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Gas welding equipment — Blowpipes for gas welding, heating and cutting — Specifications and tests

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

Reference number
ISO 5172:2006(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5172 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This third edition of ISO 5172 cancels and replaces ISO 5172:1995, ISO 5172:1995/Amd.1:1995 and ISO 5186:1995, of which it constitutes a technical revision.

Introduction

Requests for official interpretations of any aspect of this standard should be directed to the Secretariat of ISO/TC 44/SC 8 via your national standards body, a complete listing which can be found at www.iso.org.

Gas welding equipment — Blowpipes for gas welding, heating and cutting — Specifications and tests

1 Scope

This International Standard specifies specifications and tests for blowpipes for gas welding, heating and cutting of metals. It applies to manual blowpipes for welding and heating with a nominal thermal power up to 32 000 kcal/h, and manual and machine cutting blowpipes with a cutting range up to 300 mm.

This International Standard does not apply to air-aspirated blowpipes which are covered in ISO 9012.

NOTE 1 Blowpipes with greater nominal thermal power or cutting range can also be tested in accordance with this International Standard if the test requirements are suitable.

NOTE 2 For the most common fuel gases, the corresponding flow rates are given in Table A.1.

NOTE 3 Examples of blowpipes are shown in Annex B, which also gives the terminology concerning these blowpipes.

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

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 5175, *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 9539, *Materials for equipment used in gas welding, cutting and allied processes*

ISO 15296, *Gas welding equipment — Vocabulary — Terms used for gas welding equipment*

3 Terms and definitions

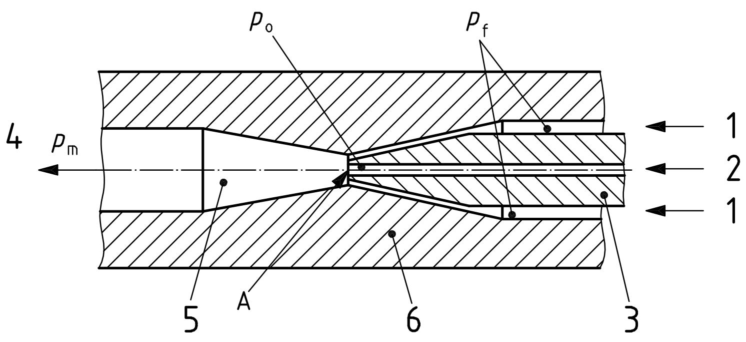
For the purposes of this document, the terms and definitions given in ISO 15296 and the following apply.

3.1 Mixing system

3.1.1
low-pressure blowpipe
blowpipe, in which the fuel gas pressure, measured immediately before the mixing chamber, is lower than the pressure of the gas mixture, measured between the mixing chamber and the welding nozzle

$$p_f < p_m$$

NOTE 1 Fuel gas and oxygen/compressed air are mixed by the action of oxygen/compressed air which, being discharged from the orifice of the injector generates suction at point “A” of the mixing system, thus entraining the fuel gas. See examples of injector-mixer, fixed or adjustable, in Figure 1 and Figure 2.

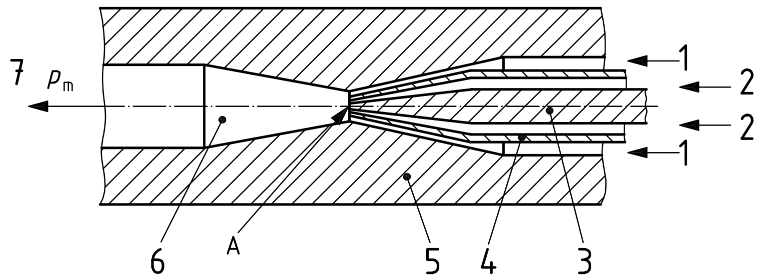


Key

1 fuel gas
2 oxygen/compressed air
3 pressure nozzle
4 mixture
5 mixing chamber
6 mixing nozzle
A point A

p_f pressure of fuel gas
p_o pressure of oxygen (or compressed air)
p_m pressure of mixture
$p_\mathrm{f} < p_\mathrm{m}$ low pressure
$p_\mathrm{f} > p_\mathrm{m}$ high pressure
$p_\mathrm{o} > p_\mathrm{m}$

Figure 1 — Injector-mixer for low-pressure and high-pressure blowpipes



Key

1 fuel gas
2 oxygen/compressed air
3 needle
4 pressure nozzle
5 mixing nozzle
6 mixing chamber
7 mixture
A point A

NOTE The control of the flow of oxygen/compressed air is effected by means of a needle valve inside the pressure nozzle.

Figure 2 — Mixer with adjustable injector

NOTE 2 The pressure in the fuel gas channel is below the atmospheric pressure during discharge of oxygen/compressed air when the fuel gas valve between valve and mixing chamber is closed. If the fuel gas valve is open during discharge of oxygen/compressed air and the fuel gas hose connection is exposed to the atmosphere, air will be entrained (suction test, see instruction for use).

3.1.2
high-pressure injector blowpipe
blowpipe in which the pressure of both the fuel gas and the oxygen/compressed air, measured immediately before the point of mixing, is higher than the pressure of the mixture, measured between the point of mixing and welding nozzle

$$p_m < p_f$$

$$p_f < p_0$$

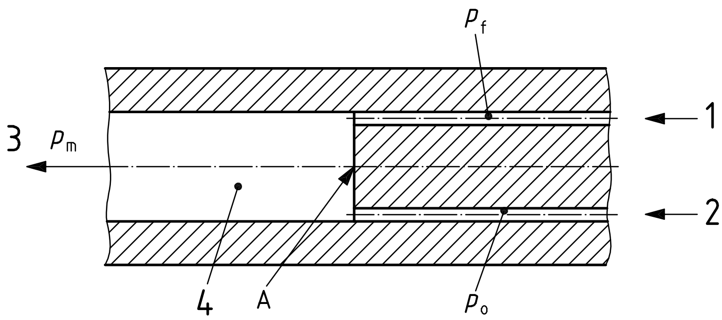
NOTE Fuel gas and oxygen/compressed air are mixed when both gases meet at pressures greater than that of the resulting mixture but with the oxygen/compressed air pressure higher than the fuel gas pressure. When the valve in the fuel gas channel is closed while oxygen/compressed air is discharged, the pressure in this channel is higher than the atmospheric pressure. If the fuel gas valve is open and the fuel gas hose connection is exposed to the atmosphere, oxygen/compressed air will be discharged (fuel gas valve open), see Figure 1.

3.1.3
equal-pressure blowpipe
blowpipe, where the pressures of fuel gas and oxygen/compressed air are identical, measured immediately before the point of mixing “A”, but are higher than the pressure of the mixture, measured between the point of mixing and welding nozzle

$$p_m < p_f$$

$$p_f = p_0$$

NOTE See Figure 3.



Key

1 fuel gas
2 oxygen/compressed air
3 mixture
4 mixing chamber
A point A

p_f pressure of fuel gas
p_o pressure of oxygen (or compressed air)
p_m pressure of mixture

Figure 3 — Mixer for equal-pressure blowpipes

3.2 Blowpipes classified according to the possibility of varying the gas flow rate

3.2.1
blowpipe with a single flow rate
blowpipe which, due to design, gives a single nominal gas flow rate which can only be varied within narrow limits

3.2.2
blowpipe with multiple flow rates
blowpipe giving a range of flow rates corresponding to a series of nozzles

3.2.2.1
blowpipe with multiple gas flow rates adjusted by means of the injector
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)

3.2.2.2
blowpipe with multiple gas flow rates, adjusted by the pressure
blowpipe with multiple gas flow rates, which are varied by adjusting the pressures (blowpipe with fixed mixer), e.g. welding blowpipe attachments and manual cutting blowpipes

NOTE See Figure 1.

3.2.2.3
blowpipe with multiple gas flow rates adjusted by changing the welding, heating or cutting attachments (combination blowpipes)
blowpipe with multiple gas flow rates which are varied by changing the welding or cutting attachment with injector, e.g. welding, heating and cutting attachments

NOTE See Figure 1.

3.2.2.4
blowpipe with multiple gas flow rates adjusted by means of gas control valves
blowpipe with multiple gas flow rates, which are varied by means of the adjustment valves

3.3 Cutting and heating blowpipes classified according to the mixing position

3.3.1
blowpipe with preliminary mixer
blowpipe in which the mixture of heating oxygen and fuel gas is ensured by the mixer before the welding, heating or cutting nozzle

3.3.2
blowpipe with nozzle mixing
blowpipe in which the heating oxygen and fuel gas are mixed in the cutting or heating nozzle (nozzle mixing)

3.4 Operational incidents

3.4.1
backfire
momentary return of the flame into the blowpipe

NOTE This return of the flame generates a popping sound, the flame being either extinguished or re-ignited at the nozzle.

3.4.2
sustained backfire
return of the flame into the blowpipe with continued burning within the mixer

NOTE This is accompanied by an initial popping sound followed by a hissing sound caused by continued burning within the blowpipe.

3.4.3
flashback
return of the flame into the blowpipe and possibly extending into the hoses and the upstream equipment

3.4.4
gas backflow
flowing back of gas from one blowpipe passage at higher pressure into the other gas passage at lower pressure and possibly into the hose

NOTE This can have the effect that oxygen (or compressed air) and fuel can form a mixture capable of being ignited in the blowpipe passages and possibly in the hoses.

3.5 Flame specifications (reference values)

3.5.1
nominal thermal power
thermal power obtained by the product of the nominal fuel gas flow and the lower heat of combustion of the fuel gas at 15 °C and 101,3 kPa

3.5.2
neutral flame
⟨for acetylene only⟩ acetylene flame obtained with a mixing ratio of approximately 1 part acetylene to 1,1 parts oxygen by volume under standard conditions

NOTE It is a flame which is neither reducing (carburising) nor oxidising.

3.5.3
normal flame
⟨for all fuel gases⟩ flame obtained with the practical mixing ratio (in normal volumes) used in normal operation and which gives approximately the maximum flame temperature

NOTE 1 For type testing, the mixing ratios are indicated in Table C.1.

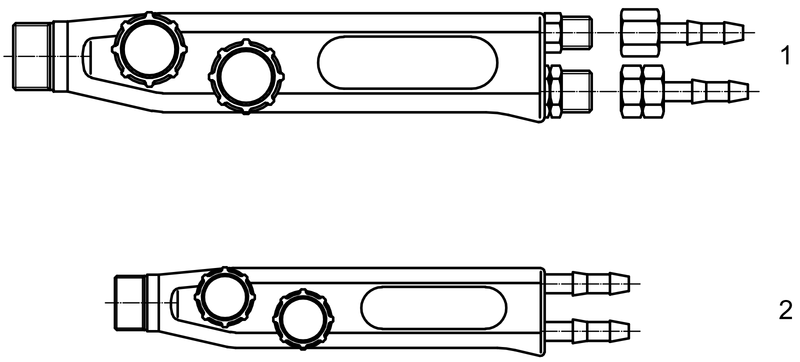
NOTE 2 The normal acetylene flame is used in heating operations only.

3.5.4
neutral mixture
acetylene/oxygen mixture necessary to obtain a neutral flame (see 3.5.2)

3.5.5
normal mixture
fuel gas/oxygen or fuel gas/compressed air mixture necessary to obtain a normal flame (see 3.5.3)

4 Hose connections

The hose connections shall be either detachable or integral to the shank (see Figure 4). Inlet connections of blowpipes shall comply with the national standard or regulatory requirements of the country where they are used. If no national standard is enforced, it is recommended that the connection comply with ISO 3253.



Key
1 detachable hose connection
2 integral hose connection

Figure 4 — Examples of hose connections — detachable — integral

5 Material

The material requirements according to ISO 9539 shall be fulfilled. Components in contact with oxygen shall be free from oil, grease or other contaminants.

6 Marking

6.1 General

The marking shall be legible and durable and shall be in accordance with 6.2 to 6.7. Table D.1 gives an overview for preferred marking of the components of a blowpipe.

6.2 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 6.7 and 6.8. The connection adjacent to the oxygen inlet of blowpipes with fixed hose-connecting nipples shall be identified by the letter “O” and the connection adjacent to the fuel gas inlet shall be identified with the appropriate letter from Table 1.

6.3 Marking of oxygen and fuel gas valves

The heating oxygen valves (body or knob) shall be identified by the letter “O”, or the colour blue, or both the letter “O” and the colour blue. In the case where a country has a colour identification other than blue in their national requirements, then the colours detailed in Annex I shall apply.

The fuel gas control valve (body or knob) shall be identified by the appropriate letter in Table 1, or the colour red, or both the appropriate letter in Table 1 and the colour red.

The cutting oxygen valve, if fitted, shall be identified in a similar manner.

6.4 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.

6.5 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.

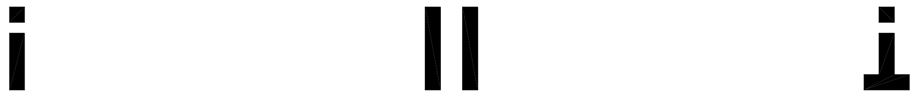
6.6 Marking of cutting attachment

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).

6.7 Marking of mixing systems

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 kilopascals (kPa).

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



a) Fuel gas injector-mixer   b) Mixer without injector action   c) Fuel gas injector-mixer with backflow resistance

Figure 5 — Marking of mixing systems

6.8 Gases to be used, symbols for gases

Where the marking requires the identification of the gas, either the full name of the gas or 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
Ethane	E
MPS (methylacetylene-propadiene mixtures) and other fuel gas mixtures	Y
Compressed air	AIR
For more than one fuel gas (if required)	F

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 gas-tightness test shall be according to 8.2 as follows:

a) on new blowpipes;

b) after the valve endurance test according to 8.5;

c) after the sustained backfire test according to 8.3.4 or 8.3.5;

d) after the overheating test according to 8.3.2 or 8.3.3.

7.1.2 Valves

Each gas line shall be separately closed with a valve. Internal and external gas tightness shall be achieved in the closed position. Valve elements shall remain captive in all positions.

7.1.3 Resistance of blowpipes to sustained backfire

7.1.3.1 Resistance to overheating

The blowpipe shall be tested in accordance with 8.3.2 and/or 8.3.3.

7.1.3.2 Resistance to occlusion of the nozzle outlet

The blowpipe and nozzle shall be resistant to sustained backfire when the nozzle outlet(s) is (are) partially and totally closed (see test conditions according to 8.3.4 and 8.3.6 for welding and heating blowpipes and to 8.3.5 for cutting blowpipes). An alternative test (simple brick test) is given in Annex G. Heating nozzles without a flat front shall be tested in accordance with Annex G.

7.1.4 Protection against backflow

For mixers marked with the symbol shown in Figure 5 c), backflow shall not occur at 0,5 to 2 times the nominal gas operating pressures (see 8.6 for test conditions).

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

7.2 Operational requirements

7.2.1 General

The following operational requirements shall be fulfilled for the gas flow rates and pressures specified by the manufacturer in the operating instructions.

7.2.2 Flow rate

Gas flow rates and gas pressures shall be as specified by the manufacturer in the operating instructions. It shall be verified that the gas flows and pressures are achieved.

7.2.3 Adjustment of flame

It shall be possible to adjust the flame continuously from the flows stated by the manufacturer to a reducing state obtained by increasing the fuel flow by 10 % and to an oxidising state obtained by increasing the oxygen flow by 10 %.

7.2.4 Turn-down ratio

It shall be possible to obtain a stable 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 8.4.

8 Tests

8.1 General

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

The test devices shall be subjected to the tests specified in Table 2.

Table 2 — Tests

Test	Types of blowpipe		
	Welding blowpipe	Heating blowpipe	Cutting blowpipe
	Front ends of nozzle		
	flat	flat/recessed	flat/recessed
Overheating	8.3.2	8.3.3	
Sustained backfire with partially closed nozzles	8.3.4	—	
Sustained backfire by successive partial or complete closing of the nozzle orifices	—	8.3.6	8.3.5
Leak-tightness test	8.2		
Stability in wind	—	8.4	—
Valve endurance	8.5		
Gas backflow	8.6 [a]		
Alternative test for sustained backfire	Annex G		

[a] This test is applicable only to mixers marked according to Figure 5 c).

8.2 Leak test

The test shall be carried out in accordance with ISO 9090. The leakage rate is given in ISO 9090.

8.3 Sustained backfire test

8.3.1 General

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

The blowpipe, equipped with its nozzle, shall be resistant to sustained backfire if subjected to overheating (see 8.3.2 or 8.3.3) and a period of total or partial closure of the nozzle orifice (see 8.3.4 or 8.3.5 or 8.3.6).

If the test has to be repeated, two further test periods with a new blowpipe of the same size shall be carried out.

The blowpipe and nozzle should be cooled to ambient temperature before each test period.

An alternative sustained backfire test is given in G.2. For a suitable production test, see H.2.

8.3.2 Overheating test — Single-flame welding blowpipes

8.3.2.1 Test principles

The nozzle and the mixing tube of the blowpipe to be tested are subjected to an overheating at neutral/normal flame conditions for a duration of 3 min in which no sustained backfire shall occur.

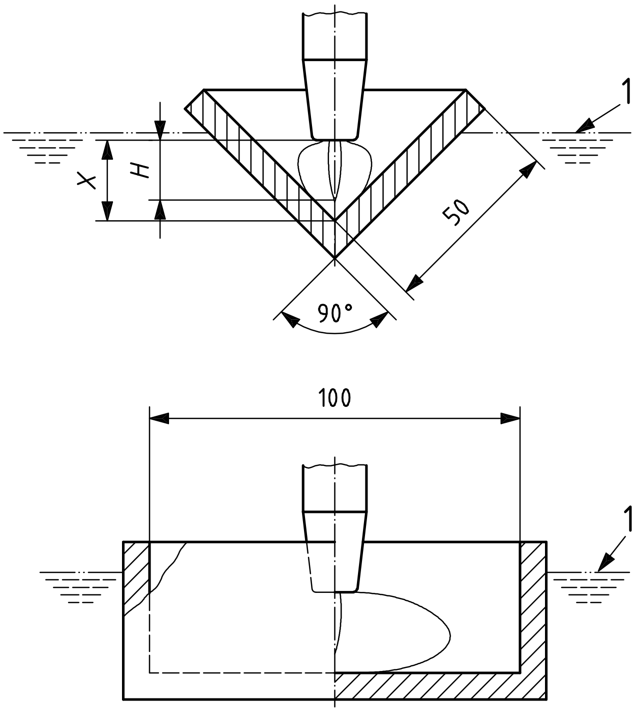
NOTE The test device is immersed in water to maintain its temperature under 100 °C.

8.3.2.2 Equipment necessary for the test

For the overheating test of blowpipes with single flames, a groove-shaped test specimen is used (see Figure 6), the including angle of which is 90°.

The test specimen consists of copper or steel and should be cooled with water.

Dimension in millimetres



Key

1 cooling water

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 — Single-flame welding blowpipes

8.3.2.3 Flow and flame setting conditions

The blowpipe fitted with its nozzle shall be adjusted to neutral/normal with the nominal pressures stated by the manufacturer.

8.3.2.4 Setting-up conditions

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

By actuating the valves, a neutral/normal flame is produced at nominal flow rates. After an ignition time of approximately 1 min in the atmosphere, the nozzle is positioned inside a 90° angle of copper or steel, as shown in Figure 6.

The immersion value (*X*) depends on the length of the primary-flame inner cones (*H*).

During the test, it shall be possible to adjust the heating flame at the blowpipe valve to maintain the neutral/normal flame condition.

8.3.2.5 Acceptance requirements

The test is deemed acceptable if, within 3 min, no backfire and no sustained backfire occur.

The test is also deemed acceptable, if backfire occurs at the blowpipe after 1 min and the heating is continued for a further 2 s without sustained backfire of the blowpipe.

If sustained backfire occurs before backfire or within 2 s of the first backfire, the blowpipe shall pass the test twice before being accepted.

8.3.3 Overheating test — Heating and cutting blowpipes with multi-heating flames or oxygen/fuelgas, and heating blowpipes with multiple heating flames for compressed air/fuelgas

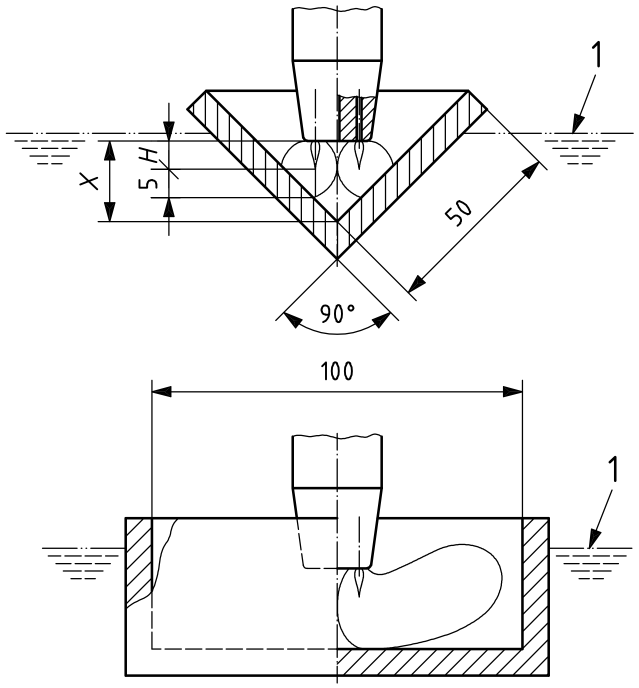
8.3.3.1 Test principles

Heating with normal flame conditions is applied to the nozzle and the mixing tube of the blowpipe being tested for a duration of 3 min in which no sustained backfire shall occur.

8.3.3.2 Equipment necessary for the test

For the overheating test of blowpipes with several heating flames, the same groove-shaped test specimen is used as for the overheating test of blowpipes with a single flame (see Figure 7).

Dimension in millimetres



Key

1 cooling water

H = length of primary-flame inner cones

$X = H + 5 + \frac{d_2}{2}$ (d_2 see Figure 11)

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

Figure 7 — Overheating test — Cutting blowpipes with multi-heating flames

8.3.3.3 Flow and flame setting conditions

The blowpipe fitted with its nozzle shall be adjusted to neutral/normal with the nominal pressures stated by the manufacturer.

The cutting oxygen valve or device is closed.

8.3.3.4 Setting-up conditions

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

By actuation of the valves, a normal/neutral flame is generated at the nominal flow rates. After an ignition time of approximately 1 min in the atmosphere, the nozzle is positioned inside a 90° angle of copper or steel, as shown in Figure 7.

The immersion value (X) depends on the pitch circle of the outer bore circle (d_2, see Figure 11) and the primary-flame inner cone length (H).

During the test, it shall be possible to adjust the flame to maintain it neutral/normal by actuating the fuel gas valve.

8.3.3.5 Acceptance requirements

The test is deemed acceptable if no backfire and sustained backfire occur within 3 min.

The test is also deemed acceptable if backfire already occurs at the blowpipe after 1 min, and the heating is continued for 2 further seconds without sustained backfire of the blowpipe.

If sustained backfire occurs without backfire or within 2 s of the first backfire, the blowpipe shall pass the test twice before being accepted (cooling and cleaning between tests is permitted).

8.3.4 Sustained backfire test with partially closed orifices — Single-flame welding blowpipes

8.3.4.1 Test principles

The front of the nozzle is brought into sliding contact with the surface of a test segment, so that the heating orifices are completely or partially closed.

The test shall be performed in a device capable of producing consistent results. This test includes 520 complete closures and 515 partial closures within 0,5 min at five revolutions of the segment.

The flame shall always be maintained under normal flame conditions. The conditions are specified by the manufacturer.

During the test, backfires shall occur. The flame shall be re-ignited naturally or by means of a pilot flame, during contact with the test segment, and at the end of the test. No sustained backfire shall occur.

8.3.4.2 Equipment necessary for the test

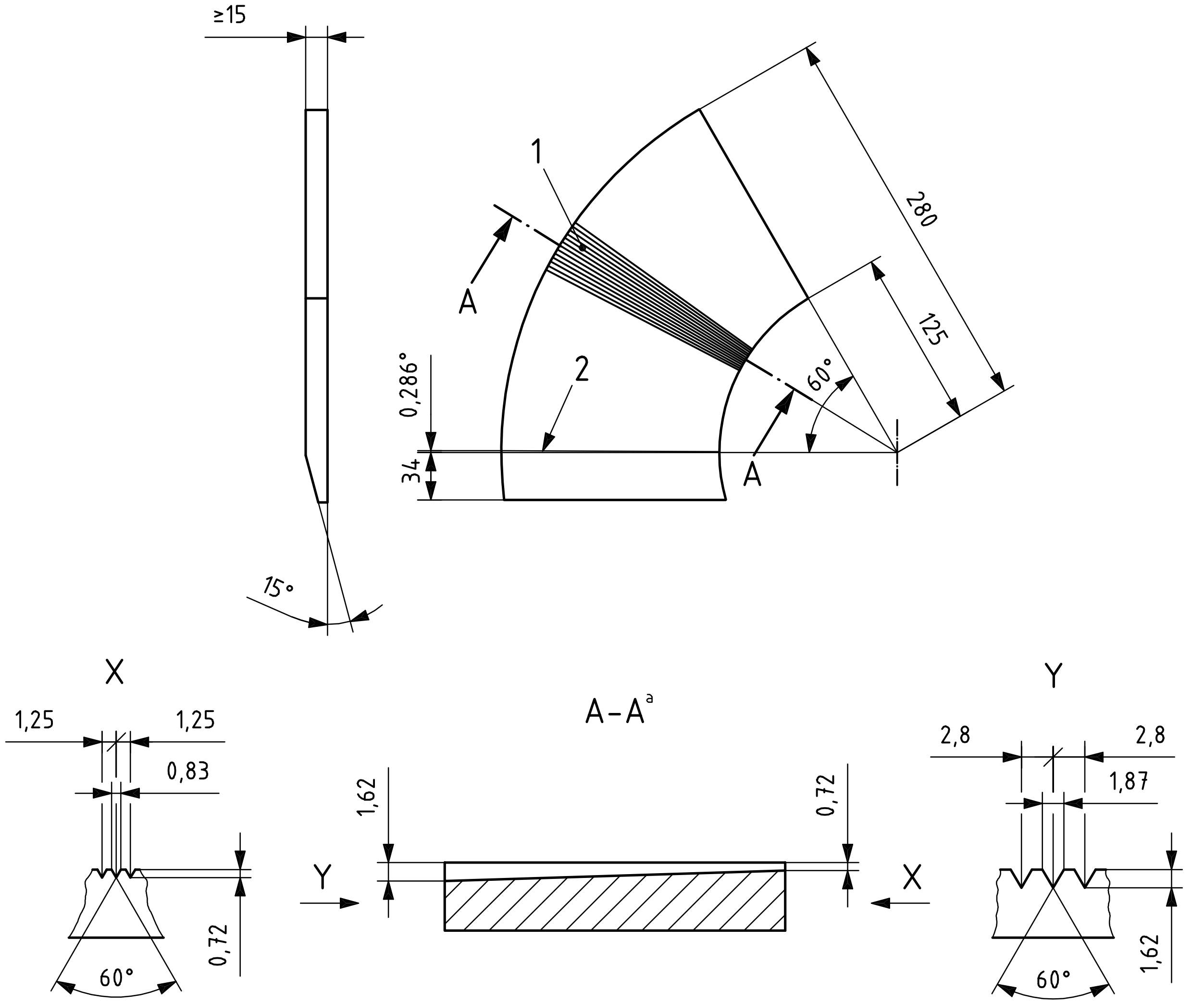
The test assembly is shown in Figure 8.

The assembly consists of a segment (e.g. made of copper) the surface of which is equipped with V-shaped grooves and closes the nozzle orifice of the welding blowpipe in defined periods.

The nozzle orifice of the blowpipe is positioned vertically to the grooved segment surface.

The vertical load between the test segment and the nozzle shall be 5 N.

Dimension in millimetres



Key

1 104 grooves positioned radially over the 60° surface area; radial angle 0,573° between grooves

2 centreline of first groove

[a] Typical section A-A on centreline of groove (enlarged scale).

Figure 8 — Drawing of grooved copper test segment (welding blowpipe)

8.3.4.3 Flow and flame setting conditions

The nozzle and the blowpipe to be tested shall be adjusted to the nominal flows and pressures stated by the manufacturer and to neutral/normal flame conditions.

The test shall be carried out at two flow conditions as stated by the manufacturer:

a) at nominal flow (see 7.2.2);

b) at reduced flow (see 7.2.4).

The flame shall be neutral/normal.

8.3.4.4 Setting-up conditions

The setting-up conditions shown in Figure 9 are as follows:

— Test radius:

$R_t = 100 (1 + 0{,}4 \lg Q)$ mm

where Q is the nominal flow of fuel gas, in litres per hour (l/h), under the conditions defined in ISO 554;

— Vertical load between test segment and nozzle:

$F \approx 5$ N

— Rotational frequency of the copper segment:

$n = 10$ min^{-1}

— Orifice parallel to and in contact with the test segment.

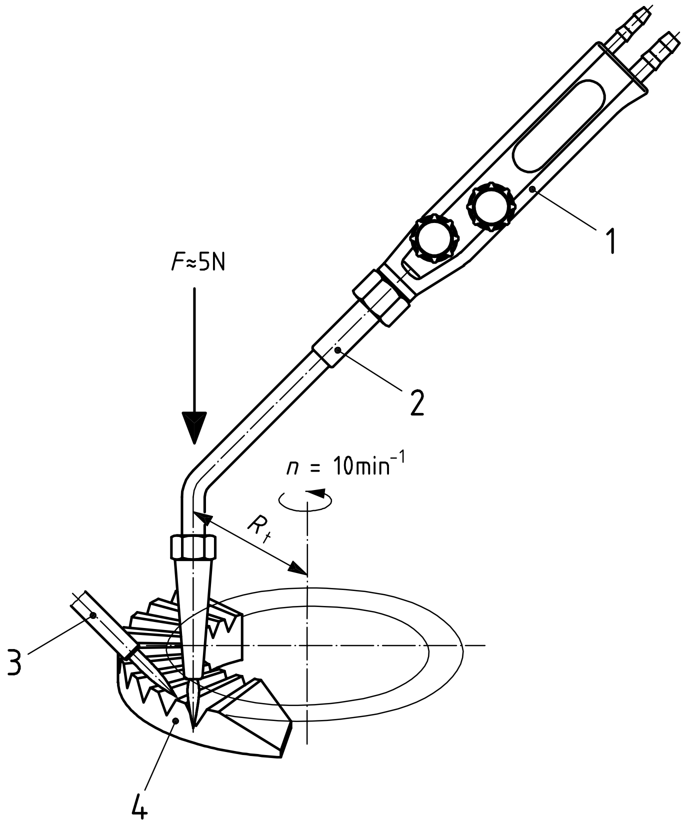
The type of blowpipe clamping is optional.

For stabilising the flame setting (re-adjustment for maintaining a neutral flame is permitted), the blowpipe is allowed to burn in the atmosphere for 30 s before it is placed onto the rotating test segment. Re-adjustment during rotation to maintain a neutral/normal flame is not permitted.

8.3.4.5 Acceptance requirements

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

WARNING — If a sustained backfire occurs, the test shall be stopped immediately.



$R_t = 100\ (1 + 0{,}4\ \lg Q)$ mm

Key

1 shank

2 welding attachment

3 pilot flame

4 copper test segment

Figure 9 — Equipment for testing welding blowpipes for resistance to sustained backfire

8.3.5 Sustained backfire test with orifices successively closed partially or totally — Cutting blowpipes with flat front-end nozzles

8.3.5.1 Test principles

The front of the nozzle is brought into sliding contact with the surface of a 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 closures (i.e. $5 \times 5 = 25$) and partial 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.

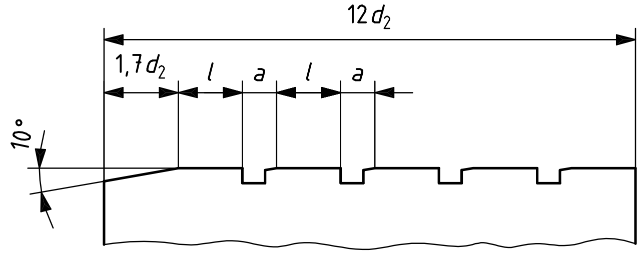
During the test, backfires shall occur. The heating flame shall be re-ignited naturally or by a pilot flame, during contact with the test segment, and at the end of the test. No sustained backfire shall occur.

8.3.5.2 Equipment necessary for the test

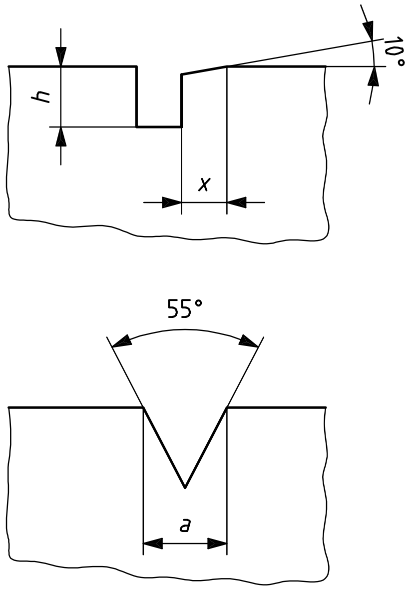
The major assembly used for tests is shown in Figure 10.

The test segment shape can either be a circle sector or a rectangle.

Dimensions depend on diameter d_2 circumscribed to heating orifices (see Figure 11). The test segment profile is defined in the vertical plane including the nozzle axis.



a) Longitudinal section along nozzle axis



$a = k_1 d_2$, k_1 = 0,7 ± 0,1

$l = k_2 d_2$, k_2 = 1,5 ± 0,25

$h = (3\,^{+0,5}_{\;\;0})$ mm

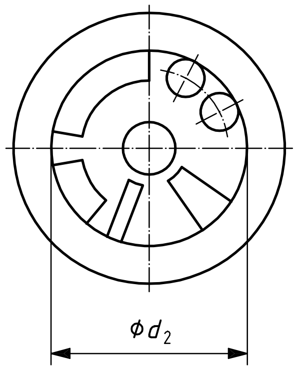
$$\frac{1}{3}a \leqslant x \leqslant \frac{1}{2}a$$

4 partial closures

5 total closures

b) Test segment shape (U-groove and V-groove)

Figure 10 — Test assembly for cutting and heating blowpipes



Example of diameter d_2 according to the shape of heating orifices

Figure 11 — Front end of nozzle

8.3.5.3 Flow and flame setting conditions

The nozzle and the blowpipe being tested shall be adjusted to the nominal flow rates specified by the manufacturer.

8.3.5.4 Setting-up conditions

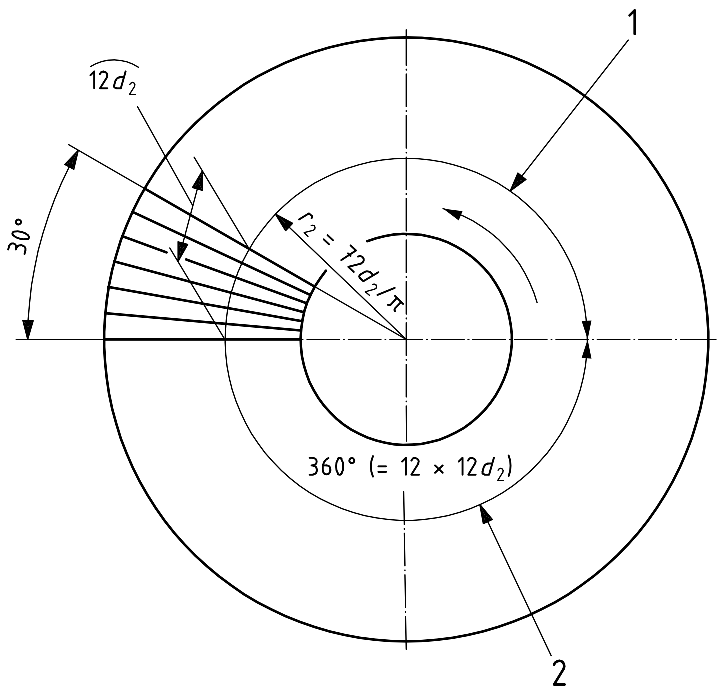
The nozzle axis shall be vertical. The plane of the upper surface of the test segment shall be horizontal.

The vertical load between the test segment and the nozzle shall be 5 N.

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

The test assembly shall be set in motion at a speed of n = 5 min^{-1} and the test segment shall pass five times in 1 min under the nozzle for one test. Each time the nozzle has passed over the test segment, it shall then remain in the 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.



Key

1 nozzle axis

2 periphery

Rotation n = 5 min^{-1}

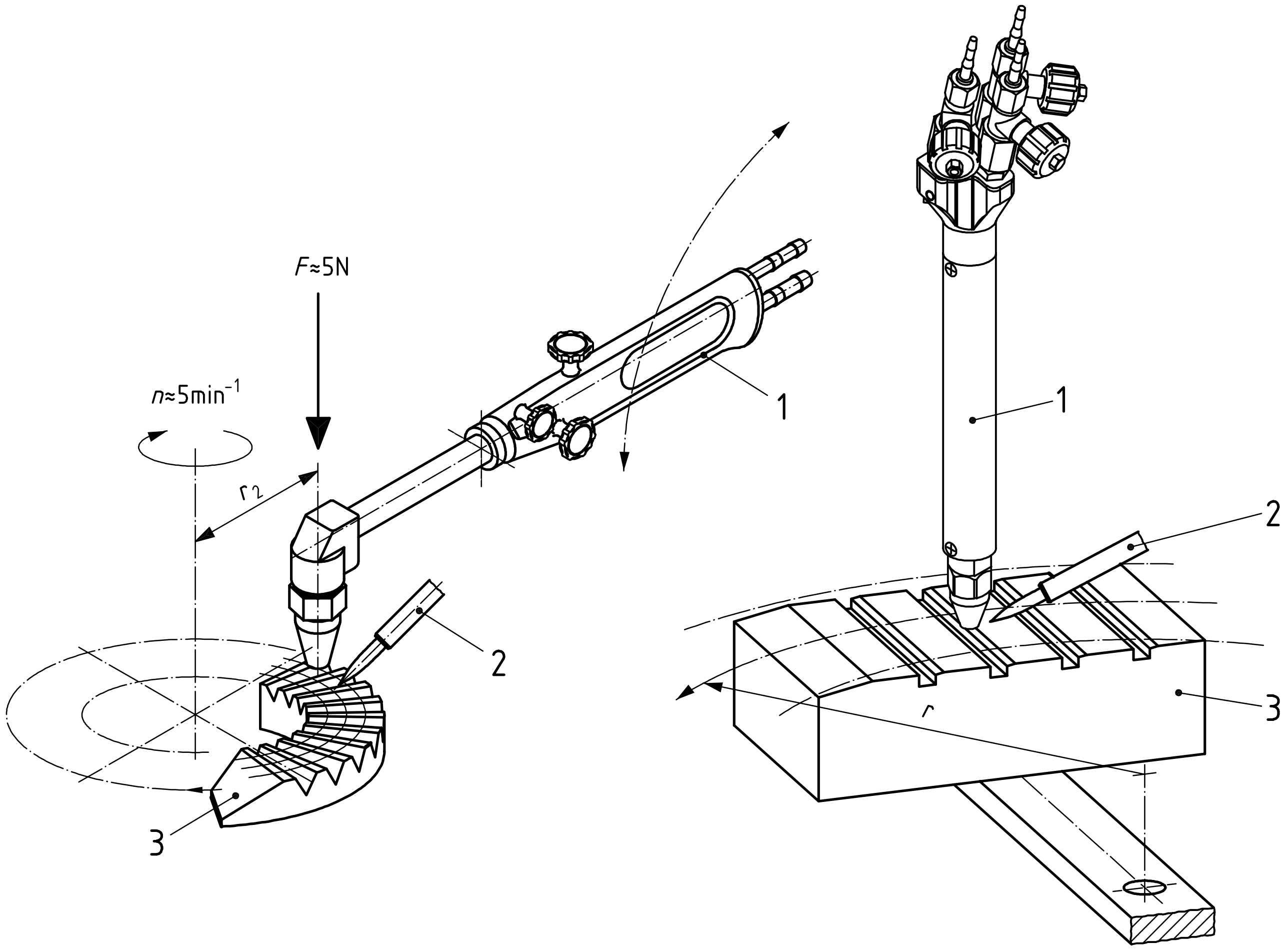
Figure 12 — Copper circular test segment for testing, cutting and heating blowpipes

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 should be carried out using rectangular copper test segments or a circle sector (Figures 12 and 13).

The type of blowpipe clamping is optional.



Key

1 cutting blowpipe

2 pilot flame

3 copper test segment

$$r_2 = \frac{72 d_2}{\pi}$$

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

8.3.5.5 Test conditions

The tests shall be carried out for each nozzle at two pressures according to Table 3 and to case No. 1 or case No. 2 given below.

A normal 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 shall be marked. It shall not be modified afterwards. If necessary, adjustment of the normal 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 highest oxygen and fuel gas pressures.

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

Table 3 — Test conditions

Case	Test No.	Pressure	
		p_0 [a]	p_1 [b]
1	1	max.	max.
	2	min.	min.
2	1	+15 %	+15 %
	2	–15 %	–15 %

[a] Oxygen pressure specified in the manufacturer's operating data (kPa).

[b] Fuel gas pressure specified in the manufacturer's operating data (kPa).

8.3.5.6 Acceptance requirements

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

8.3.6 Sustained backfire test with orifices successively closed partially or totally — Heating blowpipes with flat front-end nozzles

8.3.6.1 Test principles

The same test principles as in 8.3.5.1 apply.

8.3.6.2 Equipment necessary for the test

For testing heating blowpipes, the same test assembly is used as for the test of cutting blowpipes according to 8.3.5.2.

8.3.6.3 Flow and flame setting condition

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

8.3.6.4 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 between the test segment and the nozzle shall be 5 N.

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

The test assembly shall be set in motion at a speed of $n = 5\ \text{min}^{-1}$ 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 the 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 to ambient temperature 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 should be carried out using rectangular copper test segments or a circle sector (Figures 12 and 13).

8.3.6.5 Test conditions

Tests at two pressure conditions shall be carried out for each nozzle according to Table 3 and to case No. 1 or case No. 2 given below.

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

The position of the oxygen valve shall be marked. It shall not be modified afterwards. If necessary, adjustment of the normal 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 tests 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 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 %.

8.3.6.6 Acceptance requirements

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

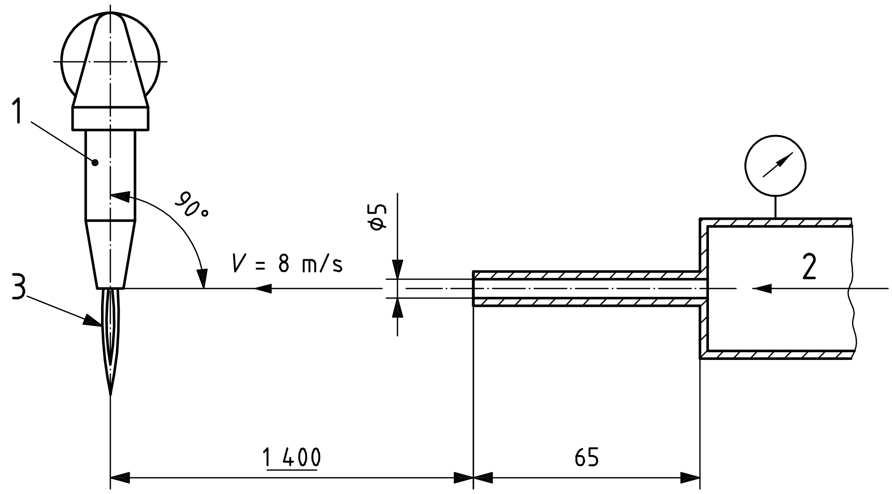
8.3.7 Sustained backfire test for cutting and heating blowpipes with recessed nozzle ends

The partial closure of nozzles with recessed nozzle ends shall be carried out in accordance to the alternative test in Annex G.

8.4 Test for stability in wind for fuel gas/compressed air flames

The blowpipe shall be tested using the apparatus shown in Figure 14.

Dimensions in millimetres



Key

1 blowpipe nozzle under test

2 compressed air supply 50 kPa

3 fuel gas/compressed air flame

Figure 14 — Apparatus for test for stability in wind for fuel gas/compressed air flames

The flame shall not be extinguished when an air stream with a velocity of 8 m/s meets the working flame normal for the application with fuel gas and compressed air at nominal flow conditions specified in the manufacturer's operating data.

This test applies only to blowpipes with a fuel gas flow of more than 150 l/h.

8.5 Valve endurance test

The valves shall be subjected to an endurance test of 5 000 openings and closings. The closing torque used shall be given by the manufacturer. Valves with adjustable glands or packings can be adjusted once (at maximum) during the test. After this endurance test, a leak test shall be carried out (see 8.2).

8.6 Backflow test for all blowpipes

8.6.1 General

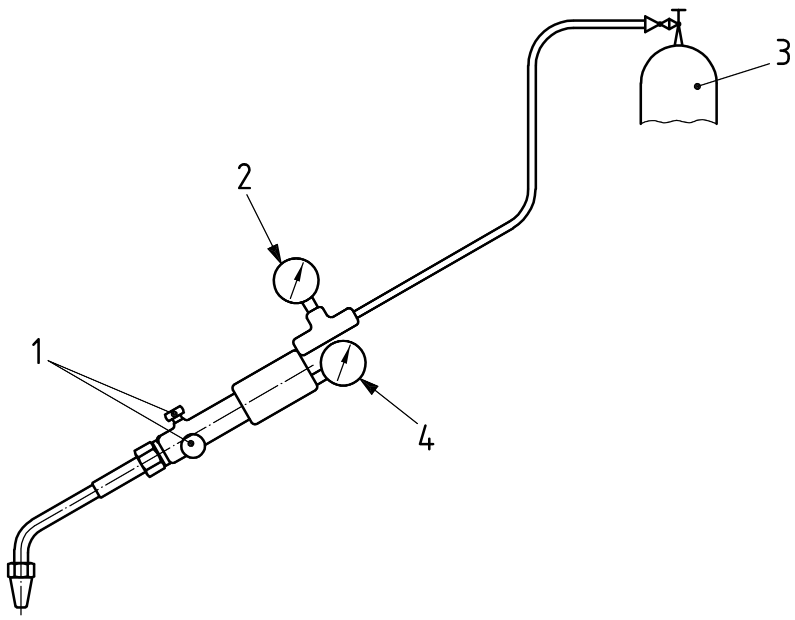
For mixers for all blowpipes if marked according to Figure 5 c).

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

8.6.2 Testing of resistance against backflow of oxygen/compressed air in the fuel gas line

8.6.2.1 Test conditions

The test arrangement is shown in Figure 15.



Key

1 valves fully opened

2 pressure gauge at the oxygen hose connection

3 compressed air/nitrogen cylinder

4 pressure gauge at fuel gas hose connection

Figure 15 — Assembly for testing the resistance against backflow of oxygen in the fuel gas line

8.6.2.2 Test procedure

The blowpipe shall be tested using the following procedure:

— fully open the heating oxygen/compressed air and fuel gas valve;

— for cutting blowpipes, close the cutting oxygen valve;

— adjust pressure on the oxygen/compressed air 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.

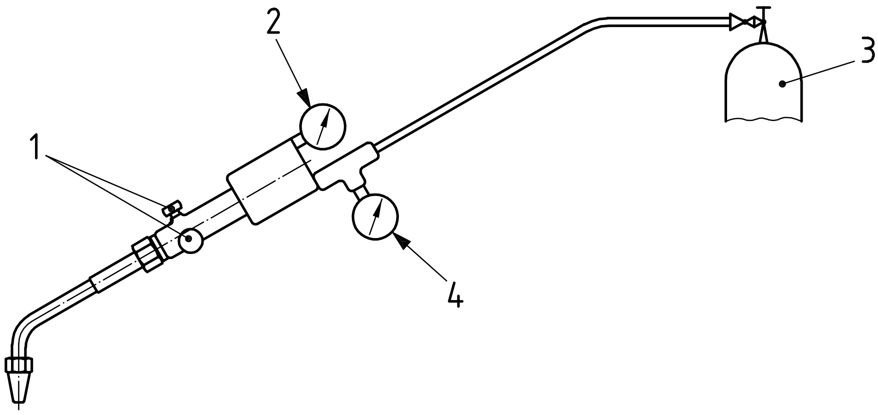
8.6.2.3 Assessment

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 in the fuel gas line is met.

8.6.3 Testing of resistance against backflow of fuel gas in the oxygen/compressed air line

8.6.3.1 Test conditions

The test arrangement is shown in Figure 16.



Key

1 valves fully opened

2 pressure gauge at the oxygen hose connection

3 compressed air/nitrogen cylinder

4 pressure gauge at fuel gas hose connection

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

8.6.3.2 Test procedure

The blowpipe shall be tested using the following procedure:

— fully open the heating oxygen/compressed air and fuel gas valve;

— for cutting blowpipes, 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 is 150 kPa);

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

8.6.3.3 Assessment

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

9 Typical dimensions of machine cutting blowpipes

Typical dimensions for machine cutting blowpipes are given in Annex E for information.

10 Instructions for use

The manufacturer, supplier or distributor shall supply instructions for use with each blowpipe, in the language of the country where it is sold, covering at least:

a) permissible types of gas;

b) all relevant pressure and flow data;

c) explanation of all the marking;

d) details of the mixing principle;

e) safety devices which are required or recommended;

f) safety warnings;

g) steps to be taken before operation, including leak testing;

h) how to operate, including lighting-up and shutdown;

i) service, maintenance and repair.

Annex A
(informative)

Corresponding flow rates for the most common fuel gases

The values in Table A.1 are rounded off to practical values and for families according to the marking. For gases not indicated in Table A.1, the flow rate is achieved by dividing the nominal thermal power by the lower heat of combustion at 15 °C.

Table A.1 — Flow rates

Gas	**Chemical formula**	**Lower heat of combustion at 15 °C and 101,3 kPa** [a] kcal/m^3	**Symbol**	**Maximum flow where this International Standard is applicable** l/h
Acetylene	C_2H_2	12 700	A	2 500
Propane (LPG)	C_3H_8	21 200	P	1 500
Butane (LPG)	C_4H_{10}	28 000		1 200
Natural gas, methane	CH_4	8 120	M	4 000
Hydrogen	H_2	2 450	H	13 000
Ethylene	C_2H_4	13 450	E	2 200
Ethane	C_2H_6	14 600		
MPS (methylacetylene-propadiene mixtures)	C_3H_4/C_3H_4	19 580	Y	1 600

[a] If the lower heat of combustion is available at 0 °C, divide by 1,055 to obtain the value at 15 °C

NOTE The relevant oxygen or compressed air quantity is derived from the mixing ratio of the type of fuel gas used.

Annex B
(informative)

Terminology concerning welding and cutting blowpipes and example of construction

The terminology concerning welding and cutting blowpipes is shown in Figures B.1 to B.14 and given in Table B.1

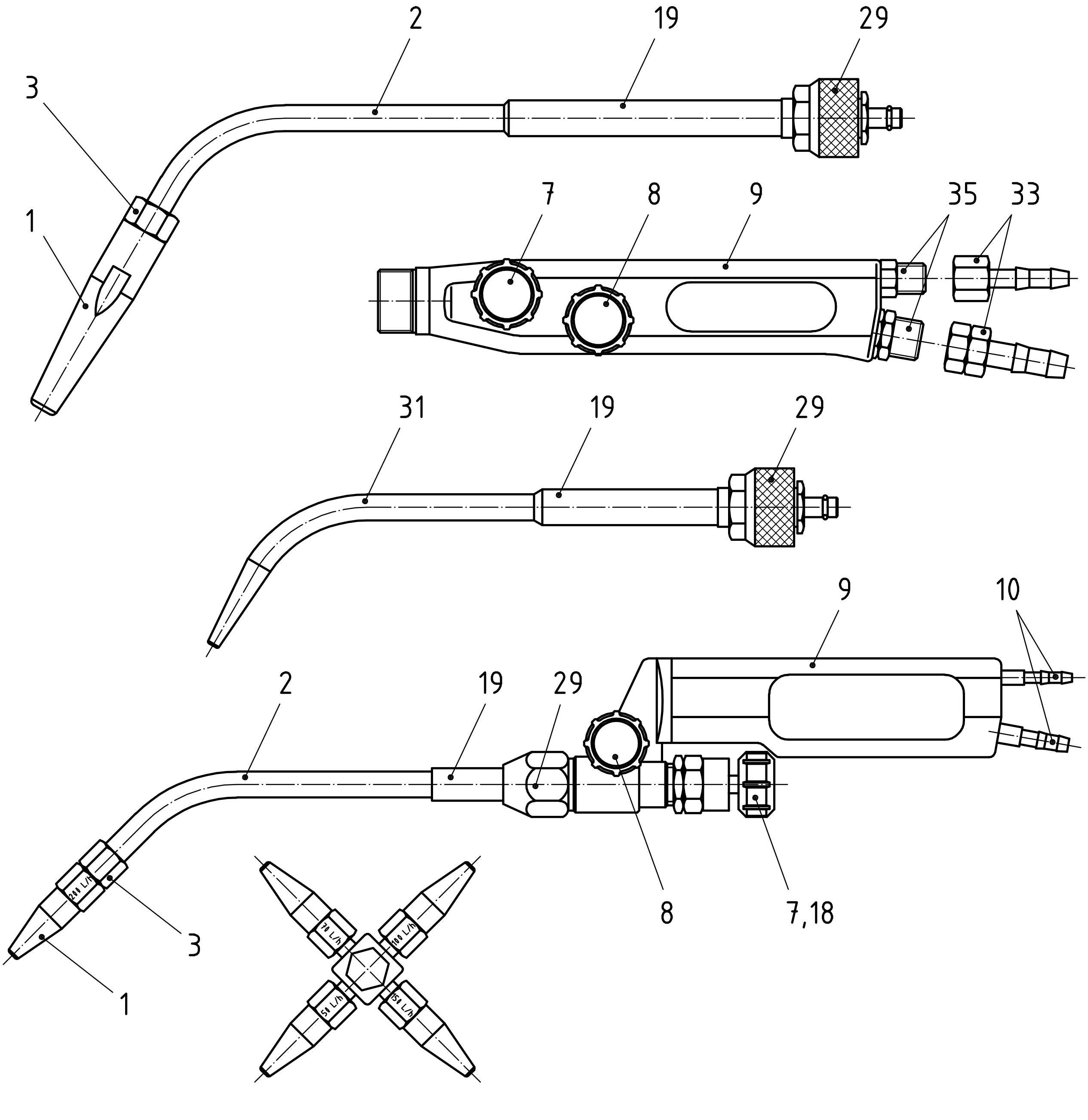


Figure B.1 — Welding blowpipes

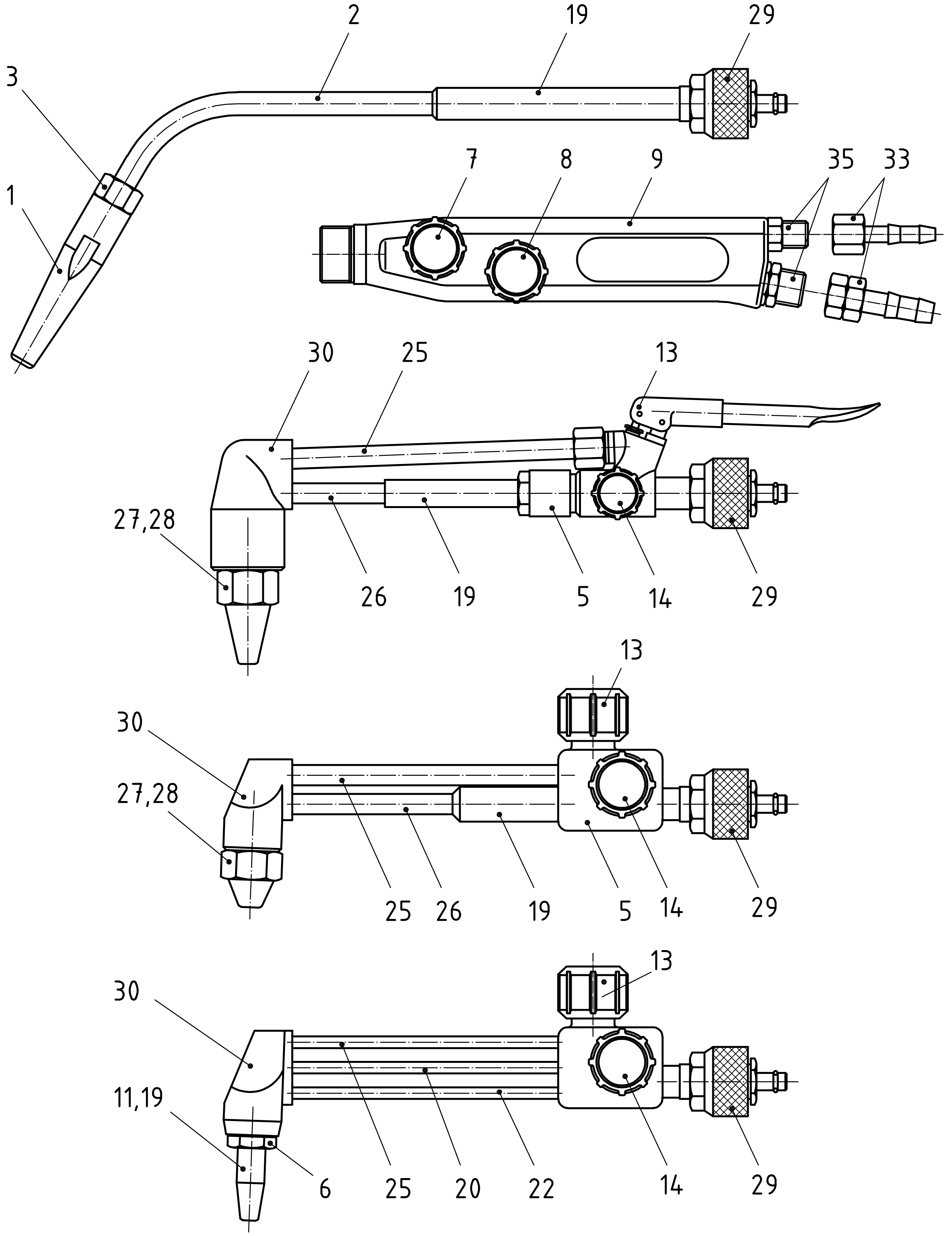
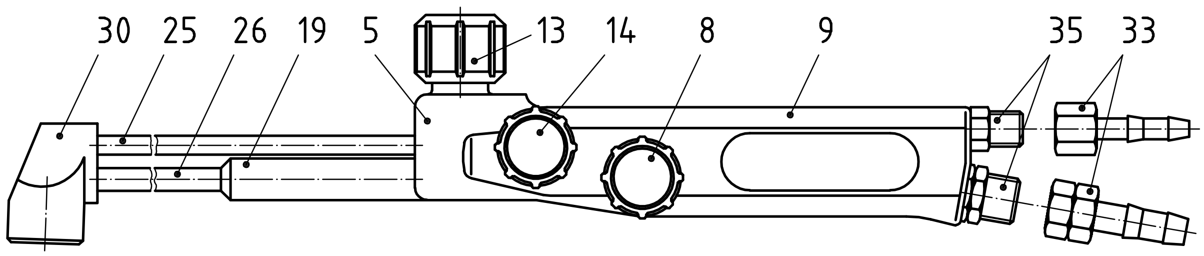
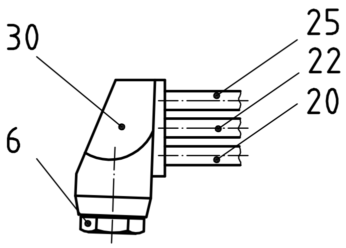


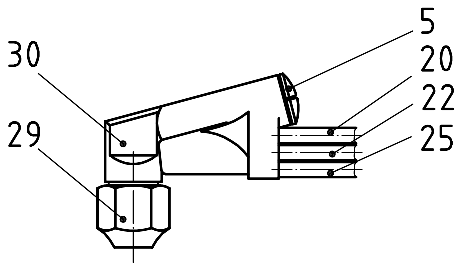
Figure B.2 — Combination of welding and cutting blowpipes



a) Blowpipe with premixing (injector cutting blowpipe)

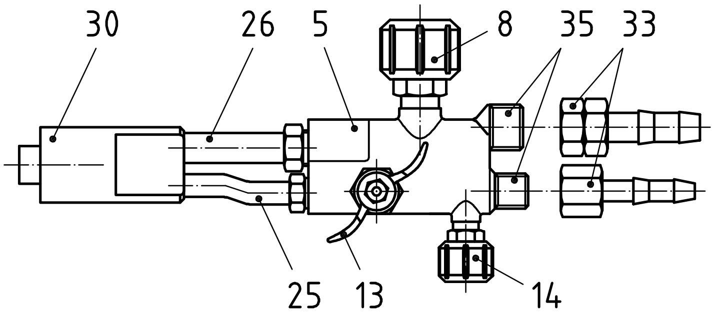


b) Blowpipe with nozzle mixing (nozzle-mixer cutting blowpipe)

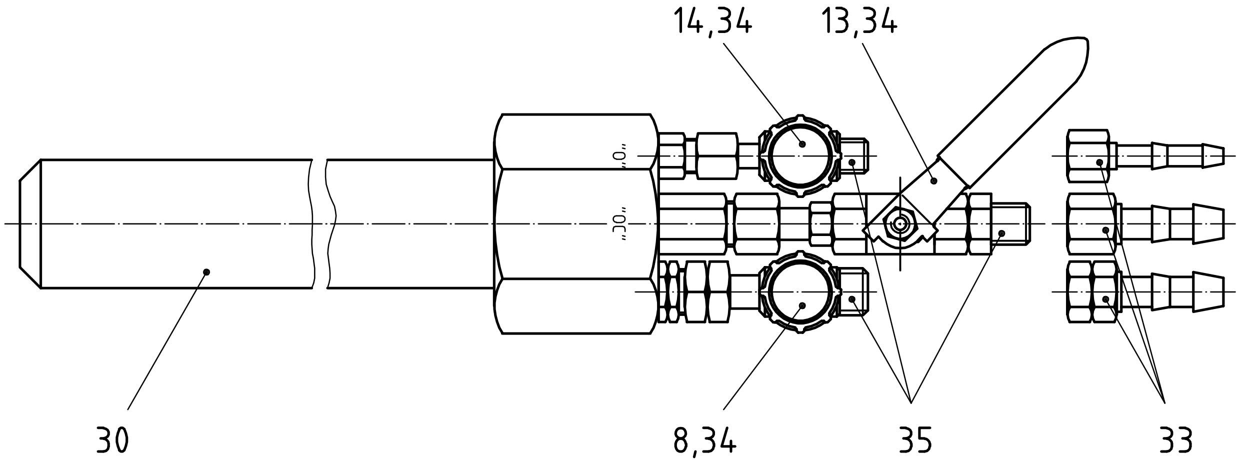


c) Blowpipe with head mixing (injector cutting blowpipe)

Figure B.3 — Manual cutting blowpipes



a) Machine cutting blowpipe with premixing (2-hose blowpipe)



b) Machine cutting blowpipe with pre-mixing or nozzle mixing (3-hose blowpipe)

Figure B.4 — Machine cutting blowpipe

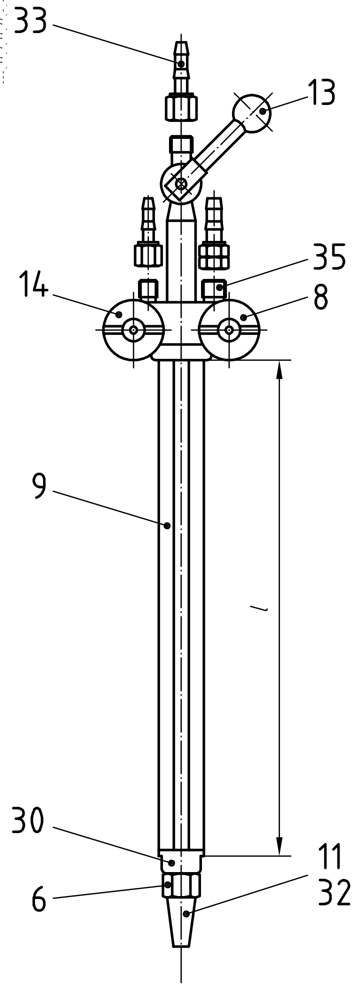


Figure B.5 — Blowpipe with built-in valves

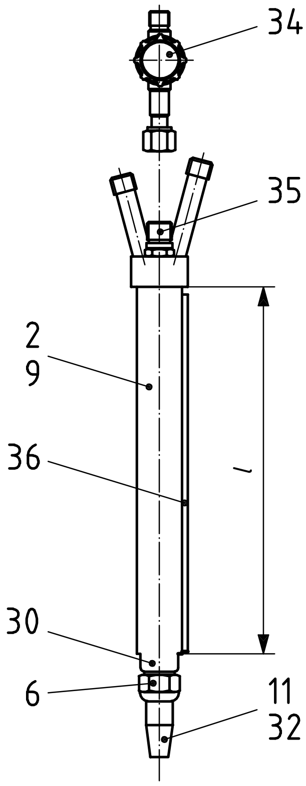


Figure B.6 — Blowpipe with screw-on valve

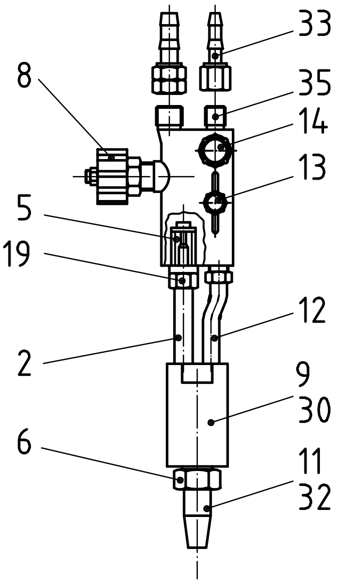


Figure B.7 — Two-hose blowpipe

Dimensions in millimetres

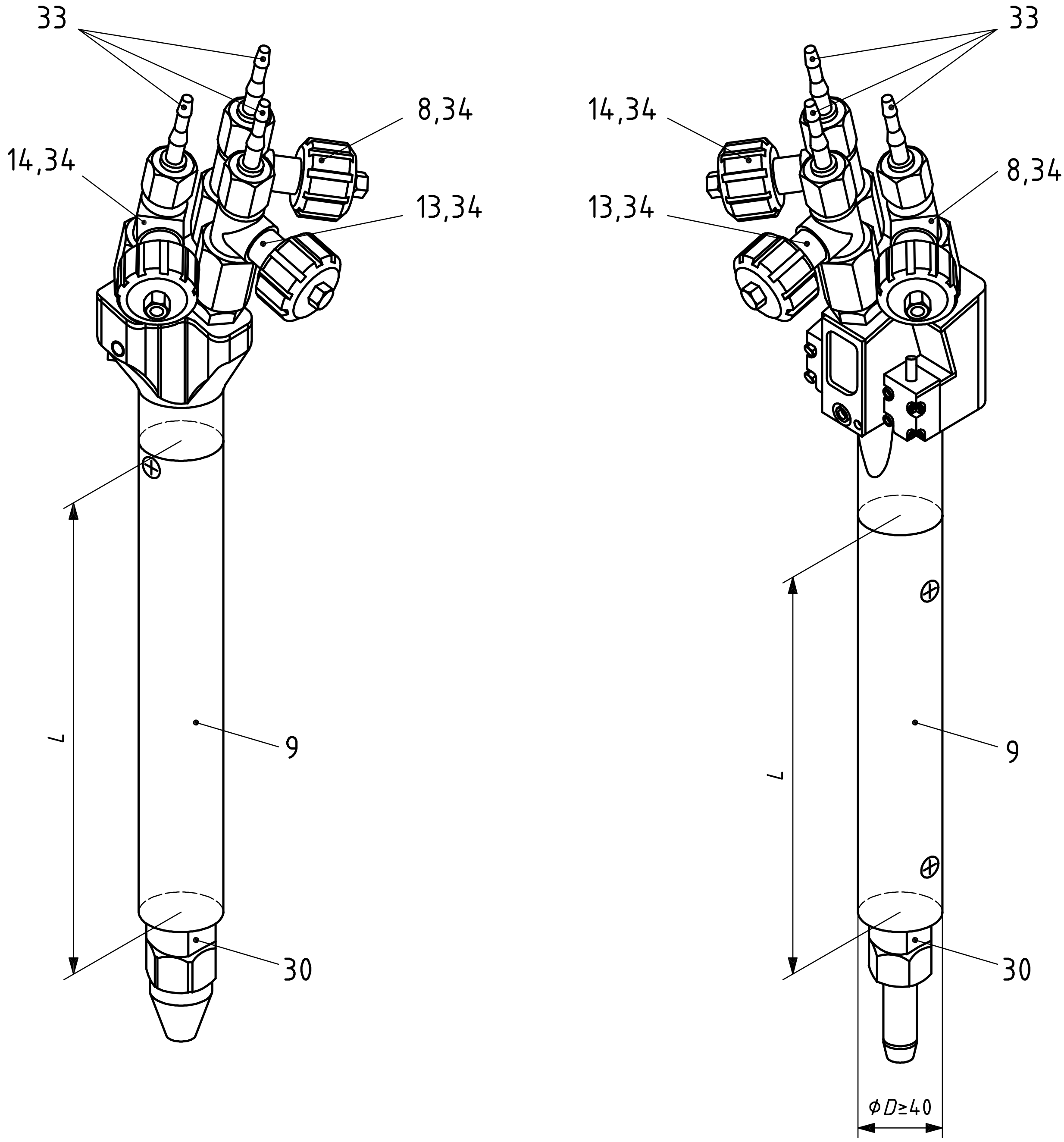
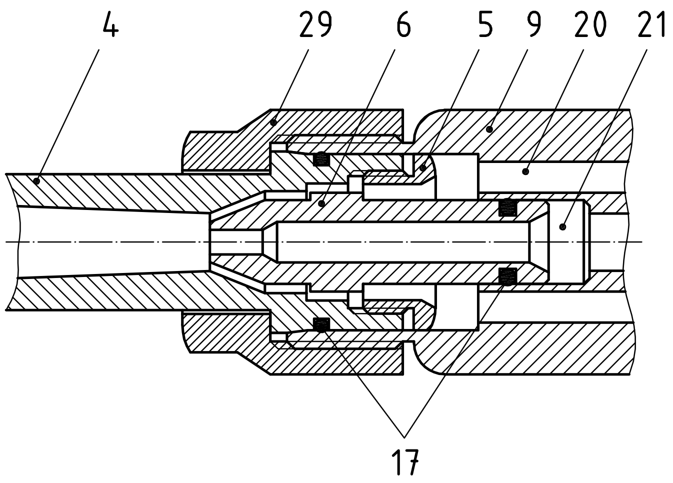
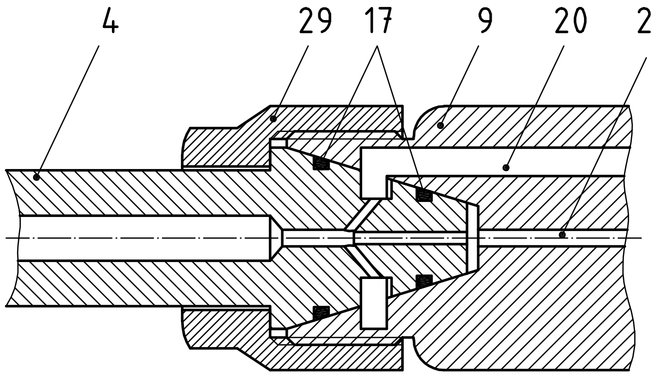


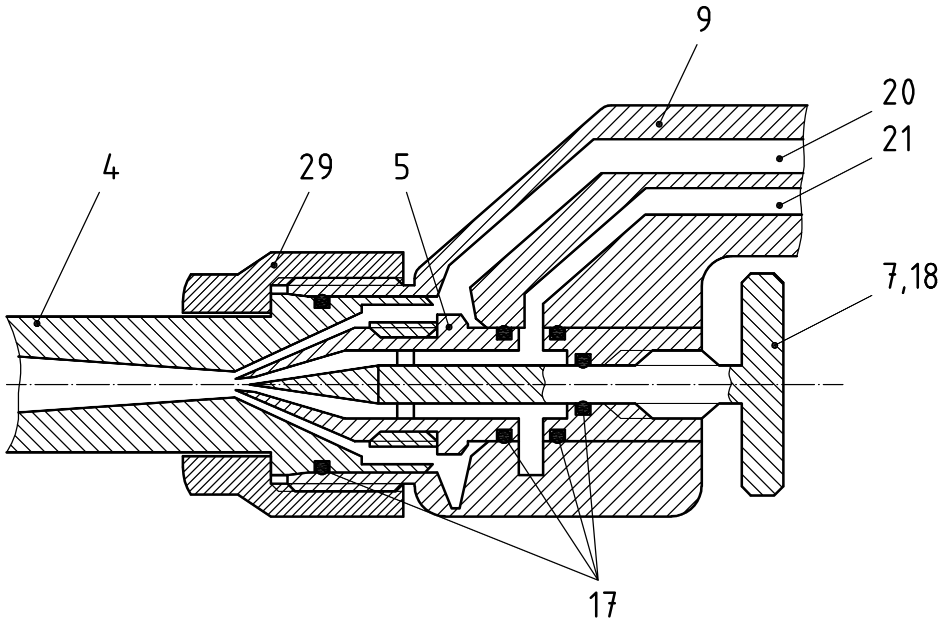
Figure B.8 — Three-hose machine blowpipe



a) Injector-mixer



b) Equal-pressure mixer



c) Mixer with adjustable injector

Figure B.9 — Mixing systems

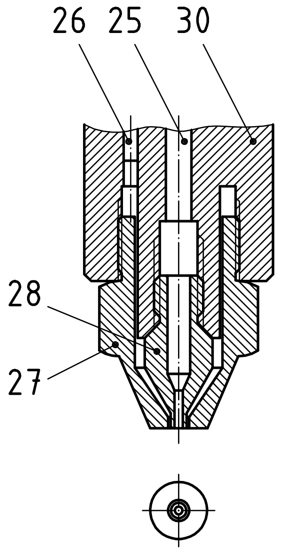


Figure B.10 — Ring-type nozzle (premixing)

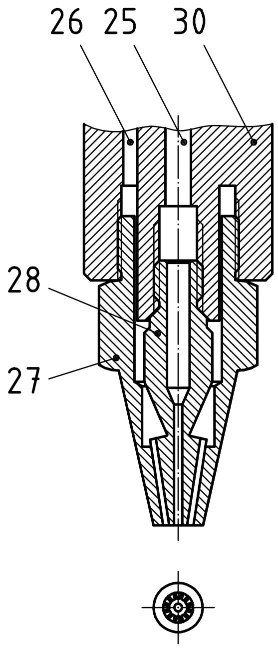


Figure B.11 — Slot-type nozzle (premixing)

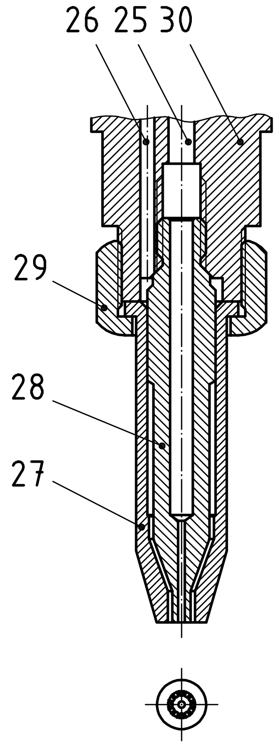


Figure B.12 — Fillet slot-type nozzle (premixing)

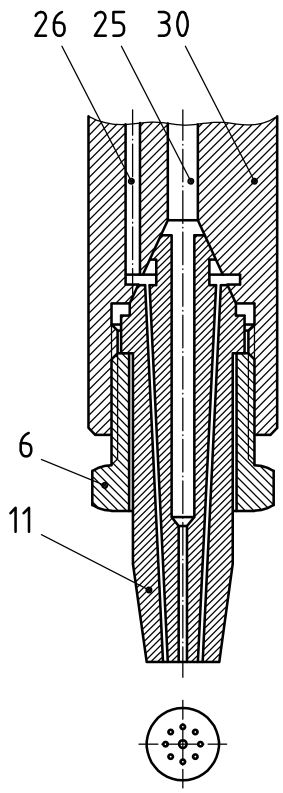


Figure B.13 — Block-type nozzle (premixing)

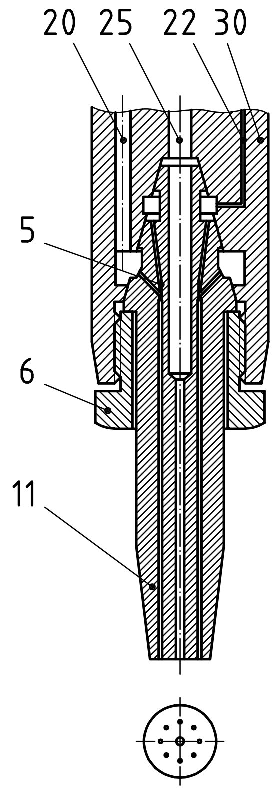


Figure B.14 — Nozzle-mixing-type nozzle (nozzle mixing)

Table B.1 — List of terms

No.	English	French	German
1	Welding nozzle	Buse de soudage	Schweißdüse
2	Neck	Tube de mélange	Mischrohr
3	Nozzle adaptor	Embout de lance	Anschlussriegel
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 or body	Manche de chalumeau	Griffstück
10	Hose connection integral or detachable	Douille porte-tuyau intégrée 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 or passage	Conduit d'amenée du gaz combustible	Brenngaszuführung
21	Oxygen channel or passage	Conduit d'amenée de l'oxygène	Sauerstoffzuführung
22	Heating oxygen channel or passage	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 de chauffe	Heizkanal
25	Cutting oxygen channel or passage	Conduit d'amenée de l'oxygène de coupe	Schneidsauerstoffzuführung
26	Mixed gas channel or passage	Conduit d'amenée du mélange	Gasgemischzuführung
27	Nozzle outer	Buse externe	Heizdüse
28	Nozzle inner	Buse interne	Schneiddüse, intern
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
33	Hose coupling nipple with union nut	Douille porte-tuyau avec écrou de fixation	Schlauchtülle mit Überwurfmutter
34	Single valve	Robinet	Einzelventil
35	Threaded union	Mamelon fileté	Gewindestutzen
36	Rack	Crémaillère	Zahnstange
37	Valve gland	Valve étoupe	Ventil-Stopfbuchse

Annex C
(informative)

Approximate mixing ratios for normal flames

Table C.1 — Mixing ratio

Gas	Chemical formula	Fuel gas/ oxygen	Fuel gas/ compressed air
Acetylene [a]	C_2H_2	1:1,3	1:6,2
Propane (LPG)	C_3H_8	1:3,75	1:18
Butane	C_4H_{10}	1:4,5	1:21,4
Natural gas, methane	CH_4	1:1,6	1:7,6
Hydrogen	H_2	1:0,25	1:0,45
Ethylene	C_2H_4	1:2,6	1:12,4
Ethane	C_2H_6	1:3,0	1:14,3
MPS (methylacetylene-propadiene mixtures)	C_3H_4/C_3H_4	1:3,5	1:16,5
Other fuel gas mixtures		According to manufacturer's specifications	
a Most oxy-acetylene blowpipes are operated at the neutral flame setting which requires a ratio of 1:1,1.			

Annex D
(informative)

Marking of components of a blowpipe

Table D.1 — Marking of components of a blowpipe

Components of the blowpipe		Manufacturer (Name or trademark of manufacturer or distributor)	Series/ Code	Type of fuel gas	Mixing system	Size code and/or operating pressures in kPa
Shank	with mixing nozzle	+	+	+	+	+
	without mixing nozzle	+	+	–	–	–
Welding attachment	with mixing nozzle	+	+	+	+	+
	without mixing nozzle	+	+	–	–	–
Mixing chamber		+	+	+	+	+
Welding/heating nozzle		+	+	+	–	+
Heating nozzle		+	+	+	–	+
Cutting nozzle		+	+	+	–	+
Gas mixing nozzle		+	+	+	+	+
Shut-off valves in the shank		–	–	+	–	–
Oxygen-compressed air connection (for blowpipes with integral hose connection)		–	–	+	–	–

Key

\+ Marking required

– No marking required

NOTE 1 The thickness range of the workpiece or the oxygen or compressed air flow rate or the size are recommended for the code.

NOTE 2 The marking with series/code is required in order to exclude confusion of interchangeable components.

NOTE 3 Marking of the type of gas is effected by distinguishing letters according to 6.4.

NOTE 4 Marking is effected on the parts (e.g. handle, welding, heating or cutting attachment) into which the mixing chamber is integrated. Non-exchangeable mixing chambers (e.g. soldered-in) need not be marked.

NOTE 5 Fuel gas valves shall be marked according to the type of gas as described in 6.5.

NOTE 6 For 3 hose machine blowpipes, the inlets for heating oxygen and for cutting oxygen shall be marked by “O” and “OC”, respectively.

NOTE 7 Additional relevant information shall be included in the operating instructions.

Annex E
(informative)

Typical dimensions of machine cutting blowpipes

E.1 Shank diameter

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

— 32 mm, 35 mm usual diameters;

— 28 mm useful diameter for multiple blowpipe systems or variable burner adjustment;

— $\geqslant$ 40 mm used for example, for automatic internal ignition systems.

The tolerance of the shank diameter is ${}^{0}_{-0,2}$ mm.

E.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, 220 mm and 400 mm. If other lengths are to be used, they should comply with the series R 20 (see ISO 3).

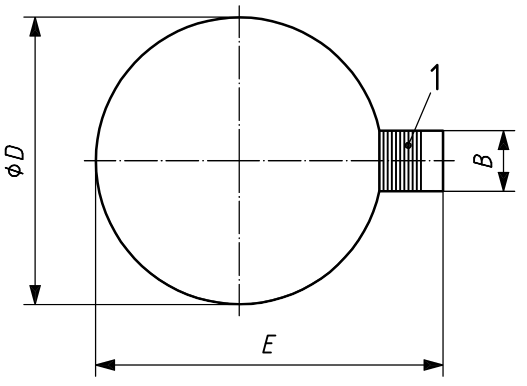
E.3 Rack

The rack is not mandatory, unless required by the blowpipe-fixing or height-adjusting device. If a rack is used, it should preferably comply either with type F or S, see Table E.1.

Table E.1 — Dimensions of rack

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

A spur tooth rack is characterised by its width, the module and pitch of its teeth, its position on the cylinder shank (dimension E in Figure E.1).



Key

1 rack

Figure E.1 — Dimensions of rack

Annex F
(informative)

Cutting-nozzle seat angles

The angle used for taper seats is not standardized.

Users should refer to operating instructions and ensure that the nozzle seat angle is compatible with the blowpipe head before use.

Mismatching of angles could lead to seat leakage and nozzle backfire.

Annex G
(normative)

Alternative sustained backfire test — Use with all blowpipes

G.1 Purpose

This Annex provides an alternative test method to those of 8.3, to satisfy the requirement of 7.1.3. The test methods of 8.3 are limited to blowpipes of certain size, shape or capacity, and are not common or recognized in certain jurisdictions.

Furthermore, the test set forth in this Annex is suitable for repair facilities or other field entities that have a need to consistently test blowpipes for sustained backfire and do not have the capabilities of a laboratory.

G.2 Alternative sustained backfire test — Type testing

G.2.1 Setting-up conditions

The blowpipe shall be connected to the oxygen and fuel gas supply for which it is intended. Each oxygen and fuel gas combination shall be tested separately. For blowpipes specifically designed for use with air only, air shall be used instead of oxygen.

As a minimum, the testing should be performed on both the smallest and largest nozzles (tips) recommended for the equipment. Hoses used to connect the blowpipe to the gas supply shall not be restrictive at the recommended pressure and flow conditions of the nozzle being used.

G.2.2 Neutral/normal test

Using the median pressures and flows stated by the manufacturer, adjust the blowpipe oxygen and fuel control valves to obtain a neutral or normal flame. Perform the test given in G.2.5.

G.2.3 Oxidizing test

Adjust the oxygen and fuel control valves as indicated in G.2.2. Without touching the control valves on the blowpipe, increase the oxygen pressure by 10 % and decrease the fuel pressure by 10 %. Perform the test given in G.2.5.

G.2.4 Reducing test

Adjust the oxygen and fuel control valves as indicated in G.2.2. Without touching the control valves on the blowpipe, decrease the oxygen pressure by 10 % and increase the fuel pressure by 10 %. Perform the test given in G.2.5.

G.2.5 Sustained backfire test

With the flame adjusted to one of the previous conditions, position the blowpipe so that the axis of the nozzle is vertical. While maintaining this vertical contact, place the nozzle in contact with a surface such as carbon, metal, wood or firebrick, so as to force the flame back into the blowpipe thus producing a backfire. Repeat this procedure for a minimum of 30 times at a frequency of 30 to 50 backfires per minute. If no sustained backfire occurs during this test, the blowpipe is considered acceptable.

The blowpipe may be cooled to ambient temperature before each test period.

Annex H
(informative)

Alternative sustained backfire test — Production and field acceptance

H.1 Setting-up conditions

The blowpipe should be connected to the oxygen and fuel gas supply for which it is intended. For blowpipes specifically designed for use with air only, air should be used instead of oxygen. If the blowpipe is designed for use with all fuel gases, including acetylene, then acetylene should be the fuel gas used for testing. If the blowpipe is designed for fuel gases other than acetylene, then propane should be the fuel gas used for testing. If the blowpipe is designed for use with only one fuel gas type, then the blowpipe should only be tested with that particular fuel gas.

The testing should be performed using the most commonly used nozzle (tip) as specified by the manufacturer. Hoses used to connect the blowpipe to the gas supply should not be restrictive at the recommended pressure and flow conditions of the nozzle being used.

H.2 Sustained backfire test

Using the median pressures and flows stated by the manufacturer, adjust the blowpipe oxygen and fuel control valves to obtain a neutral or normal flame. Where flow-measuring devices are not available or not practical, the neutral or normal flame may be adjusted visually, as recommended by the manufacturer.

With the flame properly adjusted, contact the nozzle to a surface such as carbon, metal, wood or firebrick so as to force the flame back into the blowpipe, thus producing a backfire. Repeat this procedure for a minimum of 30 times at a frequency of 30 to 50 backfires per minute. If no sustained backfire occurs during this test, the blowpipe is considered acceptable.

Annex I
(normative)

Alternative colour codes for oxygen

Table I.1 below details alternative colour codes for oxygen, for the case where a country has colour identification in their national requirements other than blue, see 6.3.

Table I.1 — Alternative oxygen gas colour codes

Country	National standard/regulation	Colour
USA	CGA E-5	Green
	UL 123	

Bibliography

[1] ISO 3, *Preferred numbers — Series of preferred numbers*

[2] ISO 3253, *Gas welding equipment — Hose connections for equipment for welding, cutting and allied processes*

[3] ISO 9012, *Gas welding equipment — Air-aspirated hand blowpipes — Specifications and tests*

[4] ISO 9090, *Gas tightness of equipment for gas welding and allied processes*

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