied by instructions in the national language of the country where it is sold. The instructions shall include at least the following aspects:

— permissible type of gas;

— pressure and flow data;

— explanation of the markings and of the mixing principle;

— use of the necessary safety devices;

— safety references;

— measure before putting into service;

— putting into service;

— behaviour in the case of defects;

— stopping of operation;

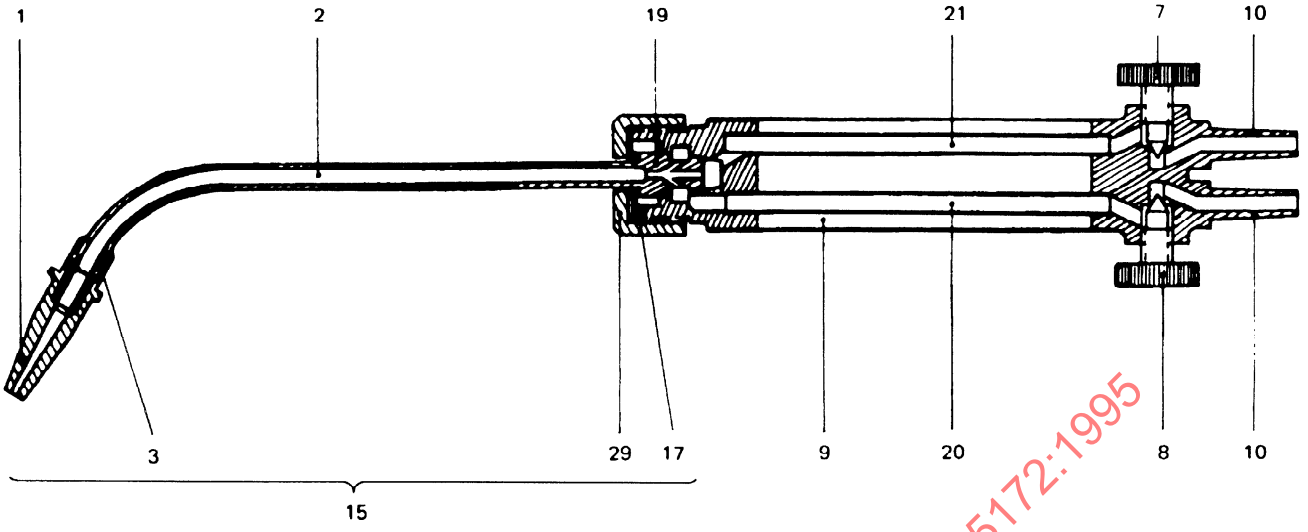
— service, maintenance and repair.

Annex A
(informative)

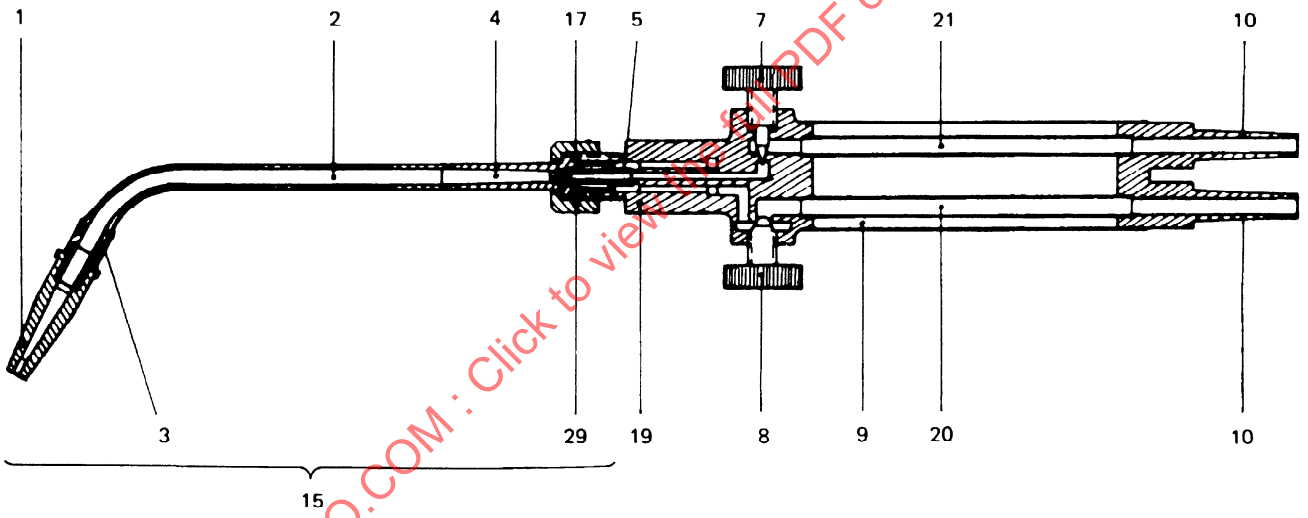
Terminology concerning welding and cutting blowpipes

Table A.1 — List of terms

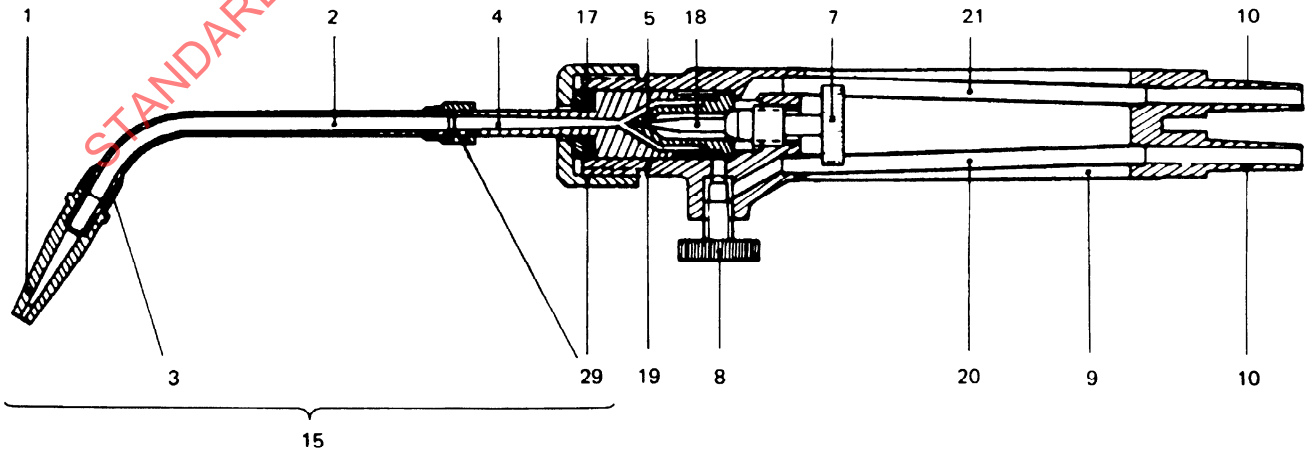
No.	English	French	German
1	Welding nozzle	Buse de soudage	Schweißdüse
2	Neck	Tube de mélange (lance)	Mischrohr
3	Nozzle adaptor	Embout de lance	Anschlußnippel
4	Mixing chamber	Chambre de mélange	Mischkammer
5	Injector	Injecteur	Druckdüse
6	Nozzle nut	Écrou de fixation de la buse de coupe	Düsenschraube
7	Oxygen valve	Robinet d'oxygène	Sauerstoffventil
8	Fuel gas valve	Robinet de gaz combustible	Brenngasventil
9	Shank	Manche de chalumeau	Griffstück
10	Hose coupling integral or detachable	Douille porte-tuyau intégré ou démontable	Unlösbarer oder lösbarer Schlauchanschluß
11	Cutting nozzle	Tête de coupe	Schneiddüse
12	Cutting oxygen tube	Tube d'oxygène de coupe	Schneidsauerstoffrohr
13	Cutting oxygen valve	Robinet d'oxygène de coupe	Schneidsauerstoffventil
14	Heating oxygen valve	Robinet d'oxygène de chauffe	Heizsauerstoffventil
15	Welding attachment	Lance de soudage	Schweißeinsatz
16	Cutting attachment	Dispositif de coupe	Schneideinsatz
17	Seal	Joint	Dichtung
18	Needle	Aiguille	Nadel
19	Mixer	Dispositif mélangeur	Mischer
20	Fuel gas channel	Conduit d'amenée du gaz combustible	Brenngaszuführung
21	Oxygen channel	Conduit d'amenée de l'oxygène	Sauerstoffzuführung
22	Heating oxygen channel	Conduit d'amenée de l'oxygène de chauffe	Heizsauerstoffzuführung
23	Cutting oxygen orifice	Orifice du canal de coupe	Schneidsauerstoffkanal
24	Preheating flame orifice	Orifice du canal (des canaux) de chauffe	Heizkanal
25	Cutting oxygen channel	Conduit d'amenée de l'oxygène de coupe	Schneidsauerstoffzuführung
26	Mixed gas channel	Conduit d'amenée du mélange combustible	Gasgemischzuführung
27	Outer nozzle	Buse externe — Chemise	Heizdüse
28	Inner nozzle	Buse interne	Schneiddüse, innere
29	Lance attachment coupling nut	Écrou de fixation de la lance	Überwurfmutter
30	Blowpipe head	Pièce avant du chalumeau	Brennerkopf
31	Swaged welding nozzle	Lance de soudage monobloc	Gehämmerte Schweißdüse
32	Heating nozzle	Buse de chauffage	Wärmdüse



a) High-pressure type without injector action

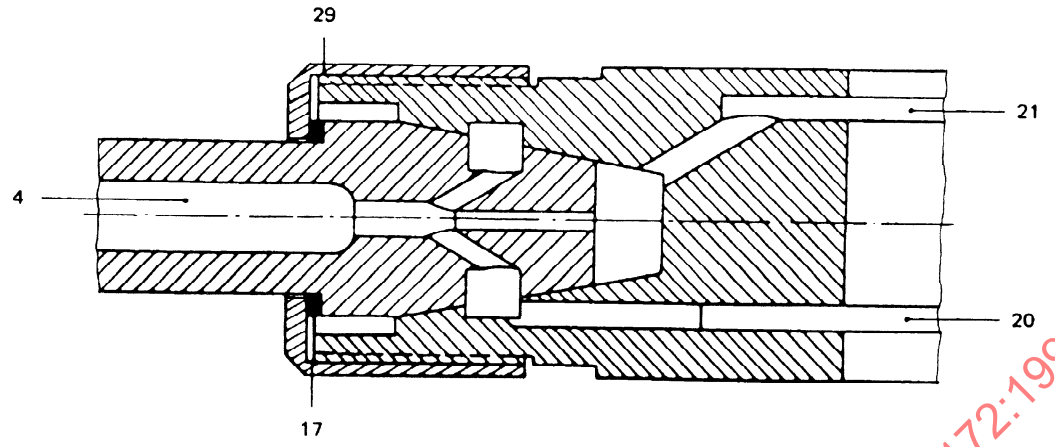


b) High- and low-pressure type with injector action

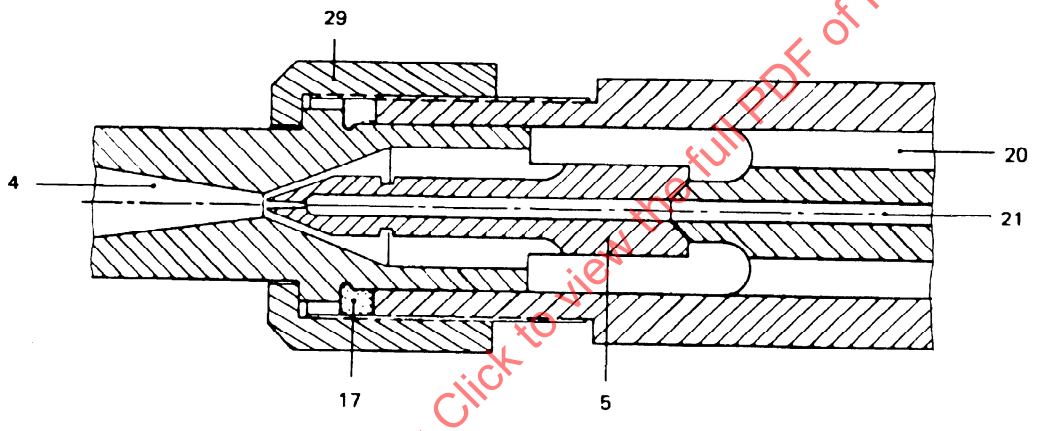


c) High- and low-pressure type with adjustable injector

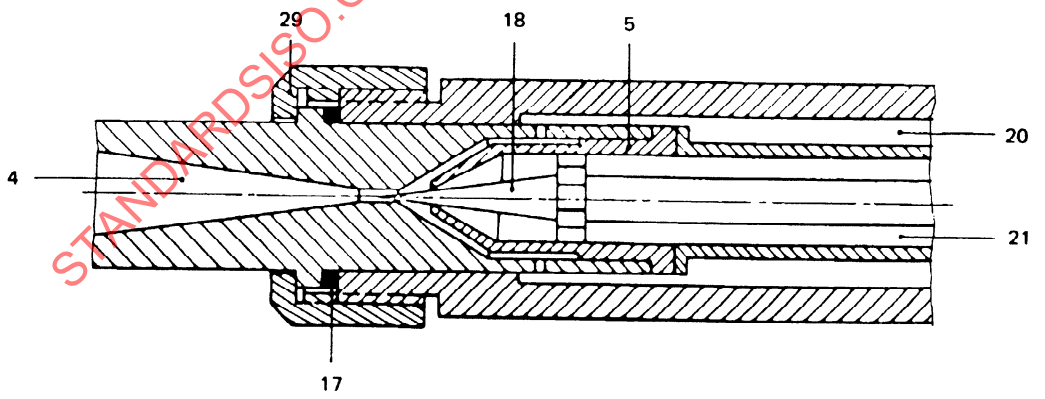
Figure A.1 — Welding blowpipes



a) Mixer (19) with equal pressures

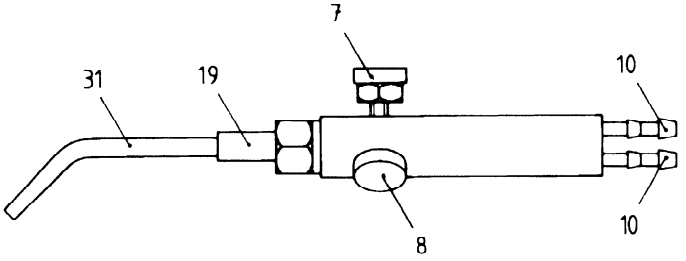


b) Injector type mixer (19)

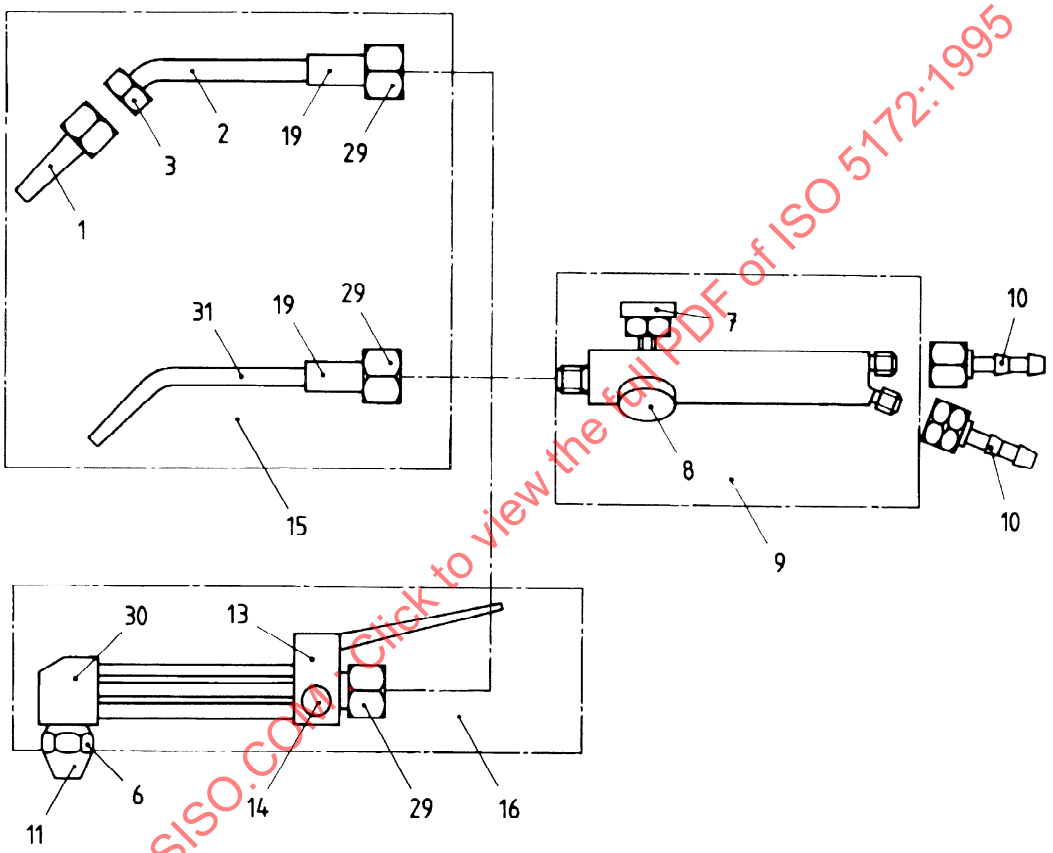


c) Injector type mixer (19) with needle (18) controlled injector (5)

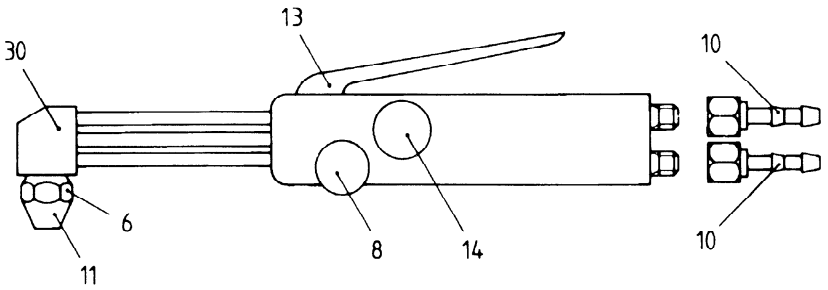
Figure A.2 — Welding blowpipes — Mixers



a) Welding blowpipe



b) Combined blowpipe (welding and cutting)



c) Cutting blowpipe

Figure A.3 — Examples of welding and cutting blowpipes

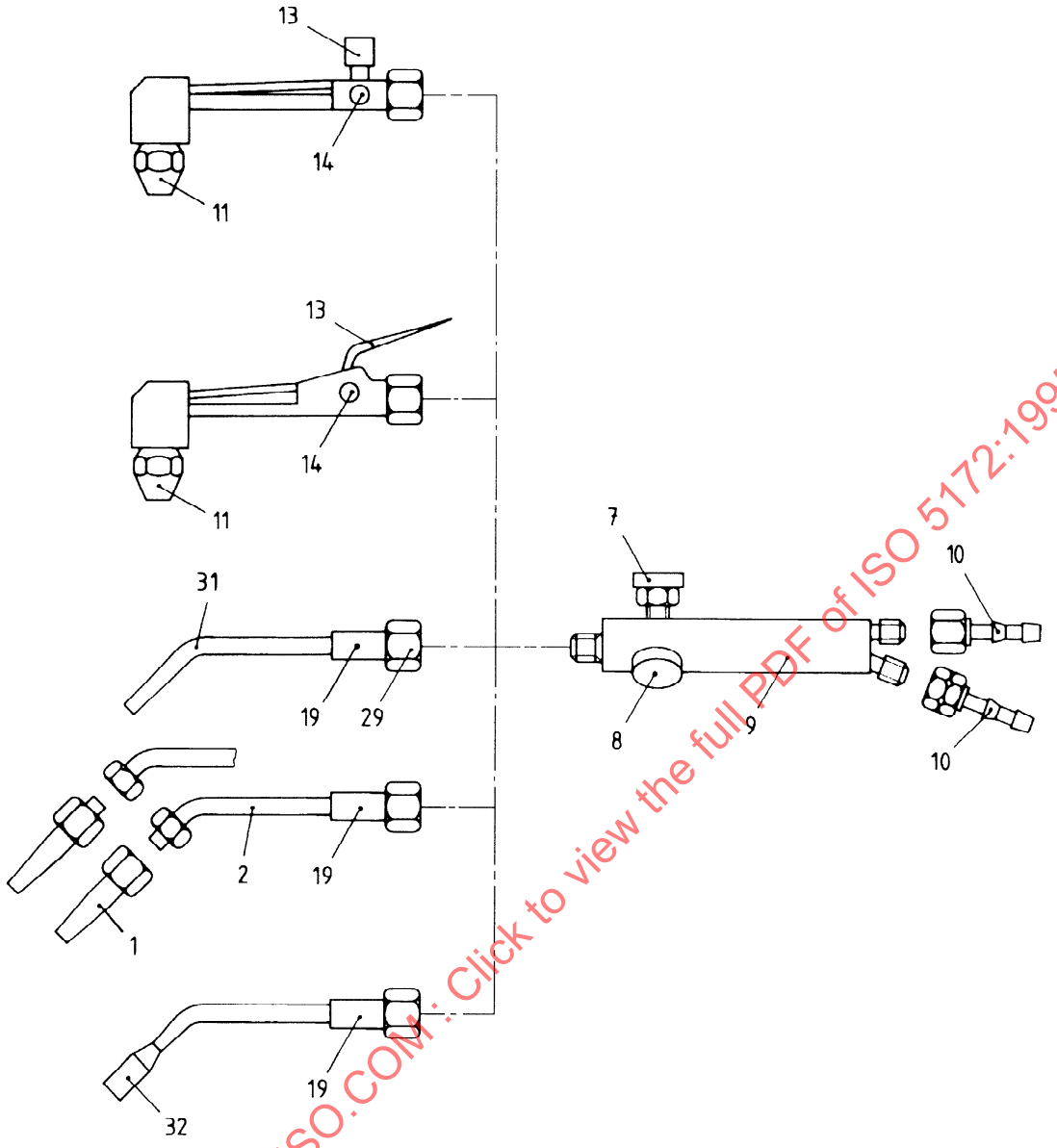
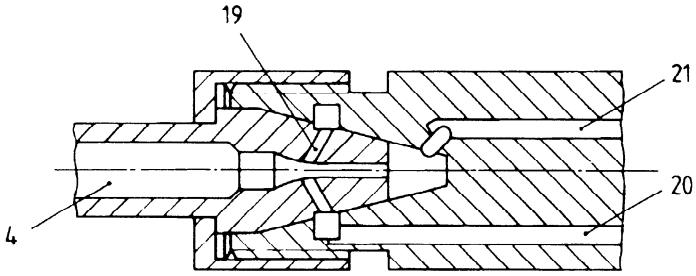
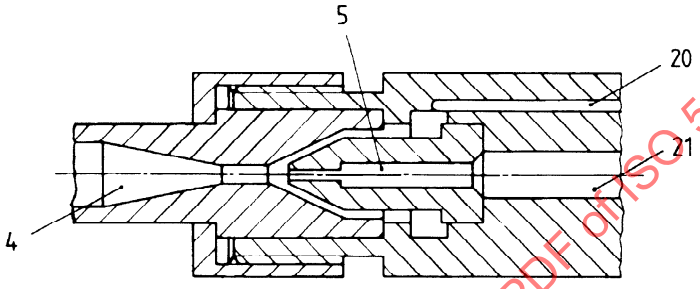


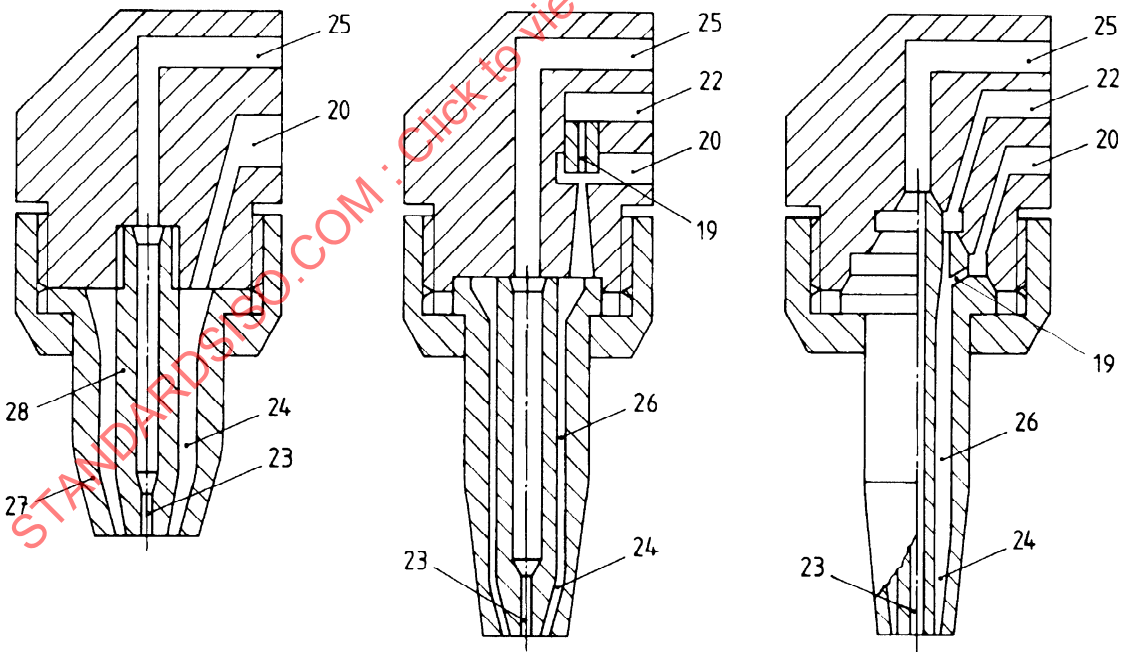
Figure A.4 — Welding and cutting blowpipe



a) Equal pressure mixer



b) Fuel gas induction mixer



c) Premix nozzle d) Head mix nozzle e) Nozzle mix

Figure A.5 — Examples of mixers and cutting nozzles