भारतीय मानक
Indian Standard

IS 3745 : 2023

चिकित्सा गैस सिलिंडर के लिए योक टाइप वाल्व कनैक्शन — विशिष्टि

(तीसरा पुनरीक्षण)

Yoke Type Valve Connections for Medical Gas Cylinders — Specification

(Third Revision)

ICS 11.040.10

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
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January 2023 **Price Group 9**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards on recommendation of the Gas Cylinders Sectional Committee, and approval of Mechanical Engineering Divisional Council.

This standard was first published in 1966 and subsequently revised in 1978 and 2006. The revision of this standard has been aligned with latest ISO/FDIS 407 : 2021 'Small medical gas cylinders — Pin-index yoke-type valve connections'. Also, certain technical requirements and tests have been adapted from revised IS 3224 : 2021 'Valve for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders — Specification'. In this revision, following major changes have been made:

a) IS/ISO 11114 (Part 1) and IS/ISO 11114 (Part 2) have been added for material compatibility with gas;
b) Provision of operating mechanism design has been adopted from revised IS 3224;
c) Provision of pressure Relief device criteria has been added;
d) Provision of hydraulic burst pressure test has been added; and
e) Provision of endurance test has been adopted from revised IS 3224.

The relevant SI units and corresponding conversion factors are given below for guidance:

1 kgf/cm^2 = 98.066 5 kPa (kilopascal) = 10 m of Water column (WC)

= 0.098 066 5 MPa (megapascal)

= 0.980 665 bar

1 Pa = 1 N/m^2

The composition of the Committee responsible for the formulation of this standard is listed in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

YOKE TYPE VALVE CONNECTIONS FOR MEDICAL GAS CYLINDERS — SPECIFICATION

(Third Revision)

1 SCOPE

This standard covers basic dimensions and constructional requirements for yoke type valve connections for medical gas cylinders with a maximum working pressure (filling pressure at 15 °C) of 200 bars. Also specifies the dimensions and positions for the holes and pins for the outlet connections for medical gases and gas mixtures given in Table 1.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 MATERIAL

3.1 Chemical Composition

Metallic and non-metallic materials, including gaskets and seals, in contact with the gas shall be compatible with the gas, according to IS/ISO 11114-1 and IS/ISO 11114-2 under all intended operating conditions. For valves used with gas mixtures, the compatibility of the gas wetted materials with each component of the gas mixture shall be considered.

3.1.1 The valve body shall be of either forged or machined from extruded section of brass.

3.1.2 The material of the valve body shall comply with the mechanical properties given in **3.2**.

3.2 Mechanical Properties

The material of the valve body shall comply with the requirements of mechanical properties given in **3.2.1** and **3.2.2**.

Table 1 Allocated Gases and Gas Mixtures
(*Clause* 1)

Sl No.	Gas or Gas Mixture	Chemical Symbol
(1)	(2)	(3)
i)	Oxygen	O_2
ii)	Oxygen/Carbon dioxide ($CO_2 \leq 7$ percent)	$O_2 + CO_2$
iii)	Oxygen/Helium (He ≤ 7 percent)	$O_2 + H_e$
iv)	Ethylene	$C_2 + H_4$
v)	Nitrous oxide (with or without liquid draw off)	N_2O
vi)	Cyclopropane	C_3H_6
vii)	Helium and helium/oxygen ($O_2 < 20$ percent)	He
viii)	Carbon dioxide (with or without liquid draw-off) and Carbon dioxide/oxygen $CO_2 > 7$ percent	CO_2
ix)	Medical air	Air
x)	Nominal mixture 50 percent oxygen/50 percent nitrous oxide (47.5 percent < N_2O < 52.5 percent)	$O_2 + N_2O$
xi)	Nitrogen	N_2

3.2.1 Tensile Strength and Elongation

The tensile strength and elongation of the material of the valve body determined according to IS 1608 (Part 1) shall be respectively at least 392 MPa (40 kgf/mm^2) and minimum 18 percent measured on a gauge length $5.65\sqrt{S_o}$ (S_o being the original area of cross-section) except for valves used for CO_2 and N_2O for which the minimum tensile strength of the material of the valve body according to IS 1608 (Part 1) shall be 343 MPa (35 kgf/mm^2) and the maximum permissible tensile strength shall be 430 MPa, minimum elongation shall be 18 percent on a gauge length $5.65\sqrt{S_o}$.

3.2.2 Izod Impact Strength

The Izod impact strength of valve body determined according to IS 1598, shall not be less than 21.5 J (2.2 kg.m).

3.3 Test Samples

Test samples for tensile and Izod impact tests shall, wherever practicable, be drawn from a valve body blank; where this is not practicable, the test samples shall be made from same raw material (wrought or extruded section), giving the same outside shape as the valve body blanks it represents. The scale of sampling and criteria for conformity shall be in accordance with the requirements of Annex A.

3.4 Protective Finishes

Valves shall be bright Ni/Cr plated conforming to service condition 2 of Table 3 given in IS 1068. Plating shall not be carried out on gas wetted areas to avoid the flaking or particle generation and on inlet and outlet threads.

4 DESIGN

Valve designs (operating mechanism and terminology) shall be as per IS 3224.

4.1 Design Criteria

4.1.1 Valve shall be designed to operate satisfactorily and be leak tight over a range of service temperatures, from – 20 °C to + 65 °C in indoor and outdoor environments.

4.1.1.1 In case of liquefiable gases, working pressure (P_w) of the valve shall at least be the maximum developed pressure in the cylinder at a temperature of 65 °C or in case of permanent gases, the filling pressure/settled pressure shall be at 15 °C (*see* IS 8775 and IS 15975).

4.1.2 The components and parts of the valve of same design of a same manufacturer shall be interchangeable.

4.1.3 Dip (siphon) tube and any other internal device such as filter arrangement, excess flow valve, anti-dust tube etc, shall be secured in a manner that will protect them from becoming loose or detached or break during transit and use.

4.1.4 If the valve operating mechanism closes the valve by rotation, this shall be in clockwise direction when viewed from the spindle end.

4.1.5 Hand wheel or knob, wherever provided, shall be clearly marked with ‘Open’ and ‘Close’ positions in words and in figures.

4.1.6 The general machining tolerances unless otherwise stated shall of medium class specified in IS 2102 (Part l).

5 PRESSURE RELIEF DEVICES

5.1 Design Criteria of Pressure Relief Devices

The materials, design and construction of a pressure relief device shall be such that it meets the following conditions:

5.1.1 There shall be no significant change in the function of the device and no detrimental corrosion or deterioration of the materials due to normal service conditions of the cylinder to which it is fitted.

5.1.2 The breakage or failure of any internal component of the valve shall not obstruct free and full flow of the gas through the pressure relief device.

5.1.3 The material of construction shall be compatible with the gas(es) to be conveyed and other service conditions.

5.1.4 The design shall be such as to deter any unauthorized interference with the assembly and/or setting of the device.

5.1.5 The outlets from all pressure relief devices shall be so positioned that free discharge from the devices is not impaired. The discharge so coming out shall not come out as a single high velocity jet emerging radially to the axis of the cylinder to avoid injury to individuals working in that area.

5.1.6 The minimum rated flow capacity of the pressure relief devices fitted to non-insulated cylinders having water capacity of 11 litre or more shall be as follows:

a) For permanent gases, $Q_1 = 0.009\ 67\ W_c$, where Q_1 is the rated flow capacity in cubic metres per minute of free air at 6 kgf/cm^2 gauge pressure, and W_c is the water capacity of the cylinder in litres; and
b) For liquefiable gases: The rated flow capacity of the pressure relief devices shall be twice that given in item (a) above.

For cylinders having water capacities of less than 11 litre, the rated flow capacities shall be as given in (a) or (b) above, except that the value of W_c shall be 11 litre.

5.2 Relief/Bursting Pressure

5.2.1 Where the pressure relief device is a bursting disc fitted to the valve of seamless or welded cylinder the bursting pressure of the disc (when tested at temperature of 65 °C) shall not exceed the test pressure of the cylinder for which device is intended and shall be more than the developed pressure of the gas at 65 °C. Bursting disc may be rated at room temperature provided correlation between room temperature and elevated temperature is determined.

5.2.2 Valves used for high pressure liquefiable gas such as CO_2 and N_2O shall be fitted with bursting disc type safety relief device (type BD of IS 5903). The rated bursting pressure shall meet the requirement of **5.2.1** and same will be specified in the drawing. The actual burst pressure of the disc shall not be in excess of its rated burst pressure and not less than 90 percent of its rated burst pressure.

6 CONSTRUCTION

A typical yoke assembly is illustrated in Fig. 1.

6.1 Cylinder Valve

Each cylinder shall be fitted with a yoke valve (*see* **7**) with a hole or holes of the dimensions and in the position or positions given in **9** for the appropriate gas.

6.2 Yoke

The yoke intended for fixing the housing apparatus to the valve shall conform to the dimensions given in **7.1** and **7.2** Two alternative constructions as given in **8.2** and **8.3** are also permissible. The yoke shall be fitted with a pin or pins, the dimensions and positions of which correspond to the hole or holes in the valves and are given in **9.1** to **9.11** for different gases or gas mixtures.

NOTE — In Fig. 2 and in Fig. 6 to 16, the circle numbers are the pin hole position.

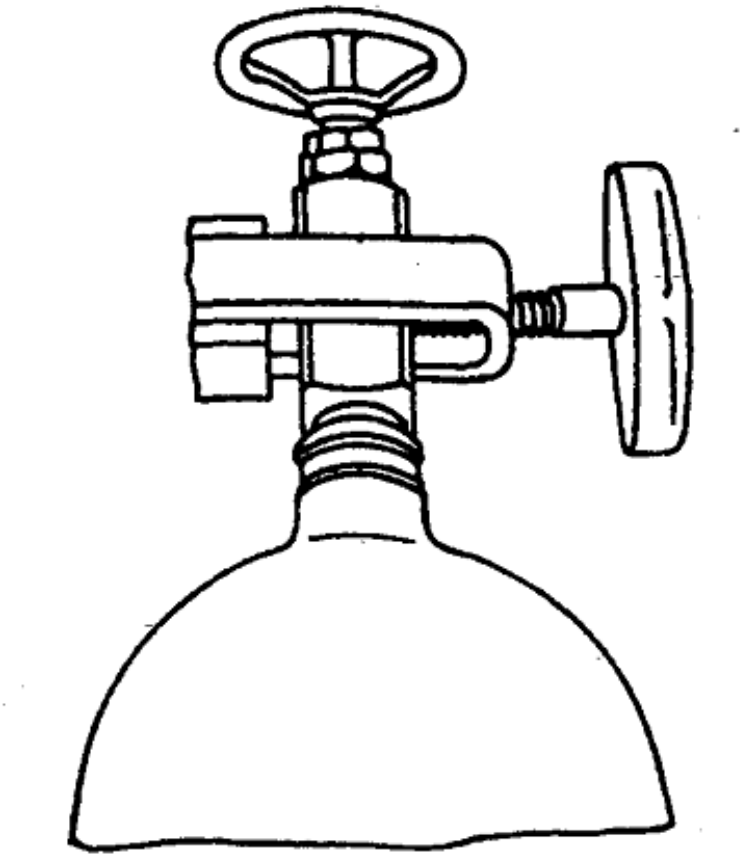
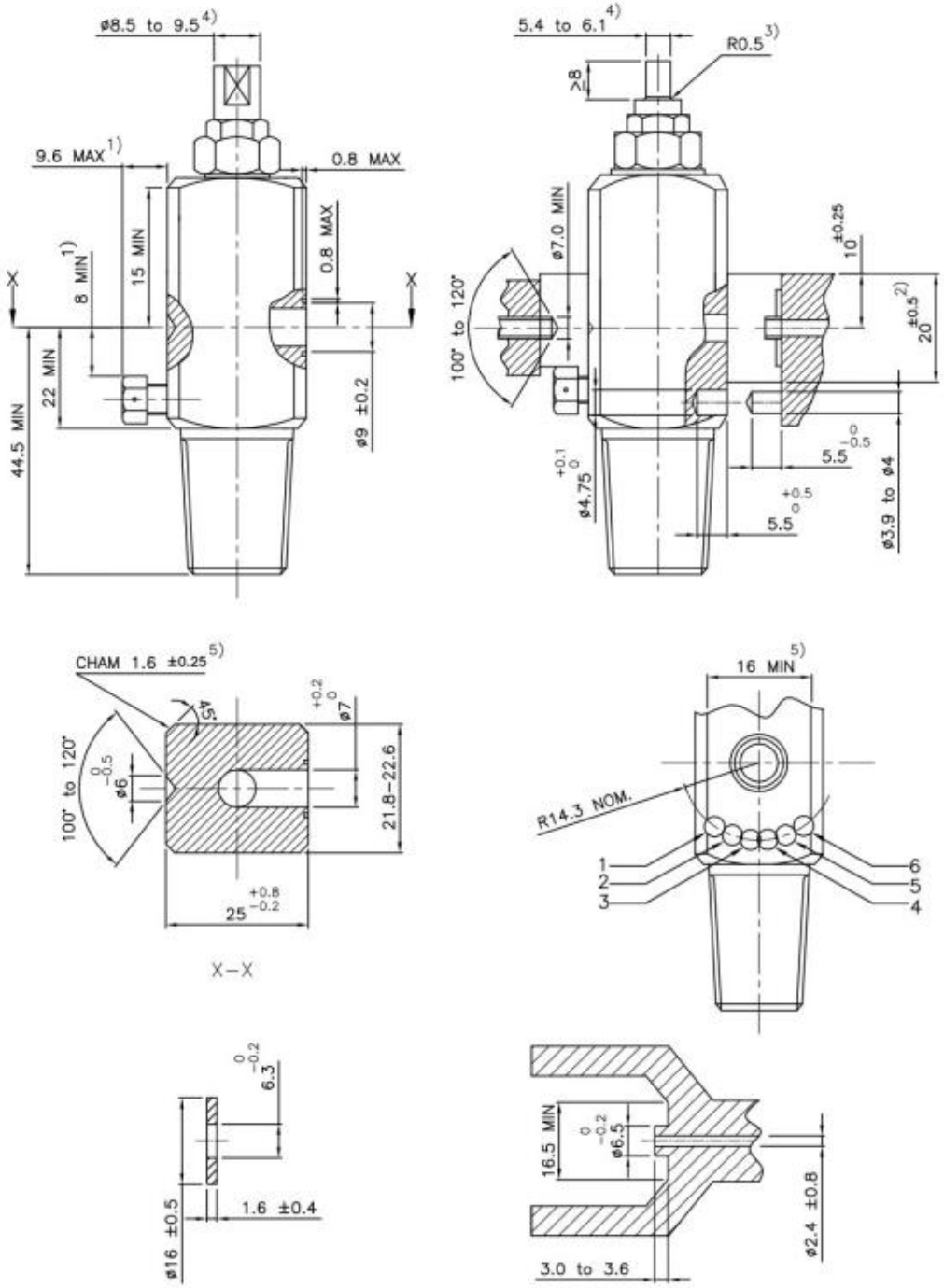


FIG. 1 TYPICAL YOKE ASSEMBLY

7 BASIC DIMENS1ONS FOR YOKE TYPE VALVE CONNECTIONS

The basic dimensions for pin-index yoke type valve connections are shown in Fig. 2 and Fig. 3.

7.1 Two-Pin System



All dimension in millimeters

FIG. 2 TWO-PIN SYSTEM

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1 Applicable only if a projecting type safety plug is used

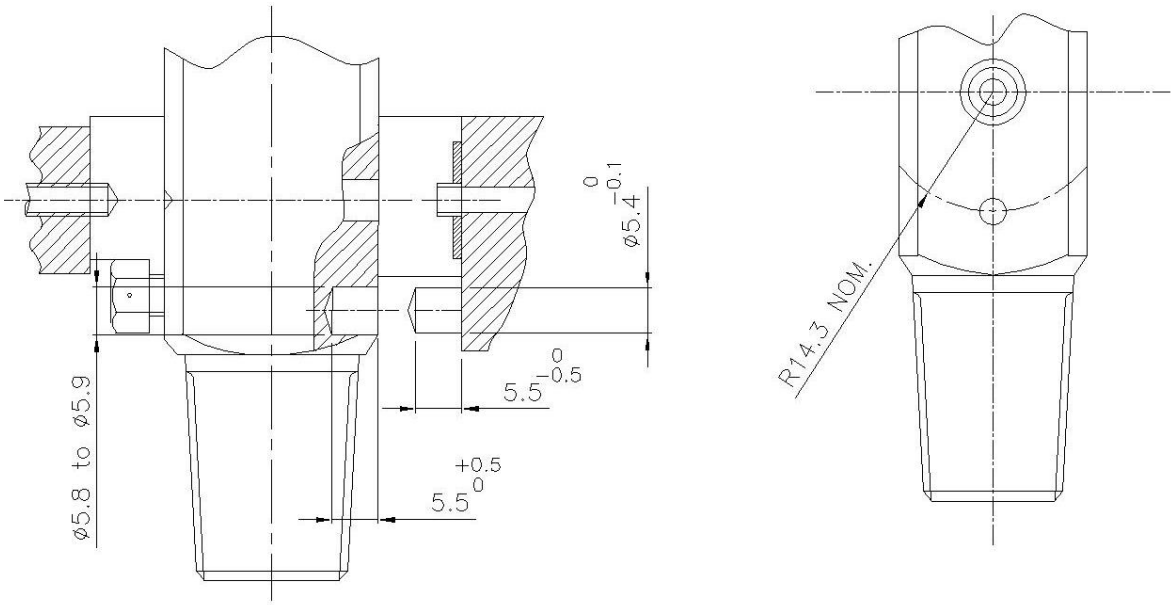
2 Alternatively the yoke or the stabilizer shall be so dimensioned as to limit the rotation of the valve on the cylinder to 6 from vertical

3 Consider introduction of radius of 0.5 mm to avoid stress concentration

4 Only applicable for key operated valves

5 Radius permitted, provided dimension 16 mm minimum is mentioned

7.2 Single-Pin System



All dimension in millimeters

FIG. 3 SINGLE-PIN SYSTEM

8 ALTERNATIVE DESIGNS OF YOKE TYPE VALVE CONNECTIONS

8.1 Requirement for the Design of Connecting Yoke

a) A gas-tight seal shall only be possible when the pins in the yoke correspond to the holes in the valve;

b) When the pins in the yoke do not correspond to the holes in the valve, a gas tight seal shall not be possible and damage to the yoke or the valve shall be prevented;

c) Pins shall be fixed or assembled in such a manner that they cannot be removed by the user or become loose in service;

d) Sealing washer shall be a retained fit on the yoke spigot;

e) Use of more than one sealing washer is not permitted;

f) The yoke shall be able to resist, without permanent deformation, the load resulting from a torque of 50 N.m applied to the valve clamping screw or locking device;

g) The dimensions of the yoke shall limit the movement of the valve in the yoke to a maximum of 6° about long axis prior to pin engagement; and

h) The dimension of the yoke shall not cause any physical interference with the valve and its operation or prevent an effective seat at the outlet connection.

8.2 First Alternative (*see* Fig. 4)

8.3 Second Alternative (*see* Fig. 5)

9 DIMENSIONS AND POSITIONS OF THE HOLES AND PINS FOR YOKE TYPE VALVE CONNECTION

9.1 Outlet Connection for Oxygen (*see* Fig. 6)

9.2 Outlet Connection for Oxygen/Carbon Dioxide Mixtures (Carbon Dioxides ≤ 7 percent) (*see* Fig. 7)

9.3 Outlet Connection for Oxygen/Helium Mixtures (Helium ≤ 80 percent) (*see* Fig. 8)

9.4 Outlet Connection for Ethylene (*see* Fig. 9)

9.5 Outlet Connection for Nitrous Oxide (*see* Fig. 10)

9.6 Outlet Connection for Cycle-Propane (*see* Fig. 11)

9.7 Outlet Connection for Helium/Oxygen Mixtures (Oxygen ≤ 20 percent) (*see* Fig. 12)

9.8 Outlet Connection for Carbon Dioxide/Oxygen Mixtures (Carbon Dioxide ≥ 27 percent) (*see* Fig. 13)

9.9 Outlet Connection for Medical Air (*see* Fig. 14)

9.10 Outlet Connection for Special Mixtures of 50 percent Nitrous Oxide and 50 percent Oxygen (*see* Fig. 15)

9.11 Outlet Connection for Nitrogen (*see* Fig. 16)

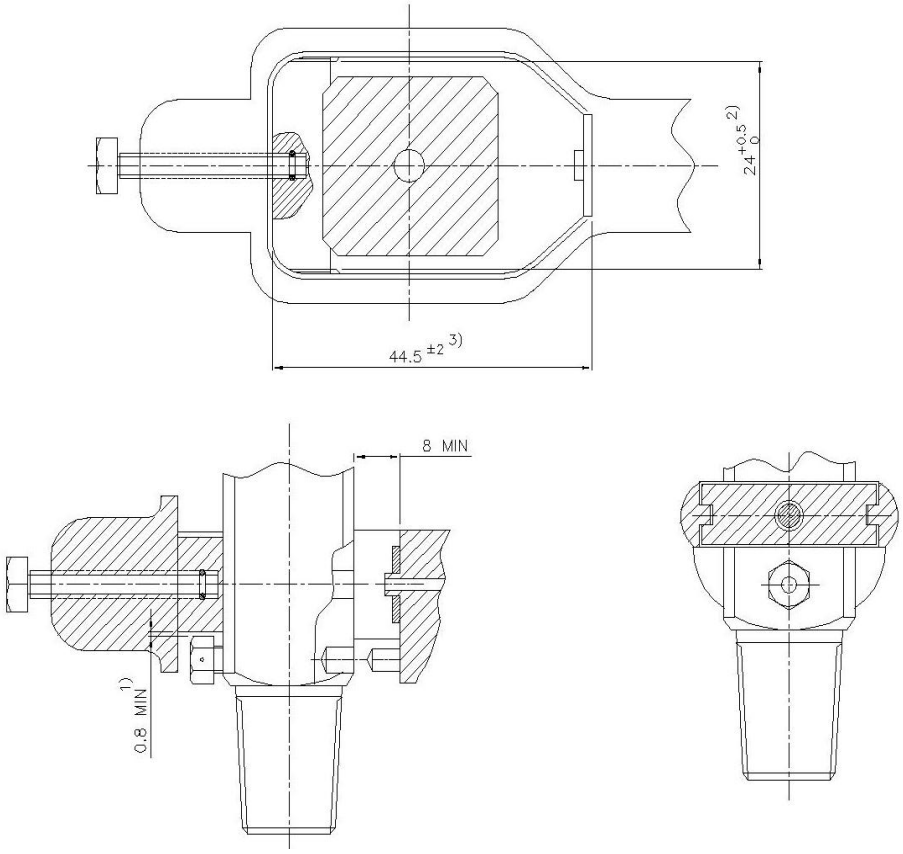
10 INLET THREADS

The valves shall have inlet threads conforming to IS 3224.

11 HYDRAULIC BURST PRESSURE TEST

One sample from each lot shall be tested. The burst pressure test shall be carried out with the valve seat in open position [valve outlet/filling connection(s)] plugged. Water or another suitable liquid shall be used as test medium. The hydraulic pressure shall be applied via the inlet connection and be raised continuously and gradually until at least 450 bar is reached. The pressure shall be maintained for at least 2 min. The test sample shall withstand 450 bar without permanent visible deformation or burst.

NOTE — For the test in closed position it is permissible for the valve to leak through the seat at a pressure above 240 bar but below 450 bar provided no parts are ejected.



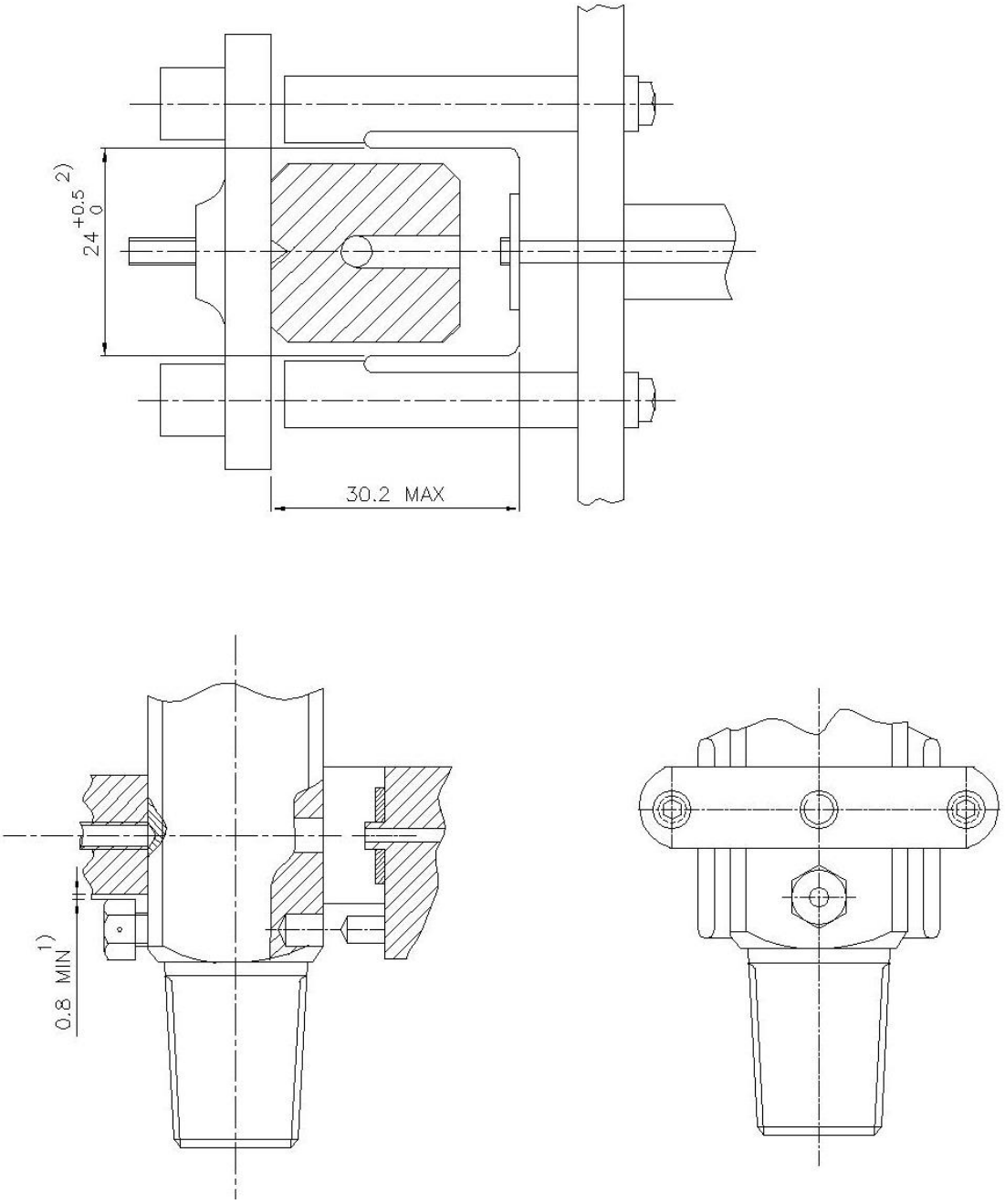
All dimension in millimeters

FIG. 4 FIRST ALTERNATIVE DESIGN OF YOKE TYPE VALVE CONNECTION

1 Applicable only if a projecting type safety plug is used;

2 Alternatively the yoke or the stabilizer shall be so dimensioned as to limit the rotation of the valve on the cylinder to 6’ from vertical; and

3 May be reduced to 35 mm. If clearance is provided for projecting safety plug.

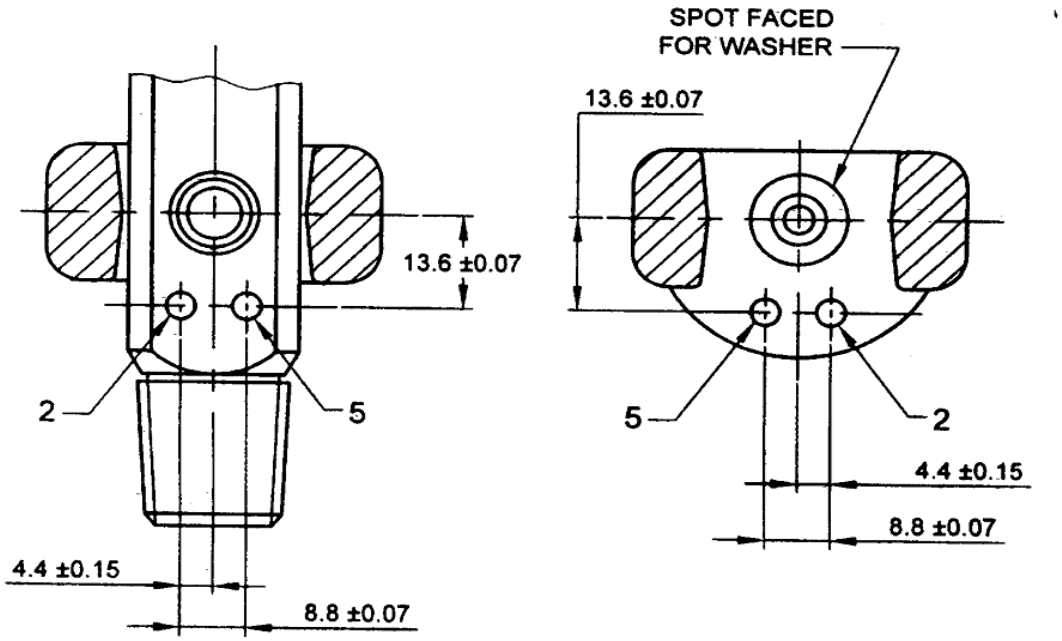


All dimension in millimeters

FIG. 5 SECOND ALTERNATIVE DESIGN OF YOKE TYPE VALVE CONNECTION

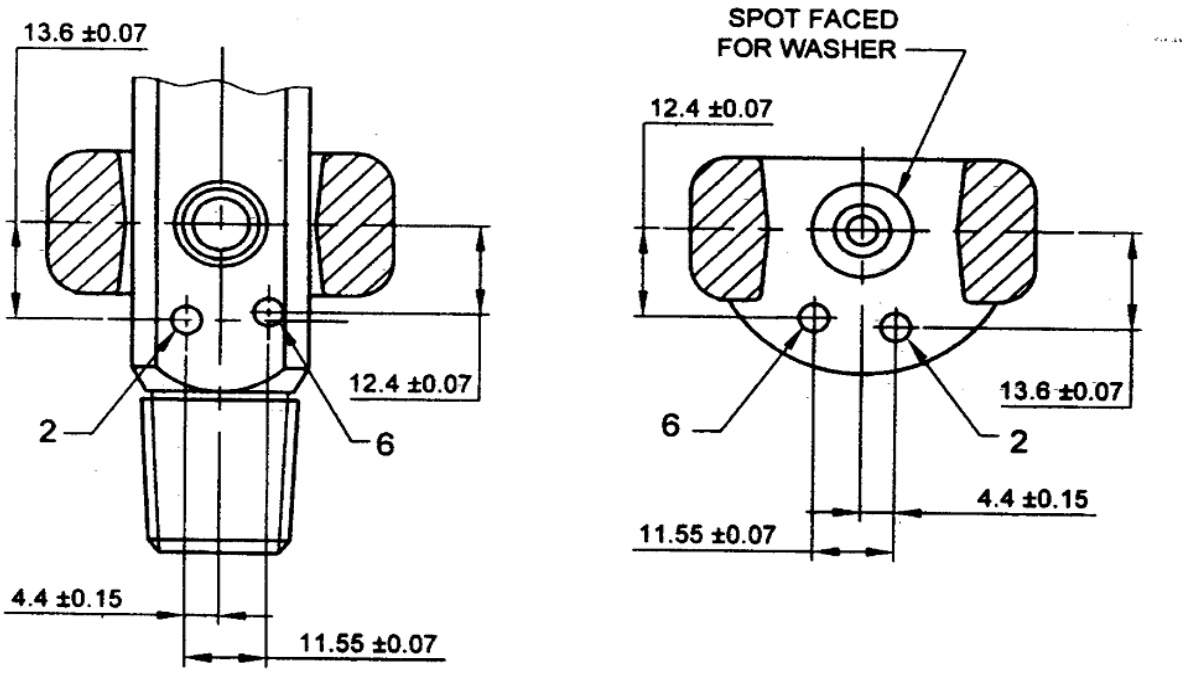
1 Applicable only if a projecting type safety plug is used

2 Alternatively the yoke or the stabilizer shall be so dimensioned as to limit the rotation of the valve on the cylinder to 6’ from vertical



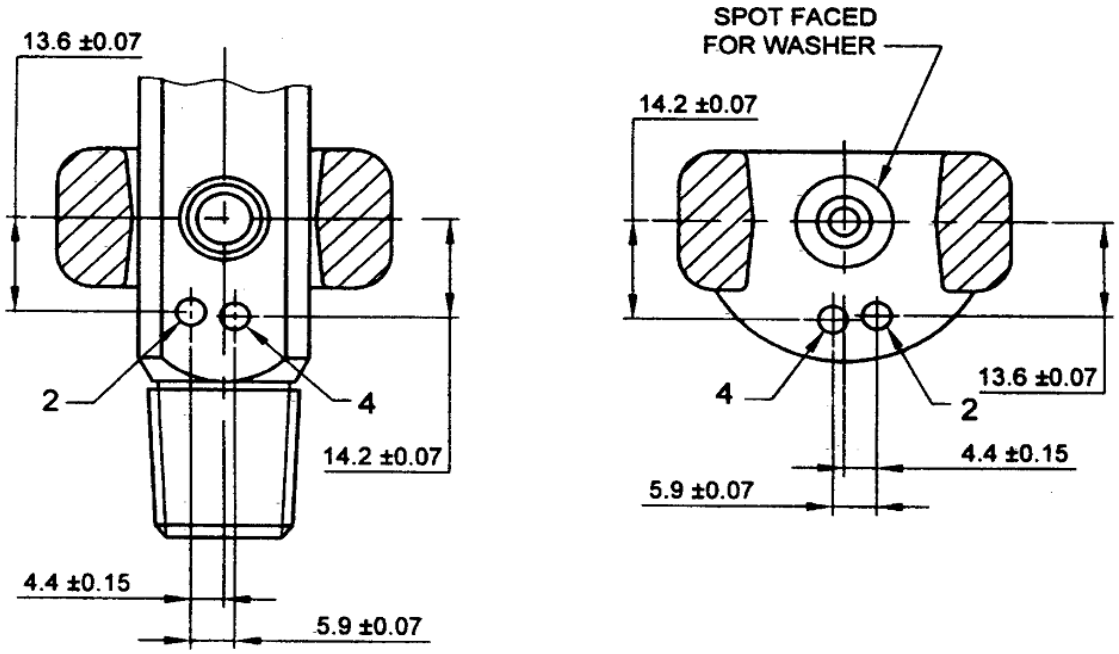
All dimension in millimeters

FIG. 6 OUTLET CONNECTION FOR OXYGEN



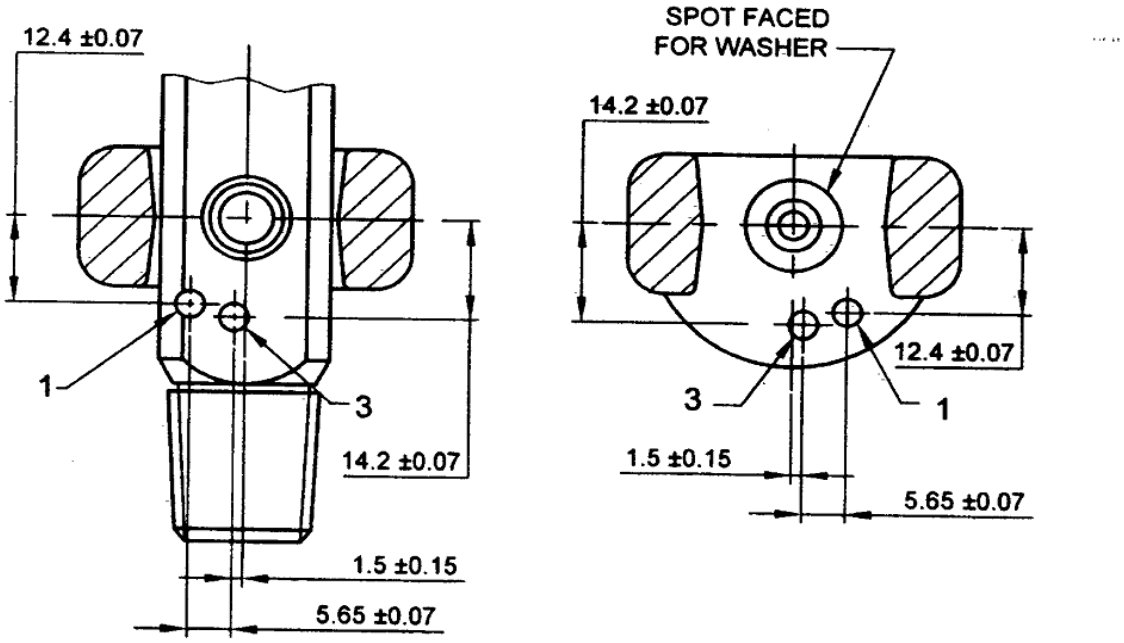
All dimension in millimeters

FIG. 7 CONNECTION FOR OXYGEN/CARBON DIOXIDE MIXTURES (CARBON DIOXIDE ≤ 7 PERCENT)



All dimension in millimeters

FIG. 8 OUTLET CONNECTION FOR OXYGEN/HELIUM MIXTURES (HELIUM ≤ PERCENT)



All dimension in millimeters

FIG. 9 OUTLET CONNECTION FOR ETHYLENE

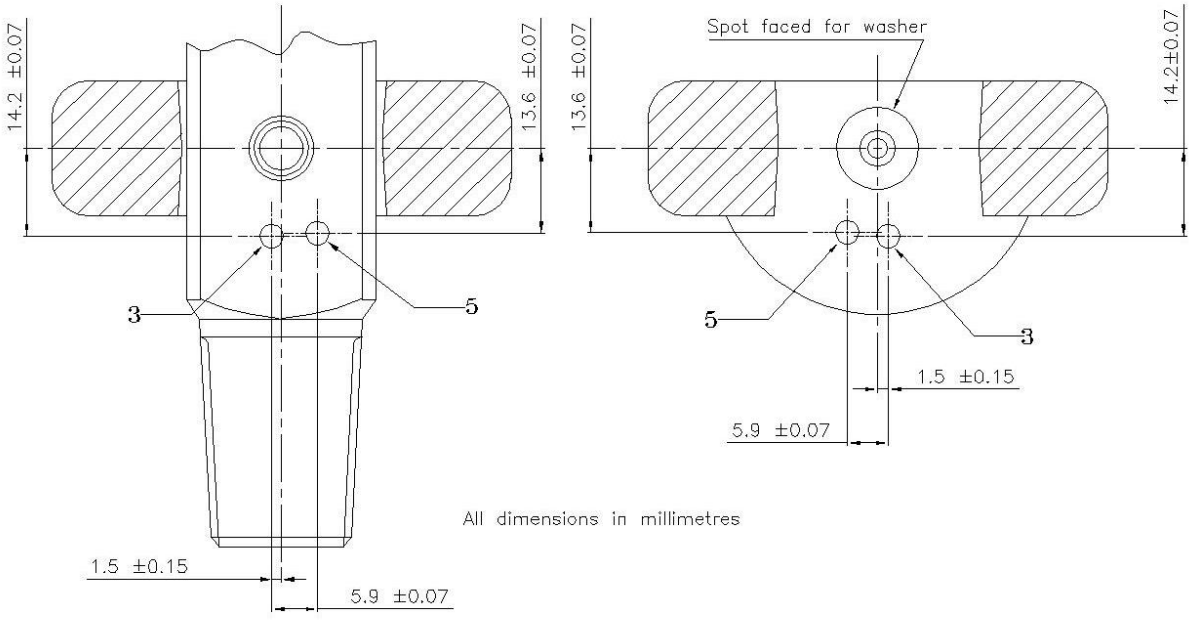
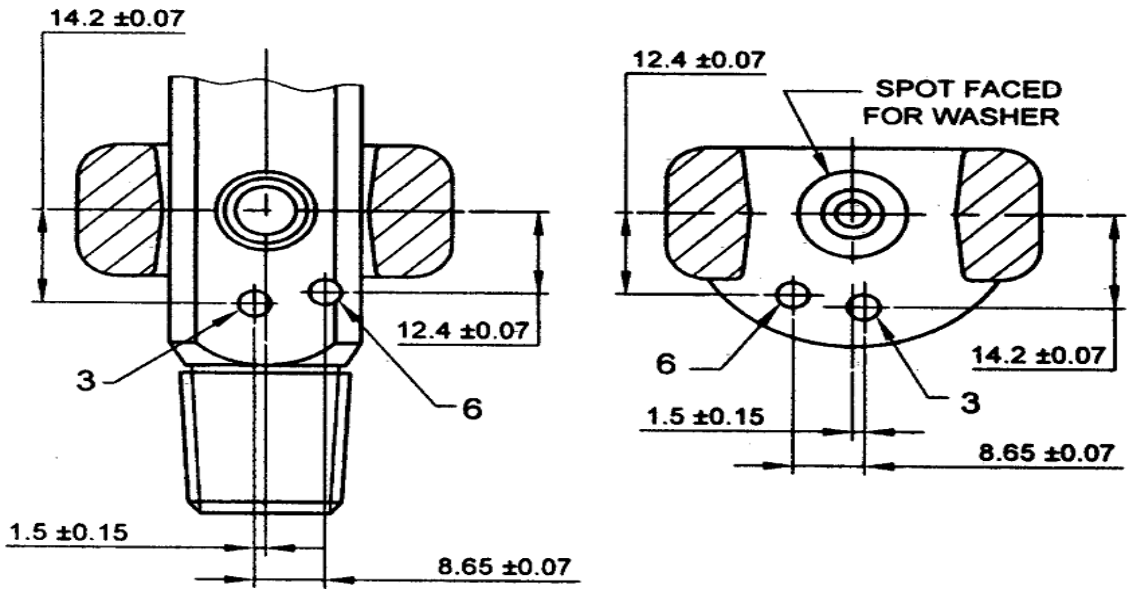
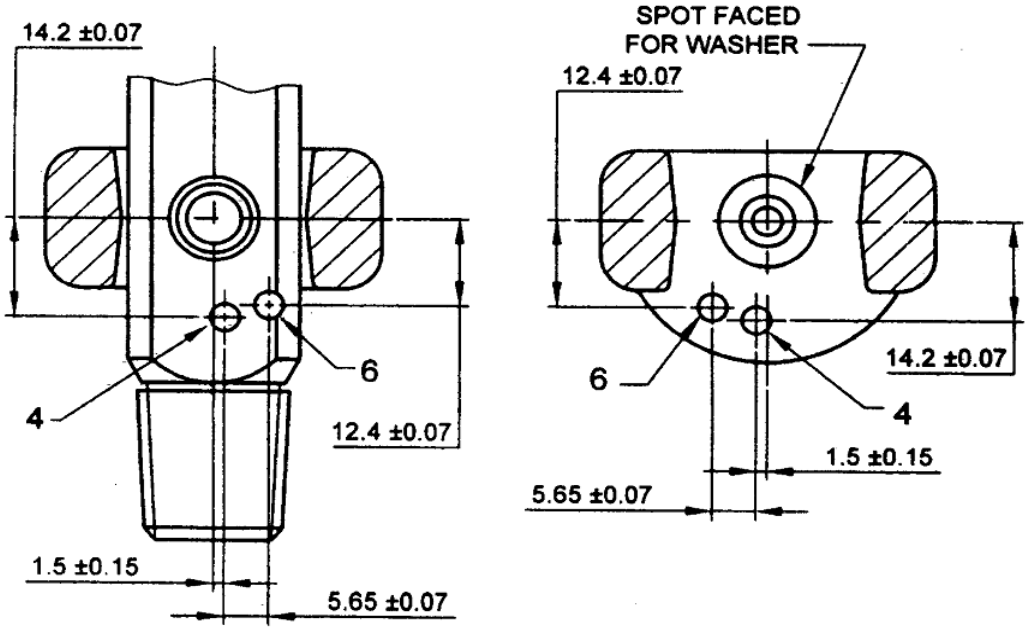


FIG. 10 OUTLET CONNECTION FOR NITROUS OXIDE (WITH OR WITHOUT LIQUID DRAW-OFF)



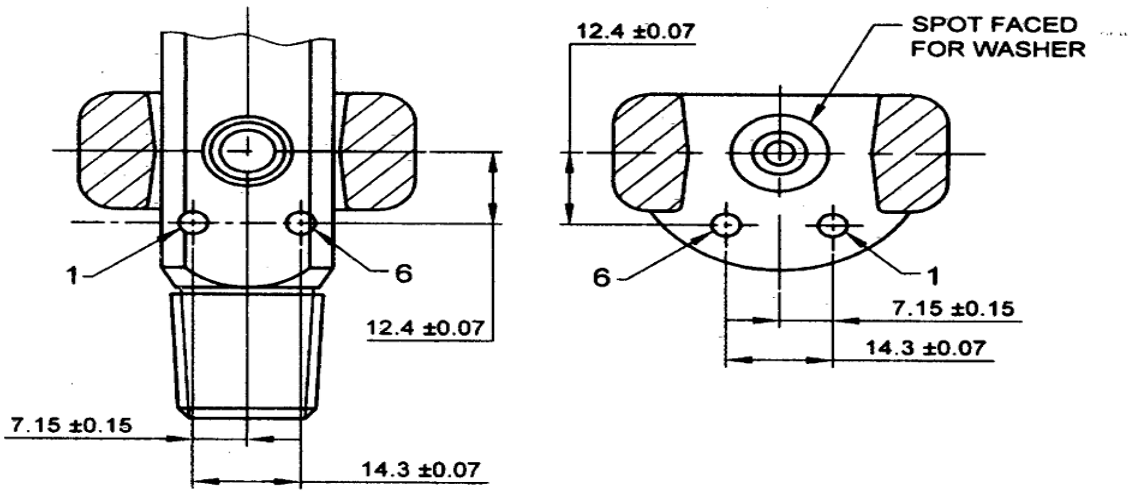
All dimension in millimeters

FIG. 11 OUTLET CONNECTION FOR CYCLO-PROPANE



All dimension in millimeters

FIG. 12 OUTLET CONNECTION FOR HELIUM AND FOR HELIUM/OXYGEN MIXTURES (OXYGEN ≤ 20 PERCENT)



All dimension in millimeters

FIG. 13 OUTLET CONNECTION FOR CARBON DIOXIDE (WITH OR WITHOUT LIQUID DRAW-OFF) AND FOR CARBON DIOXIDE/OXYGEN MIXTURES (CARBON DIOXIDE ≥ 7)

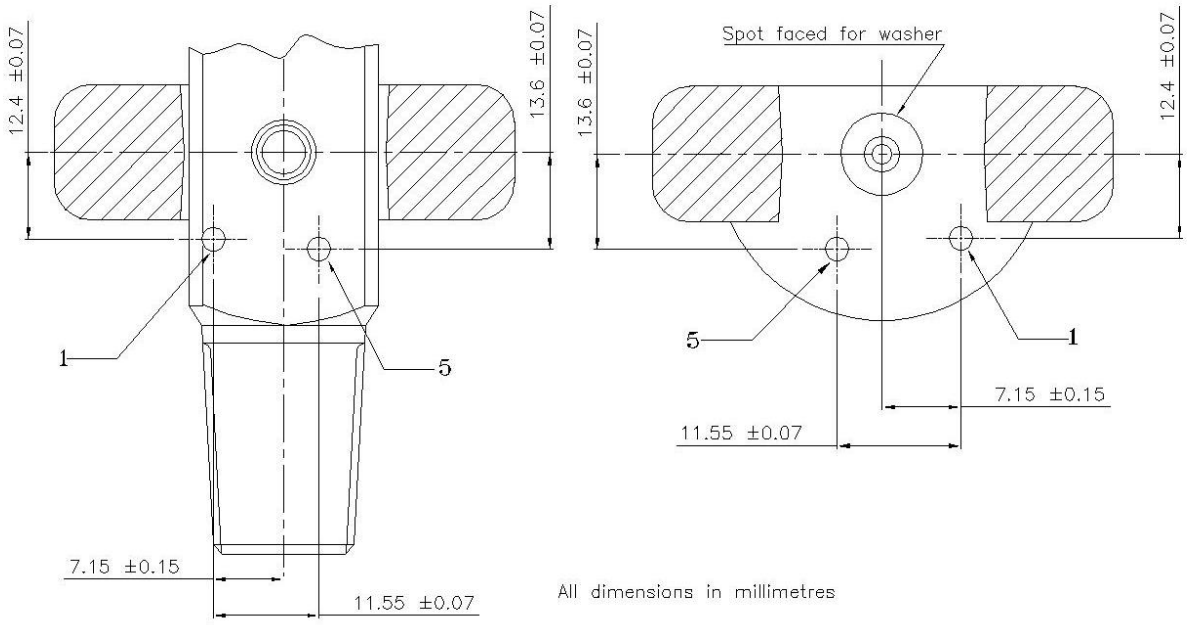


FIG. 14 OUTLET CONNECTION FOR MEDICAL AIR

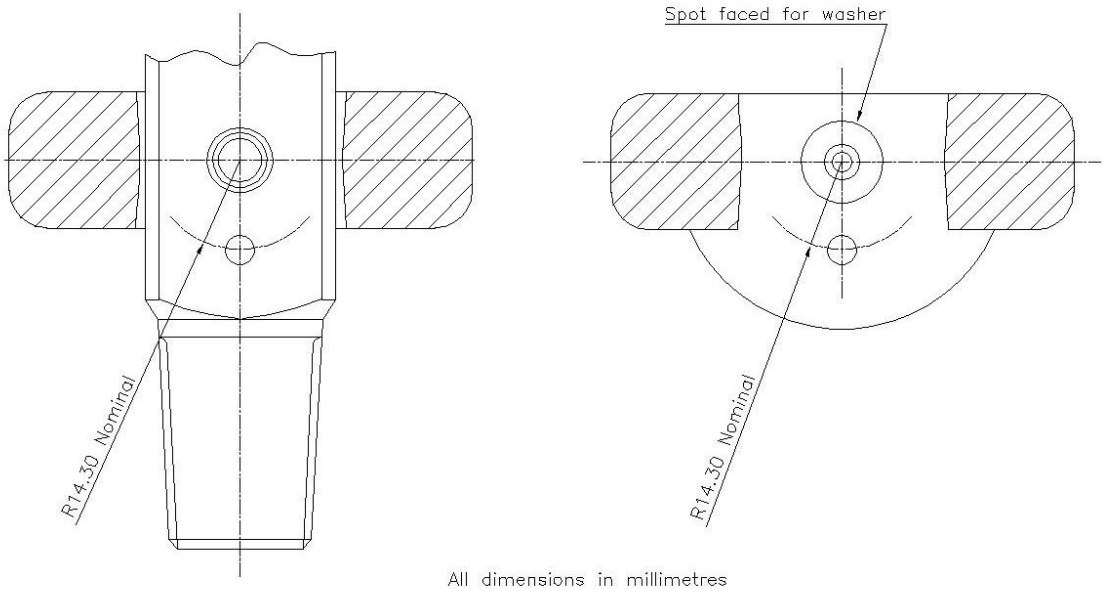


FIG. 15 OUTLET CONNECTION FOR SPECIAL MIXTURES OF 50 PERCENT NITROUS OXIDE AND 50 PERCENT OXYGEN

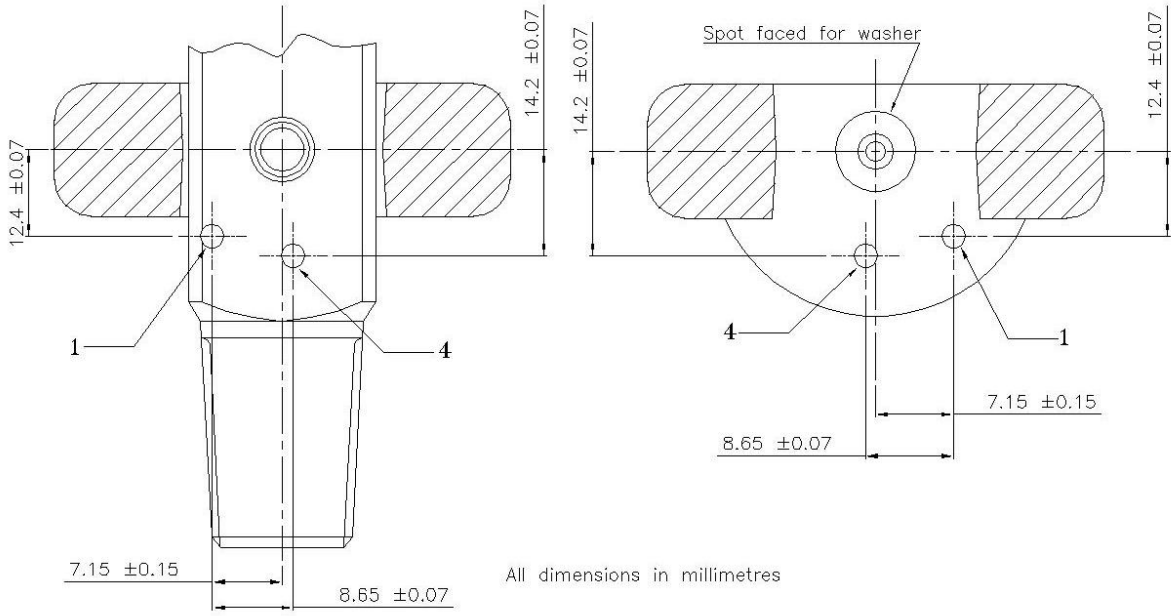


FIG. 16 OUTLET CONNECTION FOR NITROGEN

12 INTERNAL AND EXTERNAL TIGHTNESS TEST

All valves shall be subjected to both internal leak tightness and external leak tightness at room temperature at maximum working pressure. Valves shall be closed at closing torque specified by the manufacturer but not exceeding *D* X 7/65 N.m, for handwheel/knob operated valves,

where *D* = Diameter of hand wheel/knob.

For internal leak tightness the valve shall be pressurized from the valve inlet gas passage. For external leak tightness the valve in open position shall be pressurized from the valve inlet gas passage with the valve outlet connection sealed or pressurized from the valve outlet connection with the valve inlet connection sealed. The leakage shall be checked by a suitable method (for example, bubble method, helium testing, fluid displacement measurement device, pressure change using differential pressure transducer or equivalent) and not exceed 6 cm^3/h.

For valves equipped with pressure relief device, testing shall be done at 0.8 times the minimum rated burst pressure of pressure relief device.

13 VALVING TORQUE TEST

During type testing, one valve of each inlet size covered in the drawing shall be subjected to a torque test in a test rig using a torque value that is 50 percent in excess of the maximum given in IS 3224. There shall be no sign of cracking or permanent deformation of the valve body of cracking of the valve inlet.

NOTE — Deformation of the valve inlet thread is acceptable.

14 ENDURANCE TEST

During type testing, sample valves shall be subjected to endurance test of 2 000 cycles at 1.2 times the maximum working pressure as per IS 3224.

15 MARKING

15.1 The following shall be permanently marked on the valve:

a) Year and month of manufacture, that is, YYYY/MM;
b) Batch identification;
c) Manufacturer’s identification;

d) IS 3745;
e) Maximum working pressure, bar;
f) Inlet size;
g) Chemical symbol/name of the gas;
h) The rated pressure of the bursting disc in bar (on the PRD, if provided); and
k) Rated flow capacity on PRD.

15.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 1068 : 1993	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium — Specification (*third revision*)
IS 1598 : 1977	Method for izod impact test of metals (*first revision*)
IS 1608 (Part 1) : 2022/ISO 6892-1 : 2019	Metallic materials — Tensile testing — Part 1: Method of test at room temperature (*fifth revision*)
IS 2102 (Part l) : 1993/ISO 2768-1 : 1989	General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)
IS 3224 : 2021	Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders — Specification (*fourth revision*)
IS 5903 : 2014	Requirement of safety devices for gas cylinders — Specification (*first revision*)
IS 8775 : 1978	Filling pressure and corresponding developed pressure for permanent gases contained in gas cylinders
IS 15975 : 2020	Gas cylinders — Conditions for filling gas cylinders (*first revision*)
IS/ISO 11114-1 : 2020	Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials (*first revision*)
IS/ISO 11114-2 : 2013	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials

ANNEX B
(*Clause* 3.3)

SAMPLING SCHEME FOR EVALUATION OF PROPERTIES OF THE VALVE MATERIAL

B-1 SCALE OF SAMPLING

B-1.1 Lot

In any consignment, all the valve blanks of the same material and size manufactured under similar processes of production shall constitute a lot.

B-1.2 Valve body blanks shall be selected and examined for each lot separately for ascertaining their conformity to the requirements of mechanical properties.

B-1.3 The number of valve bodies to be selected from a lot shall depend upon the size of the lot and shall be in accordance with col (2) and (3) of Table 2. All these samples shall be taken at random from the lot.

B-1.4 All the valve body blanks, selected in accordance with col 3 of Table 2, shall be divided into two equal sets. The tensile and elongation tests shall be carried out on all the samples of the first and the Izod impact test on the second set.

B-2 CRITERIA FOR CONFORMITY

B-2.1 For Tensile and Elongation Test (*see* 3.2.1)

All the samples of the first half (*see* **B-1.4**) shall be tested for tensile and elongation test. The lot shall be declared as satisfactory with respect to the requirements of tensile and elongation tests, if each sample passes the test satisfactorily.

B-2.2 For Izod Impact Test (*see* 3.2.2)

All the samples of the second half (*see* **B-1.4**) shall be tested for Izod impact test. The lot shall be declared as satisfactory with respect to the requirements of the Izod impact test, if each sample material passes the test satisfactorily.

B-2.3 The lot shall be declared as conforming to the requirements of mechanical properties, if it has been found satisfactory according to **B-2.1** and **B-2.2**. If any test sample fails to meet the requirements of **B-2.1** and **B-2.2**, additional specimens equaling twice the number of sample size for the failed test in the same lot shall be taken and tested for the failed test only. If any of these specimens fails to meet the requirements, the entire lot represented shall be rejected.

Table 2 Scale of Sampling
(*Clauses* B-1.3 *and* B-1.4)

Sl No.	Lot Size	Sample Size
(1)	(2)	(3)
i)	up to 500	4
ii)	501 - 1 000	8
iii)	1 001 - 2 000	12
iv)	2 001 - 3 000	16

NOTE — An allowance of a maximum of 2 percent in the lot size is permissible.

ANNEX C
(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinder Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	SHRI P. KUMAR (***Chairperson***) SHRI K. S. RAO (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	SHRI SAKET TIKU SHRI K. R. SAHASRANAM (*Alternate*)
Ashok Leyland Limited, Chennai	SHRI VED PRAKASH GAUTAM SHRI FAUSTINO V. (*Alternate* I) SHRI SUCHISMITA CHATTERJEE (*Alternate* II)
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