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Draft Indian Standard

LPG EQUIPMENT AND ACCESSORIES — DESIGN, SPECIFICATION AND TESTING FOR LIQUEFIED PETROLEUM GAS (LPG) COMBO VALVES AND FITTINGS TO BE USED IN CYLINDERS WITH WATER CAPACITY MORE THAN 250 L

ICS 23.060.40; 23.020.30

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1 SCOPE

This standard specifies the minimum requirements for the material, design, fabrication and testing of combo valves and fittings to be used with containers exceeding 250 litres and up to 1000 litres water capacity for liquefied petroleum gases (*see* IS 4576). Pressure relief valves and their ancillary equipment, contents gauges and automotive LPG components are outside the scope of this Indian Standard.

2 REFERENCES

The standards given in Annex E contain provisions, which through reference in this text, constitute provisions to 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 possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

For the purposes of this standard, the following definitions in addition to given in IS 7241 shall apply.

3.1 Liquid Off Take Valve — Valve designed to allow withdrawal of liquid LPG from the cylinders and liquid filling in cylinders in its normal operating position.

3.2 Manually Operated Valve — A valve operated by hand for closing or to stop, allow or control the flow.

3.3 Combo Valve — A valve that can be used for withdrawal of LPG in Liquid form or Vapour form or both.

3.4 Poppet Valve — Self-closing, spring-loaded valve that provides leak tight seal and opens by the engagement of a special connecter or by fluid passing through it. It is closed automatically upon removal of the connector or by stopping the fluid flow.

3.5 Excess Flow Check Valve — Valve designed to close automatically with a small residual flow, when the fluid flow passing through it exceeds a predetermined value, and to re-open when the pressure differential across the valve has been restored below a certain value.

3.6 Residual Flow — The permissible flow of an excess flow check valve when the valve is in the closed position.

3.7 Liquid Withdrawal Tube (Also called Eduction Tube) — A tube fitted to the inlet of a valve to permit withdrawal of liquid LPG under vapour pressure, from a cylinder or tank in its normal operating position.

3.8 Safety Relief Valve — A valve that is used to control or limit the pressure in the container. The valve shall release the excess pressure and then reset to its original position once the pressure inside the container falls below the set pressure.

3.9 Nominal Set Pressure — The nominal pressure marked on the valve body at which the valve is set and specified to start discharge.

3.10 Flow Rating Pressure —- The pressure at the inlet of a safety relief valve, which is used for establishing its rated flow capacity.

3.11 Certified Discharge Capacity — The discharge capacity permitted to be used as a basis for the application of the safety relief valve.

3.12 Maximum Allowable Pressure — Maximum pressure for which the equipment is designed.

NOTE —All pressures are gauge pressures unless otherwise stated.

313 Fitting — Any attachment to the pressure part of the container and exposed to the Pressure of the container.

3.14 Internal Leak Tightness— Resistance to leakage across the valve seal or other internal sealing components when the valve is closed.

3.15 External Leak Tightness — Resistance to leakage through the fittings, to or from the atmosphere.

3.16 Sealing Element — Non-metallic resilient component which effects a seal by contact with the valve seat.

3.17 Shut-Off Valve — Valve to provide a leak tight seal which is operated either manually, remotely or is self-closing type.

3.18 Vapour Off-take Valve (Service Valve) — Valve for withdrawal of LPG vapour and is manually operated.

3.19 Filler Valve — Valve used for liquid fill service.

3.20 Plug — Component which seals a female connection.

3.21 Cap — Component which seals a male connection.

3.22 Overfill Protection Device (OPD) — A device designed to automatically restrict the filling rate to a minimal flow when the level in the container reaches a predetermined limit.

3.23 Internal Valve — Valve which has its seal within the profile of the pressure vessel.

3.24 Self-Closing Valve — A valve which remains in closed position under normal conditions and opens only by the engagement of a special connector.

3.25 **Vapour Equalizing Valve —** Valve which permits vapour to flow in either direction in order to equalize vapour pressure between pressure vessels during liquid transfer, and which incorporates an excess flow valve and a self-closing valve opened by a special connector valve.

3.26 Multipurpose Valve — Valve which incorporates two or more service functions and which meets the combined requirements of the individual functions.

3.27 Breakaway Coupling — Coupling which separates at a predetermined section when required and each separated section contains a self-closing shut-off valve, which seals automatically.

NOTE — Also referred to as a safe break.

3.28 Dry Disconnect Coupling — Quick coupling which connects and disconnects with minimum LPG release and each separated section contains a self-closing shut-off valve, which seals automatically.

4 MATERIALS

4.1 All components used in the construction of the valve shall be made of material compatible with LPG. The material of the valve body shall comply with the properties given in **4.2, 4.3** and **4.4**.

4.1.1 Brass components of the valve shall be subjected to mercurous nitrate test in accordance with IS 2305. The sample shall show no sign of cracking after the test.

4.1.2 Valve bodies made from forged copper alloys shall be manufactured from materials in accordance with recognized standards such as IS 8737 and IS 6912. Brass components shall be manufactured from Free Cutting Brass as per IS 319.

4.1.3 Other than the above, any other material as per agreement between the purchaser and the manufacturer shall be used subject to approval from Statutory authorities.

4.2 Chemical Composition

The chemical composition of brass alloy shall have the following elements and composition :

Sl No	Element	Composition, Percent
(1)	(2)	(3)
i)	Copper (Cu)	56.5 to 60

ii)	Lead (Pb)	1.0 to 2.0
iii)	Iron (Fe)	0.3, *Max*
iv)	Manganese (Mn)	0.5, *Max*
v)	Others	0.75, *Max (Inclusive of* iron*)*
vi)	Zinc (Zn)	Remainder

4.3 Tensile Strength and Elongation

4.3.1 The tensile strength and elongation of the material of valve body determined according to IS 1608 shall be at least 392 Mpa (40 kgf/nm2) and 18 percent measured on a gauge length 5.65√So. "So" being the original area of cross-section.

4.3.2 *Cross-section*

During the tensile test, if a specimen breaks outside the gauge length and has not registered elongation mentioned under **4.2.2.1** the specimen shall be ignored and not treated as having failed and another sample taken.

4.3.3 *Impact Strength*

The izod impact strength of the material of valve body determined according to IS 1598 or other applicable specifications shall not be less than 21.5 Nm (2.2 kg.m).

4.3.4 *Test Samples*

Test samples for tensile and izod impact tests shall, where practicable, be taken from a valve body blank; where this is not practicable, the test samples shall be made from the 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 F. Unless otherwise agreed to between the manufacturer and the purchaser.

4.4 Non-Metallic Materials

4.4.1 All rubber and other moulded parts coming in contact with LPG in the construction of the valve shall be compatible with LPG. All rubber and other moulded parts shall be suitable for external climatic conditions in which the valve is likely to used, the range of temperature being –40°C to +65°C.

4.4.2 Rubber material shall be free from porosity, pits and foreign particles and shall have a smooth non-tacky surface with minimum talk or bloom. The material shall have low compression set, cold flow and creep characteristic.

4.4.3 The rubber materials shall not show change of more than 10 IRHD when subjected to ageing of 72 h at 70°C in accordance with the method prescribed under 3 or 4 of IS 3400 (Part 4).

4.4.4 The nitrile rubber material shall be subjected to compression set in accordance with IS 3400 (Part 10) maximum – set observed shall be as specified below :

Test Condition	**Compression Set,** *Percent*
Compression 25 percent at 20°C for 24 h	10 *max*
Compression 25 percent at 100°C for 24 h	20 *max*

4.4.5 *Ozone Ageing Test (Where the Material is Exposed to the Atmosphere)*

The test shall be carried out in accordance with IS 3400 (Part 20). The test piece which has to be stressed to 20 percent elongation, shall be exposed to air at 40°C, relative humidity <65 percent, with an ozone concentration of 50 parts per hundred million during 72 h. There shall be no cracks on the test pieces.

4.4.6 The valve seat fitted in SRV packing holder shall be immersed in commercial LPG for 70 hour after which the pad shall not show evidence of being forced out of position due to swelling or other cause.

4.4.7 Immersion Test as Per Annex H.

4.5 SPRINGS

4.5.1 Spring Material shall comply with IS 4454 (Part 4).

4.6 THREADS

4.61 Taper threaded pressure vessel connections shall comply with ANSI/ASME B1.20.1 - 1983. Thread sizes shall not exceed DN 80.

4.6.2 Where taper threads are used, the design shall ensure that over-torqueing shall not impede the correct operation of the valve or fitting, *see* **7.2**.

4.6.3 Taper threaded sections of a body designed for a pressure vessel connection shall be constructed with wrenching flats.

4.6.4 All threads other than taper threaded pressure vessel connections shall be in accordance with this Standard or an International Standard, or shall be ACME threads in accordance with Annex A or Pipe Threads in accordance with Annex B or ANSI/ASME B1.5 – 1990 – ACME screw Threads.

Where the design includes 3¼ inch x 6 ACME threads, periodic inspections of the couplings are required. Annex C provides recommendations for these periodic inspections.

To avoid mismatching with ANSI/ASME B1.20.1 – 1983 threads, ISO 7-1:1994 threads shall not be used.

5 DESIGN - SPECIFIC REQUIREMENTS

5.1 Excess Flow Valve

Excess flow valves shall be designed so that when closed, the flow past the seat to allow for reduction of differential pressure across the valve, shall not exceed that of an opening of 1.8 mm^2 cross sectional area.

5.1.1 Excess flow valves shall operate at a flow-rate of not more than 10 percent above, nor less than 20 percent below the rated flow capacity specified and it shall close automatically at a pressure differential across the valve of not more than 1.4 bar.

5.1.2 The connection to the pressure vessel shall not affect the function of the valve or its rated flow.

5.2 Non-return Valve

The connection to the pressure vessel shall not affect the operation of the non-return valve.

5.3 Shut-off Valves

5.3.1 *General*

Shut-off valves shall be of the ball valve or globe valve type or shall be a service valve.

The position and/or direction of closure of shut-off devices shall be clearly indicated. This can be done by either marking indicators or thru remote signal.

5.3.2 *Excess Flow Protection*

Valves with a minimum cross section greater than 7 mm^2 (equivalent to a diameter of 3 mm) for liquid phase withdrawal, shall be protected by an excess flow valve.

Valves with a minimum cross section greater than 50 mm^2 (equivalent to a diameter of 8 mm) for vapour phase withdrawal, shall be protected by an excess flow valve.

5.3.3 *Service Valve*

5.3.3.1 *Valve operating mechanism*

The valve shall be manually operated.

a) Under normal use the valve shall operate without difficulty even after prolonged use and shall satisfy the requirements of 7.6 with the closing torque not exceeding 3 Nm.

b) All valves shall close when turned clockwise and open when turned anti-clockwise. It is recommended that the valve operating mechanism is visibly marked with a portion of circle terminating in two arrows. One arrow marked "-" and the other arrow marked "+", to indicate the result of the rotation as detailed in Figure 1.

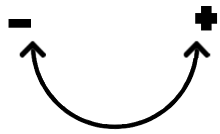


FIG. 1 — HAND-WHEEL MARKING

5.3.3.2 *Valve body*

Where the valve body is made of more than one component, precautions shall be taken to ensure that there can be no unintentional disassembly. Disassembly shall require specialized equipment.

5.3.3.3 *Sealing mechanism*

The mechanism shall ensure internal leak tightness.

5.3.3.4 *Operating torque*

After the endurance test in accordance with 8.7, which is representative of the service valve life, the operating torque shall not exceed 3 Nm.

5.4 Filler Valve

5.4.1 The filler valve shall be either :

a) Manually operated; or
b) A remotely operated shut-off valve in combination with a non-return valve; or

5.4.2 Where supplied as an assembled unit, the filler valve shall meet the following criteria:

a) The non-return valve components shall meet the requirements of **7.2**; and

b) Where liquid can be trapped, means shall be provided to relieve excess pressure; and

c) Where the body is made of two or more components, it shall not be possible to disassemble

5.4.3 The fill connection shall be provided with a leak tight cap or blind flange. When the fill connection is provided with a soft-seated non-return valve in combination with a shut-off valve, a leak tight cap shall not be required. Consideration shall be given to providing dust protection.

NOTE —Plugs and caps can be provided with a locking mechanism to prevent unauthorized interference.

5.4.4 Typical filler valve inlet connections are listed in Annex A.

When a dry disconnect coupling is used as a filler valve, the essential dimensions for a DN 50 and DN 80 connections are shown in Annex D.

5.4.5 Where the connecting seal is retained in the body of the filler valve, the seal retaining groove shall be provided with a vent hole in order to prevent the ejection of the seal on disconnection.

5.4.6 The valve shall include weak sections.

5.4.6.1 For valves with a weak section an extension of a weak section e.g. break-off grooves or shear points, shall be included so as to leave the main closure intact in the event of the valve being fractured. The bending force to fracture shall be between 400 Nm and 500 Nm.

5.4.6.2 of the type of fracture, the lower check shall remain operational. There shall be no deformation of the connecting threads between the different parts, nor between the lower body and the pressure vessel.

5.5 Filler Valve With OPD

5.5.1 *General*

The filler valve with OPD (as agreed between manufacturer & supplier) shall meet the requirements of 6.4.

5.5.2 *Performance*

5.5.2.1 The device shall operate at a predetermined percentage volume level. The tolerance on filling shall be 0 percent to −5 percent. The stop shall be gradual so as not to create a shock in the pipe-work upstream.

5.5.2.2 The maximum flow-rate after the closure of the stop fill shall be less or equal to 50 l/h (water) with a differential pressure of 1 bar.

5.6 Liquid Withdrawal Valve

5.6.1 A liquid withdrawal valve shall incorporate an excess flow valve.

5.6.2 It shall be provided with a plug or cap to provide a leak tight seal

5.6.3 The plug or cap shall contain a vent to indicate leak tightness before the plug or cap is fully disengaged.

5.6.4 The special connector shall be designed or located to ensure a sufficient engagement before activating the self-closing element. The joint between the special connector and the liquid withdrawal valve shall be designed to be leak tight.

5.7 Internal Valve

5.7.1 The internal valve shall incorporate one of the following systems:

a) A self-closing valve and an excess flow valve, when open;
b) An automatic shut-off valve, actuated by LPG pump differential pressure that will provide a leak tight seal when the pump is not in operation;
c) A self-closing valve opened by hydraulic, pneumatic or mechanical means;
d) Consideration should be given to incorporating a thermally sensitive device to ensure the valve closes in the event of fire.

5.7.2 Internal valves shall be designed so as to prevent any unintended opening through impact or an inadvertent act. This may be achieved either by the valve being operated automatically or by being actuated with a system that provides this facility.

5.7.3 A weak section, e.g. break-off grooves or shear points, shall be provided to leave the main closure intact if it should be subjected to external damage.

5.7.4 Where shear studs are provided to secure flanged valves, the stud weak section shall fail sacrificially without causing damage that can interfere with the satisfactory operation of the valve.

5.7.5 The position and/or direction of closure of shut-off devices shall be clearly apparent. This can be achieved either by marking, indicators or remote signal.

5.8 Multipurpose Valve

The design shall be such as to ensure that one function does not adversely affect other functions.

5.9 Break-away coupling

The breaking strength of the coupling shall be clearly defined by the manufacturer. Both ends of the coupling shall effect a leak tight seal when the coupling breaks away.

5.10 Dry Disconnect Coupling

5.10.1 The coupling shall be quick acting and shall contain a connection system which allows the engagement of the coupling without a threaded connection and without the use of tools. Each separated section shall contain a self-closing shut-off valve which seals automatically.

5.10.2 On engagement of the two components of the coupling, the internal leak tightness of the male and female components shall remain tight until the external leak tightness is secured. The coupling of the two components shall fully engage and provide external leak tightness prior to the opening of the self-closing shut- off valves in either component.

5.10.3 On disengagement of the two components of the coupling, the external leak tightness shall be maintained until the self-sealing components of both parts are closed. The uncoupling of the two components shall not take place and shall continue to remain leak tight until after the closure of the self-closing shut-off valves in both components.

5.10.4 The pressure vessel connector of a dry disconnect coupling shall be used in series combination with a manual shut-off valve.

5.10.5 The loading connector of a dry disconnect coupling shall be provided with either of the following designs:

a) The loading connector shall be designed to ensure that the coupling cannot be disconnected from the pressure vessel connector unless the loading connector is in the closed position; or

b) The loading connector shall be provided with a means to confirm that the self-sealing component of the loading connector is closed (e.g. bleed screw), prior to disengagement of the two components of the coupling.

5.10.6 Where liquid can be trapped, means shall be provided to relieve excess pressure.

5.10.7 On connection the coupling shall remain fully leak tight. On disconnection, the maximum allowable LPG release shall be in accordance with Table 1.

5.10.8 The dry disconnect coupling shall conform to the dimensions in Annex D.

5.10.9 The flow-rate through the coupling at a pressure difference of 0.5 bar, shall be at least in accordance with Table 2.

Table 1 – Maximum Allowable LPG Release upon Disconnection of Dry Disconnect Couplings

Coupling Nominal Size	Maximum allowable LPG release upon disconnection ml
DN 25	0.2
DN 50	0.3
DN 65	0.5
DN 80	0.7
DN 100	1.6

Table 2 – Minimum LPG Flow – Rate of Dry Disconnect Couplings

Coupling Nominal Size	**Minimum LPG Flow-Rate with a differential pressure of 0.5 bar l/min.**
DN 25	200
DN 50	600
DN 80	2500

6 TESTING

6.1 General

6.1.1 Samples representative of the design, size and type of valve or fitting shall meet the requirements of the tests described in Table 3. A minimum of four samples shall be submitted for each test unless otherwise stated.

6.1.2 Unless otherwise specified, tests shall be carried out at ambient temperature and pressure.

6.1.3 Pneumatic leakage and hydrostatic pressure strength tests shall be maintained for at least 2 min, unless otherwise specified in this Standard.

6.1.4 Sample valves or fittings shall initially be subject to visual inspection and dimensional checks.

6.1.5 The following documents shall be available to the person carrying out the tests:

a) description of the valve or fitting and the method of operation;
b) information on the use of the valve or fitting;
c) drawings consisting of the general layout, parts list and component drawings; and
d) test procedures.

6.2 Over Torquing Deformation Test

6.2.1 New samples shall be subject to an over torquing deformation test to ensure the correct operation and tightness in that condition.

6.2.2 The body shall be fitted on a test fixture representative of its intended use.

6.2.3 All stem thread types shall withstand a torque of 1.5 times the manufacturer's recommended fitting torque, or the torque as shown in Table 4, whichever is greater. Taper threaded joints shall be assembled without sealant.

6.2.4 The sample shall then be checked for freedom of movement and correct operation of the internal components prior to being removed from the test fixture. It shall then be tested for external leak tightness in accordance with **6.3** and internal leak tightness in accordance with **6.4**.

6.3 External Leak Tightness Test

6.3.1 The inlet shall be connected to a supply of either air or nitrogen.

6.3.2 The outlet shall be fitted with a pressure gauge.

6.3.3 The valve or fitting shall be in the open condition in order to subject the body to the test pressure.

6.3.4 The test pressures and the test temperatures as given in Table 5 shall be applied. The pressure shall be kept constant during the test.

6.3.5 The test pressure shall be applied for at least 1 min. The valve or fitting shall either be submerged in water to detect leakage or an equivalent leak detection system shall be used.

6.3.6 The valve or fitting shall then be depressurized.

6.3.7 There shall be no leakage.

6.4 Internal Leak Tightness Test

6.4.1 The inlet shall be connected to a supply of either air or nitrogen.

6.4.2 The valve shall be fitted with a pressure gauge.

6.4.3 The outlet end, if applicable for pressure relief valve and fittings shall be blanked.

6.4.4 The test pressure, see Table 5, shall be applied when the valve is in the open mode. The pressure shall be kept constant during the test.

6.4.5 The test pressure shall be applied for at least 1 min. The valve or fitting shall either be submerged in water to detect leakage or an equivalent leak detection system shall be used.

6.4.6 The valve or fitting shall be closed under pressure, and if a torque needs to be applied, it shall not exceed the maximum closing torque as specified by the manufacturer.

6.4.7 The outlet shall be depressurized and at least 1 min shall pass before checking internal tightness. The valve or fitting shall either be submerged in water to detect leakage or an equivalent leak detection system shall be used. The test duration shall be at least 1 min.

6.4.8 The valve or fitting shall then be depressurized.

6.4.9 The test pressures and the test temperatures as given in Table 5 shall be applied. The pressure shall be kept constant during the test.

6.4.10 There shall be no leakage.

Table 4 — Torques for deformation test

Valve stem major diameter large end mm	Torque Nm
10	30
14	50
17	90
21	160
27	200
33	240
42	290
48	310
60	330
73	350
89	360
114	380

Table 5 — Pressures and temperatures for leakage tests

Test Number	Test pressure bar	Test temperature °C
1	0,1	−20 ± 5
2	5,0	−20 ± 5
3	0,1	20 ± 5
4	25,0	20 ± 5
5	0,1	65 ± 5
6	25,0	65 ± 5

Table 3 — Design

Test	Over torquing deformation	External leak tightness	Internal leak tightness	Residual Flow	Pressure strength	Excess flow	Endurance	Weak section strength	Stress cracking	Vacuum	Flow resistance	Filler valve flow	OPD

Table key:

NOTE 1 Test equipment conne

NOTE 2 Other testing procedu

[a] Each part shall be tested separat

[b] Test only applicable to 1 ¾ inch x

[c] For shut-off valves for transportat which is demonstrated by this tes

6.5 Residual Flow Test

6.5.1 The valve or coupling inlet (outlet for a non-return valve) shall be connected to a supply of either air or nitrogen.

6.5.2 The valve or coupling under test or the test rig shall be fitted with a pressure gauge to measure the test pressure.

6.5.3 If required, the valve or coupling may be closed under pressure.

6.5.4 A pressure greater than 1 bar shall be applied when the valve or coupling is closed.

6.5.5 The valve or coupling shall either be submerged in water to detect leakage, or an equivalent leak detection system shall be used. The test duration shall be at least 1 min.

6.5.6 The valve or coupling shall be depressurized to 1 bar.

6.5.7 The residual flow shall not exceed 570 cm^3/s with air at 1 bar. If nitrogen is used, the flow rate recorded shall be corrected for air.

6.6 Pressure Strength Test

6.6.1 The pressure-containing envelope of the valve or fitting shall be capable of with standing a hydraulic pressure test without rupture or permanent distortion.

6.6.2 Water shall be used as the test fluid.

6.6.3 The test pressure shall be at least 1.5 times the maximum allowable pressure.

6.6.4 The test pressure shall be maintained for a minimum of 10 min at a constant value.

6.7 Excess Flow Test

6.7.1 Three samples of each size and type of valve which includes an excess flow function shall be subjected to these tests. A valve intended for use only with liquid shall be tested with water, otherwise the tests shall be made both with air and with water. Separate tests shall be run with each sample installed in vertical, horizontal and inverted positions. A valve intended for installation in one position only, may be tested only in that position.

NOTE— Other suitable test gases can be used, e.g. nitrogen.

6.7.2 The valve shall meet the requirements of **5.1.2**, during the tests described in **6.7.3** and **6.7.4**.

6.7.3 *Excess Flow Test With Air*

6.7.3.1 The tests shall be made without piping or other restrictions connected to the outlet of the test sample.

6.7.3.2 The test shall be conducted by using an appropriately designed and calibrated flow meter connected to an air supply of adequate capacity and pressure. The upstream pressure of the air supply shall remain within ±2 % of the set value during the test, until closure is achieved.

6.7.3.3 The valve shall be connected to the outlet of the flow meter. A recording pressure gauge shall be installed on the upstream side to indicate the closing pressure.

6.7.3.4 The test shall be conducted by slowly increasing the flow of air until the excess flow valve closes. At the instant of closing, the flow-rate shall be determined and the closing pressure recorded.

6.7.3.5 The test shall be conducted for the set values of upstream air pressure of 2 bar and 7 bar.

6.7.3.6 Air flow shall be recorded in cubic metres per minute, for each pressure setting.

LPG vapour flow-rate shall be derived from the following formula:

$$Q_{LPGv} = Q_{AIR}\sqrt{\frac{\rho AIR}{\rho LPGv}}$$

Where

Q_{LPGv} = is the volume flow-rate of LPG vapour;

Q_{AIR} = is the volume flow-rate of air;

ρ_{AIR} = is the density of air;

ρ_{LPGv} = is the density of LPG vapour.

6.7.4 *Excess flow test with water*

6.7.4.1 The test with water shall be conducted using an appropriately designed and calibrated liquid flow meter installed in a piping system having sufficient pressure to provide the required flow.

6.7.4.2 Prior to the test air shall be eliminated from the system. The test shall be conducted by slowly increasing the flow until the excess flow valve closes. Just before the instant of closing, the rate of flow shall be recorded. This closing flow-rate shall be expressed in cubic metres per minute (m^3/min) of liquid LPG. The LPG flow-rate shall be derived from the following formula:

$$Q_{LPGv} = Q_{WATER}\sqrt{\frac{\rho WATER}{\rho LPG}}$$

Where

QLPG = is the volume flow-rate of liquid LPG;

QWATER = is the volume flow-rate of water;

ρAIR = is the density of liquid LPG;

ρLPGv + is the density of water.

6.8 Excess Flow Strength Test

6.8.1 Each valve shall be subject to a strength test by the application of a differential pressure of 25 bar to close the valve.

6.8.2 After the test, the valve shall be visually inspected, and shall not show signs of damage that will interfere with normal operation.

6.9 Endurance Test

6.9.1 Where required by Table 3, a valve or fitting shall be subjected to an endurance test of 6000 cycles. A liquid withdrawal valve shall be subjected to an endurance test of 500 cycles.

6.9.1.1 The samples used for this test shall have previously been subjected to the following test(s) as required by Table 3:

a) External leak tightness test;
b) Internal leak tightness test;
c) Residual flow test;
d) Excess flow test;

6.9.2 The cyclical test shall be carried out in circumstances representative of its subsequent intended use and operated through its full range of movement.

6.9.3 The test shall be conducted at a rate not greater than 10 cycles per minute.

6.9.4 The test shall be performed at an air pressure of 12 bar.

6.9.5 The samples used for this test shall now be subjected to and pass the following test(s) as required by Table 3:

a) External leak tightness test;
b) Internal leak tightness test;
c) Residual flow test;
d) Excess flow test;

6.9.6 A visual examination shall then be carried out and there shall be no signs of deformation, damage or undue wear likely to cause failure.

6.9.7 For multipurpose valves, each service function shall be subjected to this test.

6.10 Weak Section Strength Test

6.10.1 The valve or fitting shall be fitted on a test fixture representative of its intended use. A bending force sufficient to break the valve at the weak section shall be applied.

6.10.2 After breaking at the weak section, the internal mechanism of the valve or fitting shall remain intact and operative. The valve shall then be subjected to and pass the internal leak tightness test or the residual flow test.

6.11 Stress Cracking Test

6.11.1 A stress cracking test shall be carried out on brass components in accordance with **6.11.3** or **6.11.4**.

6.11.1.1 Alternative methods for testing of stress cracking may be employed on condition that the results are comparable.

6.11.2 Each test sample shall be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses shall be applied to the sample prior to, and be effective during, the test. After being tested, a brass part shall show no evidence of cracking or lamination when examined using 25 × magnification.

6.11.3 *Mercury (l)nitrate immersion test*

The test sample shall be subjected to and shall meet the requirements of the mercury(I)nitrate test as defined in IS 2305:1988 to detect residual stress.

6.11.4 *Moist ammonia air stress cracking test*

The test sample shall be degreased and then tested in accordance with ISO 6957:1988 for a duration of 168 hours.

6.12 Vacuum Test

The valve or fitting including accessories, for example a plug or cap, shall remain leak tight when a pressure of 50 mbar absolute is applied to the valve from the pressure vessel connection or applied in a direction which would allow the sealing mechanism to be lifted off the valve seat.

6.13 Flow Resistance Test

Tests shall be carried out to establish the specified pressure loss, flow coefficient or flow resistance coefficient in accordance with EN 1267:2012. The relevant service functions of a multipurpose valve shall be tested separately.

6.14 Filler Valve Flow Test

6.14.1 The test shall be carried out with water and shall be conducted using an appropriately designed and calibrated liquid flow meter installed in a system having sufficient pressure to provide the required flow.

6.14.2 Prior to the test, air shall be eliminated from the system.

6.14.3 The test shall be conducted by slowly increasing the flow until the minimum water flow rate of 8 m^3/h is achieved at a differential pressure of 4 bar. If this flow rate has been achieved at this pressure differential, then the valve is deemed to have passed the test.

6.15 OPD Test

The maximum residual flow rate after the closure of the valve shall be equal to or less than 50 l/h (water) with a differential pressure of 1 bar when the filler valve with an OPD is in its operating orientation and with the float held in the closed position by the water level.

6.16 Level Test

The filler valve fitted with an OPD shall be mounted in its operating orientation in a test vessel. The liquid level shall be slowly raised at a differential pressure of 4 bar ± 0.4 bar (the flow rate shall be greater than 7.2 m^3/h water). The closing level of the liquid at the predetermined fill level shall be +0 % and −5 % of the diameter or height of the vessel.

6.17 Vibration Test

6.17.1 The filler valve fitted with an OPD in the open position shall be fitted to a vibration machine and subject for 4 h to vibrations with 1 mm amplitude and 50 Hz frequency, applied in the axis of the valve.

6.17.2 After the test, the valve shall be visually inspected and shall pass a flow test and a further level test. The valve shall not show signs of damage that will interfere with normal operation.

7 TEST REPORT

The testing procedure, conditions and results of each test shall be recorded. A report shall be produced for each design of valve or fitting indicating compliance with the requirements of this Standard.

This test report may be used as a basis for type approvals for valves and fittings.

8 ACCEPTANCE CRITERIA

The failure to meet any of these test requirements shall be a cause for rejection of the valve design.

9 DOCUMENTATION/TEST REPORT

9.1 The following documents shall be available.

a) A set of drawings consisting of the general arrangements, parts list, specification for metallic and non-metallic material and detail drawings;
b) Description of valve or fittings and method of operation.
c) Information on the intended use of the valve or fittings;
d) Certificate relating to material suitability and compatibility with LPG.
e) Test Report **-** A written report shall be prepared detailing the tests carried out and the results from each test.

10 MARKING

10.1 Each valve shall be permanently marked with the following information:

a) Month and year of manufacture;
b) Manufacturer's identification mark;
c) Number of this standard;
d) Maximum working pressure, in Mpa;
e) PESO's approval number.

10.2 BIS Certification Marking

Each valve may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provision of the Bureau of Indian Standards

10.2.2 Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Annex A
(normative)

ACME CONNECTIONS

ACME threads shall be in accordance with Table A.1 and shall be Class 2G, Male (M), Right Hand (RH) in accordance with ASME B1.5.

Table A.1 — ACME connections

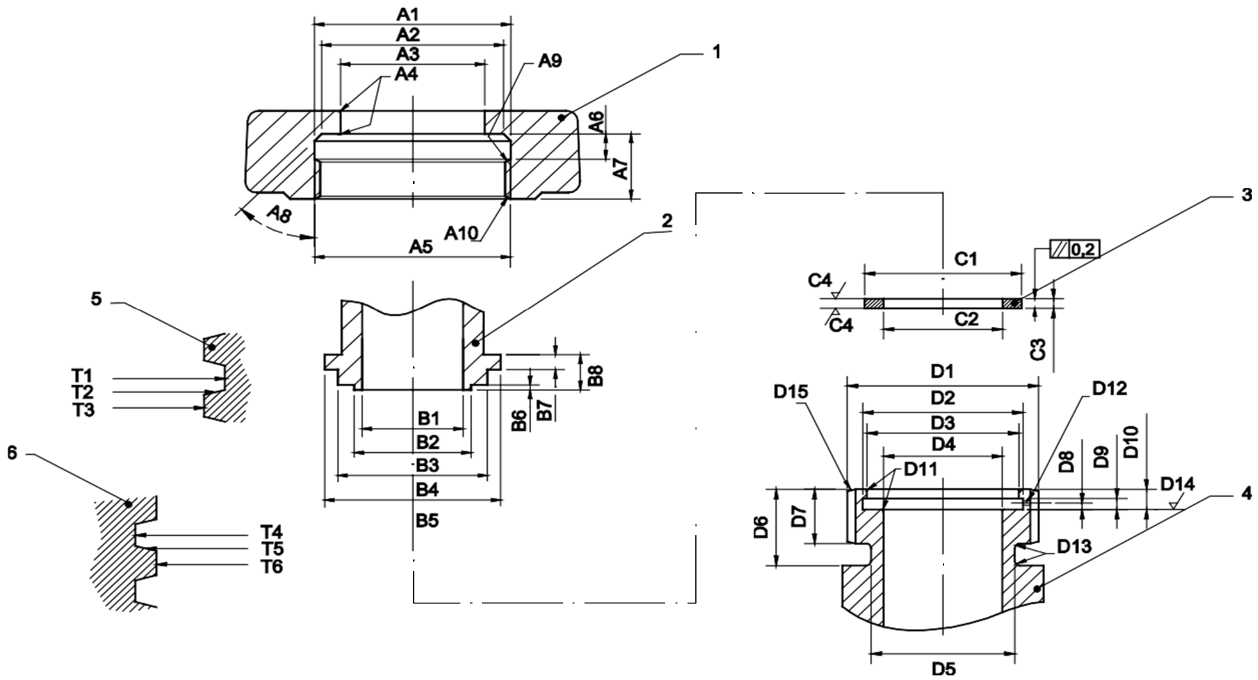
Connection	Reference
1 ¼ inch x 5 ACME	EN 15202:2012, TYPE G
1 ¾ inch x 6 ACME	EN 15202:2012, Type G 31
2 ¼ inch x 6 ACME	*See* Figure A-1
3 ¼ inch x 6 ACME	*See* Figure A-2

Figure A-1 and Figure A-.2 specify basic dimensions of ACME connections to enable them to be safely connected together.

Where a 3 ¼ inch x 6 ACME thread is used, careful inspections of the coupling shall be carried out periodically. Annex C gives recommendations relative to these periodic inspections.

These inspections are critical in the case of the 3 ¼ inch ACME due to the small thread size on the relatively large diameter coupling, but may not be required to the same extent for the smaller diameter couplings.

Dimensions in millimeters



Key

1 nut

2 connector

3 seal

4 valve

5 internal thread

6 external thread

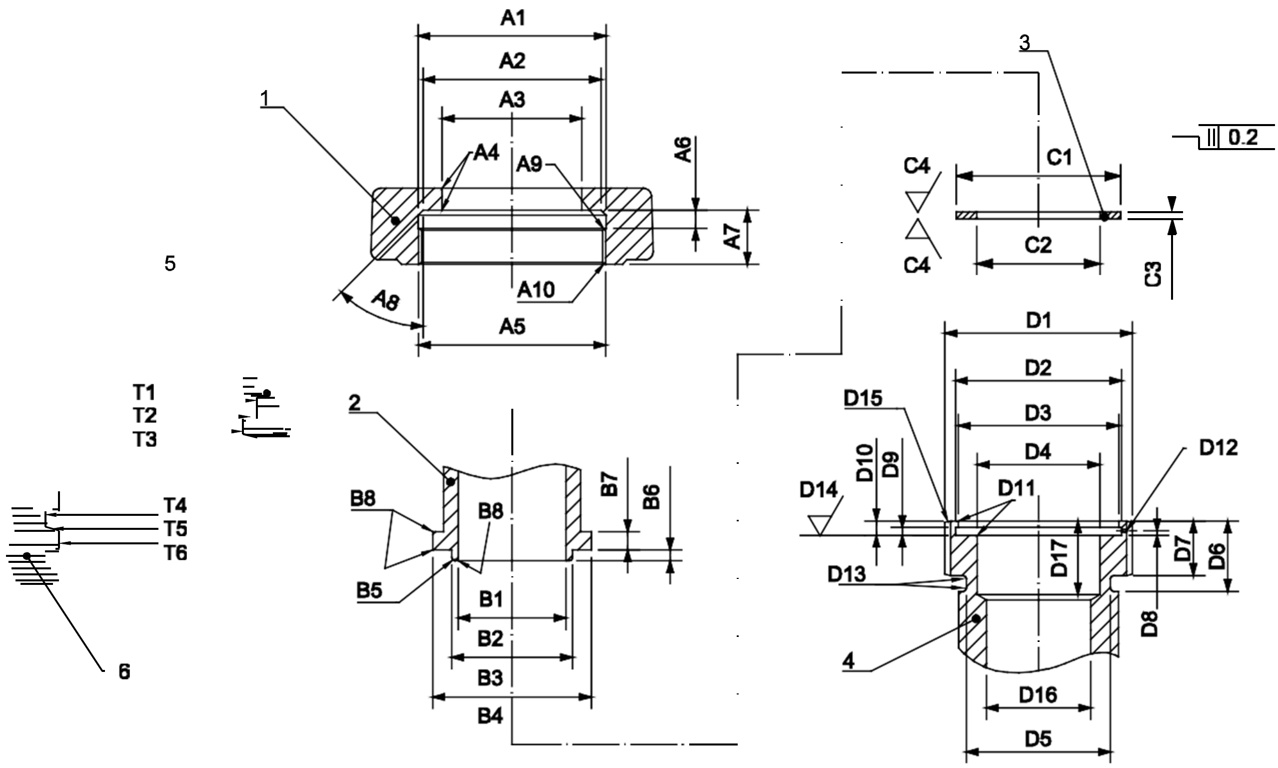
Nut		Connector		Valve	
A1	Ø 58,42 $^{0/-0.25}$	B1	Ø 30 ± 0,13	D1	2 ¼ inch x 6 ACME – 2G
A2	Ø 54,1	B2	Ø 34,9 ± 0,13	D2	Ø 47,75 ± 0,13
A3	Ø 43 0 $^{0/-0.25}$	B3	Ø 44,45 ± 0,13	D3	Ø 45,23 ± 0,13
A4	0,4 × 45° Chamfer	B4	Ø 52,4 ± 0,13	D4	Ø 35,43 ± 0,13
A5	2 ¼ inch x 6 ACME – 2G	B5	Ø 53 stock	D5	Ø 42,86
A6	8,0	B6	1,5	D6	24,0
A7	20,6	B7	4,75	D7	17,0
A8	45°	B8	11,13	D8	2,0
A9	30° Chamfer to depth of thread	**Seal**		D9	3,5 ± 0,1
		C1	Ø 46,8	D10	6,35 ± 0,13
A10	30° Chamfer to Ø 58,75	C2	Ø 35,5	D11	0,4 × 45° Chamfer
		C3	3,0	D12	Drill Ø 1,3 [A]
		C4	√ Ra 3,2	D13	R 1,5
				D14	√ Ra 1,6
				D15	15° B

Thread 2 ¼ inch x 6 ACME – 2G	
T1	Major Ø 58,16 – 57,66
T2	Pitch Ø 55,57 – 55,03
T3	Minor Ø 53,13 – 52,92
T4	Major Ø 57,15 – 56,94
T5	Pitch Ø 54,73 – 54,19
T6	Minor Ø 52,41 – 51,60

A Shall enter through minor diameter of thread. B Chamfer to thread depth each end. Sharp edges of thread to be removed by milling.

Figure A-.1 — 2 ¼ inch x 6 ACME

Dimensions in millimeters



Key

1 nut

2 connector

3 seal

4 valve

5 internal thread

6 external thread

Nut		Connector		Valve	
A1	Ø 83,82 $^{0/-0.25}$	B1	Ø 47,6 ± 0,13	D1	3 ¼ inch x 6 ACME – 2G
A2	Ø 79,5	B2	Ø 53,16 ± 0,13	D2	Ø 73,15 ± 0,13
A3	Ø 61,5 $^{0/-0.25}$	B3	Ø 69,85 ± 0,13	D3	Ø 70,6 ± 0,13
A4	0,4 × 45° Chamfer	B4	Ø 82 stock	D4	Ø 54,0
A5	3 ¼ inch x 6 ACME – 2G	B5	R1,5	D5	Ø 63,5 ± 0,13
A6	8,0	B6	4,75	D6	31,0
A7	23,8	B7	8,0	D7	24,0
A8	45°	B8	0,4 × 45° Chamfer	D8	2,0
A9	30° Chamfer to depth of thread			D9	3,5 ± 0,1

Thread 3 ¼ inch x 6 ACME – 2G	
T1	Major Ø 83,56

	- 83,06						
T2	Pitch Ø 81.03 - 80,43			**Seal**		D10	6,35 ± 0,13
T3	Minor Ø 78,53 - 78,23	A10	30° Chamfer to Ø 58,75	C1	Ø 72,25	D11	0,4 × 45° Chamfer
T4	Major Ø 82,55 – 82,34			C2	Ø 54	D12	Drill Ø 1,3 A
T5	Pitch Ø 80,08 – 79,48			C3	3,0	D13	R 1,5
T6	Minor Ø 77,81 – 76,91			C4	√ Ra 3,2	D14	√ Ra 1,6
						D15	15° B
						D16	Ø 46,0
						D17	38

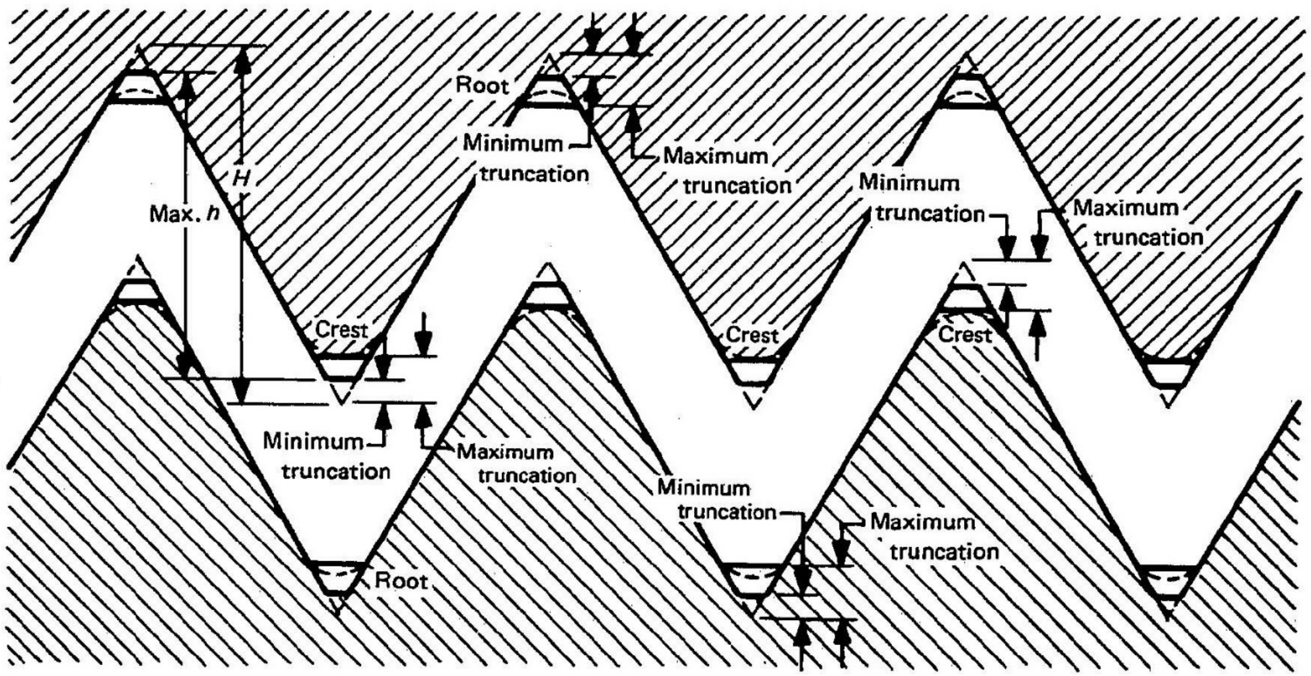
A Shall enter through minor diameter of thread.
B Chamfer to thread depth each end. Sharp edges of thread to be removed by milling.

Figure A;2 — 3 ¼ inch x 6 ACME

Annex B
(normative)

Pipe Threads

Internal Thread



External Thread

TABLE 1 LIMITS ON CREST AND ROOT TRUNCATION OF AMERICAN NATIONAL STANDARD EXTERNAL AND INTERNAL TAPER PIPE THREADS, NPT[1]

Threads/ in. (n)	Height of Sharp V Thread (H)	Height of Thread (h)		Truncation (f)					Equivalent Width of Flat (F)				
				Minimum		Maximum			Minimum		Maximum		
		Maximum	Minimum	Formula	in.	Formula	in.	Tolerance	Formula	in.	Formula	in.	Tolerance
1	2	3	4	5	6	7	8	9	10	11	12	13	14
27	0.03208	0.02963	0.02496	0.033p	0.0012	0.096p	0.0036	0.0024	0.038p	0.0014	0.111p	0.0041	0.0027
18	0.04811	0.04444	0.03833	0.033p	0.0018	0.088p	0.0049	0.0031	0.038p	0.0021	0.102p	0.0057	0.0036
14	0.06186	0.05714	0.05071	0.033p	0.0024	0.078p	0.0056	0.0032	0.038p	0.0027	0.090p	0.0064	0.0037
11.5	0.07531	0.06957	0.06261	0.033p	0.0029	0.073p	0.0063	0.0034	0.038p	0.0033	0.084p	0.0073	0.0040
8	0.10825	0.10000	0.09275	0.033p	0.0041	0.062p	0.0078	0.0037	0.038p	0.0048	0.072p	0.0090	0.0042

NOTE:

(1) The basic dimensions of the American National Standard Taper Pipe Thread are given in inches to four and five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are so expressed for the purpose of eliminating errors in computations.

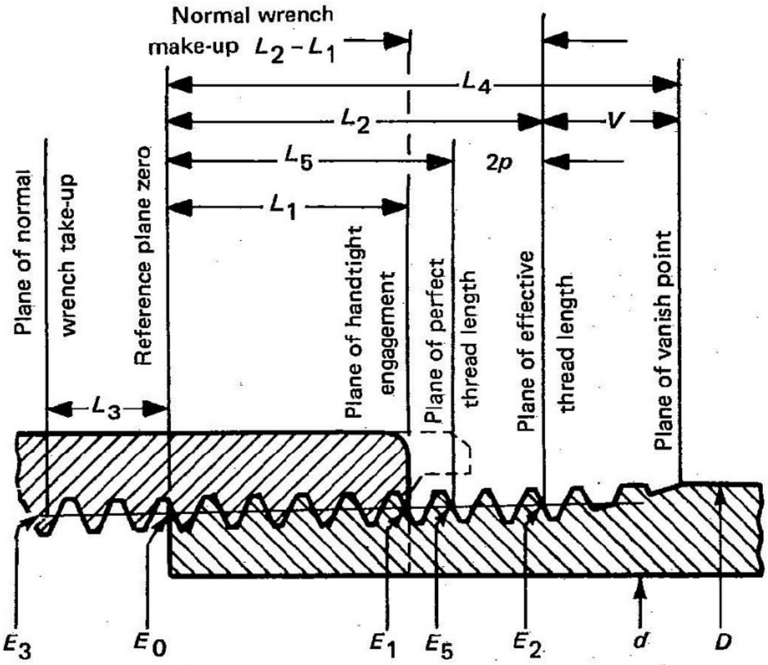


FIG. 3 AMERICAN NATIONAL STANDARD TAPER PIPE THREAD NOTATION

Sealing is affected by out-of-roundness which is possible between the wrench-tight mated parts in final assembly. This will vary depending on the method for producing the thread in conjunction with the elasticity and/or ductility of the mating parts and the resultant conformance at final assembly.

3.1.1 Thread Designation and Notation. American National Standard Taper Pipe Threads are designated in accordance with 1.2.1 as follows:

3/8 - 18 NPT

Standard notation applicable to American National Standard Taper Pipe Threads is shown in Fig. 3.

3.1.2 Designation of Plated Threads. The product specifications of this Standard do not include an allowance for plating. If plating is desired, it may be necessary to modify the threads since the same final gaging requirements must be satisfied for plated and unplated parts. This may be emphasized by adding the words AFTER PLATING to the designation. For manufacturing purposes, notes for plated taper pipe threads may specify the gage limits (turns or threads engagement) before plating followed by the words BEFORE PLATING. These should be followed by the standard gage limits (turns or threads engagement) after plating and the words AFTER PLATING.

3.1.3 Form of Thread. The form of the thread for American National Standard Taper Pipe Threads is that specified in 2.1.

3.1.4 Taper of Thread. The taper of the thread is 1 in 16 or 0.75 in./ft measured on the diameter and along the axis.

3.1.5 Diameter of Thread. The basic pitch diameters of the taper thread are determined by the following formulas[2] based on the outside diameter of the pipe and the pitch of the thread:

$$E_0 = D - (0.05D + 1.1)\,1/n$$
$$= D - (0.05D + 1.1)\,p$$
$$E_1 = E_0 + 0.0625L_1$$

where

D = outside diameter of pipe
E_0 = pitch diameter of thread at end of pipe or small end of external thread
E_1 = pitch diameter of thread at the gaging notch or large end of internal thread
L_1 = normal engagement by hand between external and internal threads
n = threads per inch

[2]For the $\frac{1}{8}$-27 and $\frac{1}{4}$-18 sizes, E_1 approx. $= D - (0.05D + 0.827)\,p$.

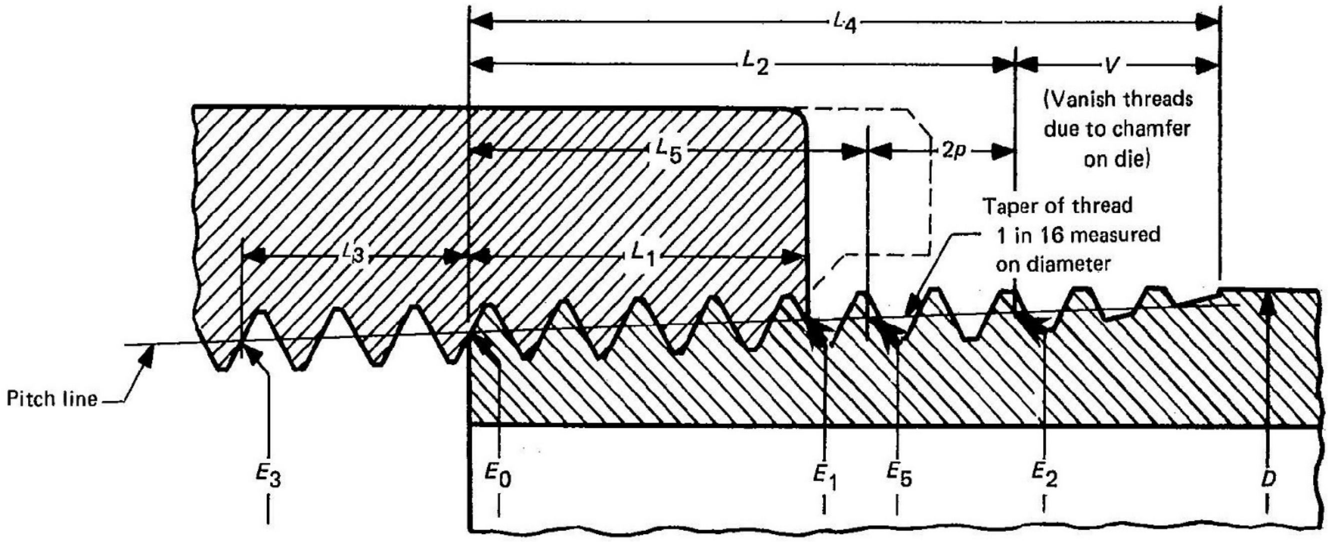


TABLE 2 BASIC DIMENSIONS OF AMERICAN NATIONAL STANDARD TAPER PIPE THREAD, NPT[1]

Nominal Pipe Size	O.D. of Pipe (D)	Threads/in. (n)	Pitch of Thread (P)	Pitch Diam. at Beginning of External Thread (E_0)	Handtight Engagement			Effective Thread, External		
					Length[2] (L_1)		Diam.[3] (E_1)	Length[4] (L_2)		Diam. (E_2)
					inch	Threads		inch	Threads	
1	2	3	4	5	6	7	8	9	10	11
1/16	0.3125	27	0.03704	0.27118	0.160	4.32	0.28118	0.2611	7.05	0.28750
1/8	0.405	27	0.03704	0.36351	0.1615	4.36	0.37360	0.2639	7.12	0.38000
1/4	0.540	18	0.05556	0.47739	0.2278	4.10	0.49163	0.4018	7.23	0.50250
3/8	0.675	18	0.05556	0.61201	0.240	4.32	0.62701	0.4078	7.34	0.63750
1/2	0.840	14	0.07143	0.75843	0.320	4.48	0.77843	0.5337	7.47	0.79179
3/4	1.050	14	0.07143	0.96768	0.339	4.75	0.98887	0.5457	7.64	1.00179
1	1.315	11.5	0.08696	1.21363	0.400	4.60	1.23863	0.6828	7.85	1.25630
1 1/4	1.660	11.5	0.08686	1.55713	0.420	4.83	1.58338	0.7068	8.13	1.60130
1 1/2	1.900	11.5	0.08696	1.79609	0.420	4.83	1.82234	0.7235	8.32	1.84130
2	2.375	11.5	0.08696	2.26902	0.436	5.01	2.29627	0.7565	8.70	2.31630
2 1/2	2.875	8	0.12500	2.71953	0.682	5.46	2.76216	1.1375	9.10	2.79062
3	3.500	8	0.12500	3.34062	0.766	6.13	3.38850	1.2000	9.60	3.41562
3 1/2	4.000	8	0.12500	3.83750	0.821	6.57	3.88881	1.2500	10.00	3.91562
4	4.500	8	0.12500	4.33438	0.844	6.75	4.38712	1.3000	10.40	4.41562
5	5.563	8	0.12500	5.39073	0.937	7.50	5.44929	1.4063	11.25	5.47862
6	6.625	8	0.12500	6.44609	0.958	7.66	6.50597	1.5125	12.10	6.54062
8	8.625	8	0.12500	8.43359	1.063	8.50	8.50003	1.7125	13.70	8.54062
10	10.750	8	0.12500	10.54531	1.210	9.68	10.62094	1.9250	15.40	10.66562
12	12.750	8	0.12500	12.53281	1.360	10.88	12.61781	2.1250	17.00	12.66562
14 O.D.	14.000	8	0.12500	13.77500	1.562	12.50	13.87262	2.2500	18.00	13.91562
16 O.D.	16.000	8	0.12500	15.76250	1.812	14.50	15.87575	2.4500	19.60	15.91562
18 O.D.	18.000	8	0.12500	17.75000	2.000	16.00	17.87500	2.6500	21.20	17.91562
20 O.D.	20.000	8	0.12500	19.73750	2.125	17.00	19.87031	2.8500	22.80	19.91562
24 O.D.	24.000	8	0.12500	23.71250	2.375	19.00	23.86094	3.2500	26.00	23.91562

NOTES:

(1) The basic dimensions of the American National Standard Taper Pipe Thread are given in inches to four or five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are the basis of gage dimensions and are so expressed for the purpose of eliminating errors in computations.

(2) Also length of thin ring gage and length from gaging notch to small end of plug gage.

(3) Also pitch diameter at gaging notch (handtight plane).

(4) Also length of plug gage.

TABLE 2 BASIC DIMENSIONS OF AMERICAN NATIONAL STANDARD TAPER PIPE THREAD, NPT[1] (CONT'D)

Nominal Pipe Size	Length, L_1 Plane to L_2 Plane External Thread (L_2 - L_1)		Wrench Makeup Length for Internal Thread[7]			Vanish Thread (V)		Overall[8] Length External Thread (L_4)	Nominal Complete External Threads[5]		Height of Thread (h)	Increase in Diam./ Thread (0.0625/n)	Basic[6] Minor Diam. at Small End of Pipe (K_0)
	in.	Thread	Length (L_3) in.	Length (L_3) Thread	Diam. (E_3)	in.	Thread		Length (L_5)	Diam. (E_5)			
1	12	13	14	15	16	17	18	19	20	21	22	23	24
1/16	0.1011	2.73	0.1111	3	0.26424	0.1285	3.47	0.3896	0.1870	0.28287	0.02963	0.00231	0.2416
1/8	0.1024	2.76	0.1111	3	0.35656	0.1285	3.47	0.3924	0.1898	0.37537	0.02963	0.00231	0.3339
1/4	0.1740	3.13	0.1667	3	0.46697	0.1928	3.47	0.5946	0.2907	0.49556	0.04444	0.00347	0.4329
3/8	0.1678	3.02	0.1667	3	0.60160	0.1928	3.47	0.6006	0.2967	0.63056	0.04444	0.00347	0.5676
1/2	0.2137	2.99	0.2143	3	0.74504	0.2478	3.47	0.7815	0.3909	0.78286	0.05714	0.00446	0.7013
3/4	0.2067	2.89	0.2143	3	0.95429	0.2478	3.47	0.7935	0.4029	0.99286	0.05714	0.00446	0.9105
1	0.2828	3.25	0.2609	3	1.19733	0.3017	3.47	0.9845	0.5089	1.24543	0.06957	0.00543	1.1441
1 1/4	0.2868	3.30	0.2609	3	1.54083	0.3017	3.47	1.0085	0.5329	1.59043	0.06957	0.00543	1.4876
1 1/2	0.3035	3.49	0.2609	3	1.77978	0.3017	3.47	1.0252	0.5496	1.83043	0.06957	0.00543	1.7265
2	0.3205	3.69	0.2609	3	2.25272	0.3017	3.47	1.0582	0.5826	2.30543	0.06957	0.00543	2.1995
2 1/2	0.4555	3.64	0.2500	2	2.70391	0.4337	3.47	1.5712	0.8875	2.77500	0.100000	0.00781	2.6195
3	0.4340	3.47	0.2500	2	3.32500	0.4337	3.47	1.6337	0.9500	3.40000	0.100000	0.00781	3.2406
3 1/2	0.4290	3.43	0.2500	2	3.82188	0.4337	3.47	1.6837	1.0000	3.90000	0.100000	0.00781	3.7375
4	0.4560	3.65	0.2500	2	4.31875	0.4337	3.47	1.7337	1.0500	4.40000	0.100000	0.00781	4.2344
5	0.4693	3.75	0.2500	2	5.37511	0.4337	3.47	1.8400	1.1563	5.46300	0.100000	0.00781	5.2907
6	0.5545	4.44	0.2500	2	6.43047	0.4337	3.47	1.9462	1.2625	6.52500	0.100000	0.00781	6.3461
8	0.6495	5.20	0.2500	2	8.41797	0.4337	3.47	2.1462	1.4625	8.52500	0.100000	0.00781	8.3336
10	0.7150	5.72	0.2500	2	10.52969	0.4337	3.47	2.3587	1.6750	10.65000	0.100000	0.00781	10.4453
12	0.7650	6.12	0.2500	2	12.51719	0.4337	3.47	2.5587	1.8750	12.65000	0.100000	0.00781	12.4328
14 O.D.	0.6880	5.50	0.2500	2	13.75938	0.4337	3.47	2.6837	2.0000	13.90000	0.100000	0.00781	13.6750
16 O.D.	0.6380	5.10	0.2500	2	15.74688	0.4337	3.47	2.8837	2.2000	15.90000	0.100000	0.00781	15.6625
18 O.D.	0.6500	5.20	0.2500	2	17.73438	0.4337	3.47	3.0837	2.4000	17.90000	0.100000	0.00781	17.6500
20 O.D.	0.7250	5.80	0.2500	2	19.72188	0.4337	3.47	3.2837	2.6000	19.90000	0.100000	0.00781	19.6375
24 O.D.	0.8750	7.00	0.2500	2	23.69688	0.4337	3.47	3.6837	3.0000	23.90000	0.100000	0.00781	23.6125

(5) The length L_5 from the end of the pipe determines the plane beyond which the thread form is incomplete at the crest. The next two threads are complete at the root. At this plane the cone formed by the crests of the thread intersects the cylinder forming the external surface of the pipe. $L_5 = L_2 - 2p$.

(6) Given as information for use in selecting tap drills. (See Appendix).

(7) Military Specification MIL–P–7105 gives the wrench makeup as three threads for sizes 3 and smaller. The E_3 dimensions are as follows: Nominal pipe size 2½ = 2.69609 and size 3 = 3.31719; sizes 2 and smaller same as above, col. 16.

(8) Reference dimension.

1/2	0.840	14	0.715	0.7717	0.7851
3/4	1.050	14	0.925	0.9822	0.9956
1	1.315	11.5	1.161	1.2305	1.2468
1 1/4	1.660	11.5	1.506	1.5752	1.5915
1 1/2	1.900	11.5	1.745	1.8142	1.8305
2	2.375	11.5	2.219	2.2881	2.3044
2 1/2	2.875	8	2.650	2.7504	2.7739
3	3.500	8	3.277	3.3768	3.4002
3 1/2	4.000	8	3.777	3.8771	3.9005
4	4.500	8	4.275	4.3754	4.3988

NOTE:

(1) Attention is called to the fact that the actual pitch diameter of the straight tapped hole will be slightly smaller than the value given when gaged with a taper plug gage as specified in 9.1.2.

Annex C
(informative)

Inspection of 3 ¼ inch ACME Couplings

C; 1 INTRODUCTION

This annex specifies the requirements for inspection of 3 ¼ inch ACME threaded couplings and end fittings.

This procedure applies to all 3 ¼ inch ACME connectors wherever they are fitted. The checks are to be carried out on both male and female couplings.

This procedure is to identify potentially worn ACME couplings and connectors for replacement.

To detect damage, thread wear beyond acceptable limits and the need for replacement seals, regular inspection of male and female couplings including both threads should be carried out. ACME threads are parallel but wear can vary along their length with most of the wear likely to be on the first thread.

There should be a visual inspection of the coupling for wear and damage together with a thread dimensional check. It is not sufficient to use only a “No-Go” gauge to check the threads as this may not identify worn or distorted threads. Pressure testing is also not a suitable method of inspection.

The nature and frequency of the inspection should be appropriate to the design, materials of construction and duty of the couplings.

A visual inspection at the time of filling then a gauge and/or measurement inspection at intervals not exceeding 10 years to be followed.

C; 2 DEFINITIONS

C- 2.1 Male Coupling

Coupling with a male thread.

C-2.2 Female Coupling

Coupling which includes a female threaded loose nut on a centre spigot.

C-3 Visual Examination

C-3.1 Visual examination should be carried out with particular emphasis on:

a) Narrowing or distortion of the thread form;
b) Cracks, dents, bulges cracked or broken threads (any of which may weaken the fitting);

c) Worn threads with a “stepped” appearance (see below);
d) Other uneven wear of the threads;
e) Debris in the threads;
f) Excessive corrosion or pitting; particularly of steel threads;
g) Damage or distortion of the internal cone on a female vapour coupling;
h) Damage to or absence of the pin on male vapour balance coupling;
j) Damage to the “lugs” of female couplings nuts (if the “lugs” of female coupling have been damaged this may prevent the use of the correct wrench and may indicate a “stretched” thread);
k) Damage to the rubber seal of male couplings; and
m) Damage to the sealing face of the female couplings.

C-3.2 Where a fault is identified, it shall be immediately rectified. If rectification is not possible, the coupling is deemed to fail the visual examination and it shall be prevented from being used further. Failed couplings shall be removed from service, disabled so as to prevent further accidental usage and shall be scrapped.

C-4 Dimensional Check

C-4.1 Visual inspection of ACME threads may not always show potentially dangerous conditions. The majority of thread wear occurs:

a) Above the thread pitch diameter of a male thread;
b) On the major diameter of the male thread;
c) Below the thread pitch diameter of a female thread; and
d) On the minor diameter of the female thread.

C- 4.2 The coupling shall be replaced when there is a maximum of 0.5 mm wear on the flank angle, after the 1st incomplete thread.

C-4.3 Male couplings shall be subjected to a dimensional check to ensure that the diameter has not been reduced below an acceptable level. Female couplings shall be subjected to a dimensional check to ensure that the diameter has not been increased above an acceptable level. In addition, the coupling shall be subjected to a “No-Go” gauge test which may identify wear on the flank of the thread.

C-4.4 The coupling shall be replaced when the major diameter of a male thread and the minor diameter of a female thread exceed the dimensions given in Table C-1. These dimensions are based on a wear allowance of 25 percent of the thread engagement.

Table C-1 — Acceptable Thread Sizes

Thread Size	**Acceptable minimum major diameter (male thread)**	**Acceptable maximum minor diameter (female thread)**
3 ¼ inch ACME x 6 TPI	82.02 mm	78.85 mm

C-4.5 Threads shall be measured to confirm that they conform and are acceptable to the dimensions given in Table C-1. Four measurements are taken equally spaced along the thread length, at axial interval angles of 45°.

C-4.6 If the "No-Go" thread gauge can be threaded more than one turn onto (or into) an ACME coupling, this indicates unacceptable thread wear of the coupling. A "No-Go" gauge may not identify a worn thread, if the thread is damaged, oval or distorted thus giving a false result.

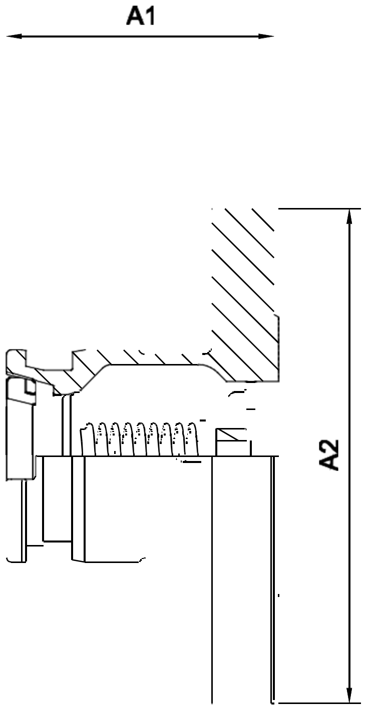
Annex D

(*normative*)

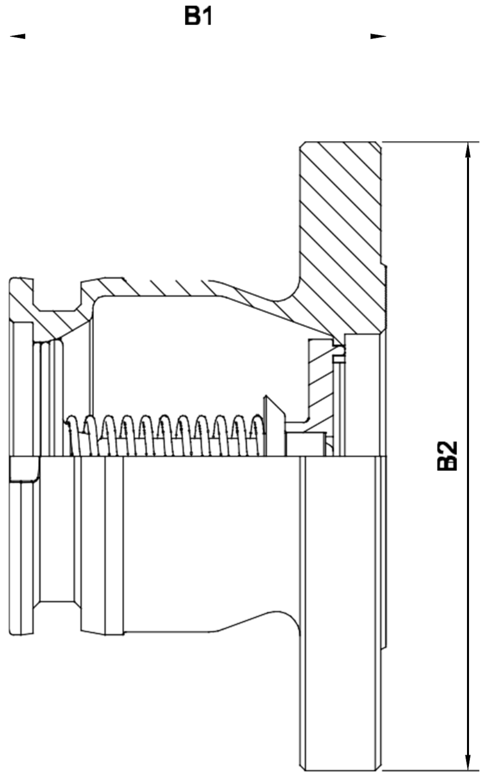
DRY DISCONNECT COUPLINGS

D-1 The general arrangement of dry disconnect couplings shall be as shown in Figure D-1, Figure D-2, Figure D-3 and Figure D-4.

D--2 The dimensions of dry disconnect couplings shall be as shown in Figure D-5 and Figure D-6. The dimensions of the gaskets shall take into account the characteristics of the gasket material in order to ensure the leak tightness, the inter-changeability and the good functioning of the dry disconnect coupling.



Coupling for vapour line DN 50

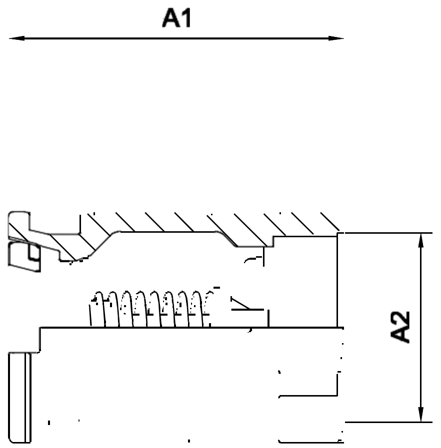


Coupling for liquid line DN 80

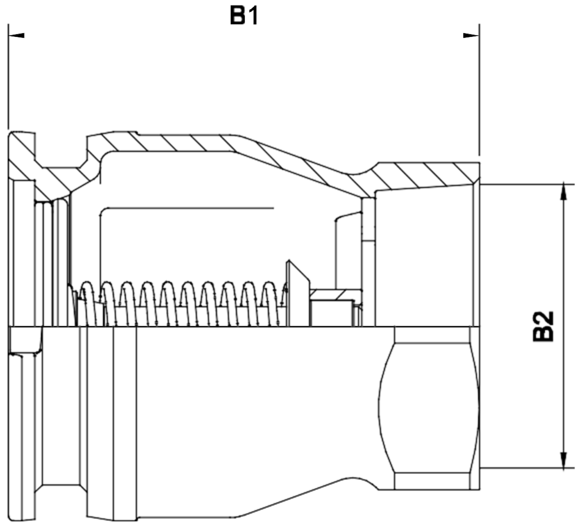
Key

A1	92 mm	B1	126 mm
A2	Flange 2 inch ANSI Class 300	B2	Flange 3 inch ANSI Class 300

FIG D-1 — PRESSURE VESSEL UNIT WITH FLANGE



Coupling for vapour line DN 50

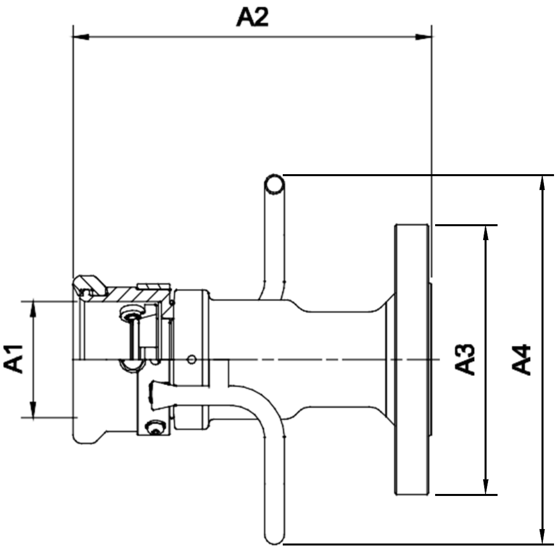


Coupling for liquid line DN 80

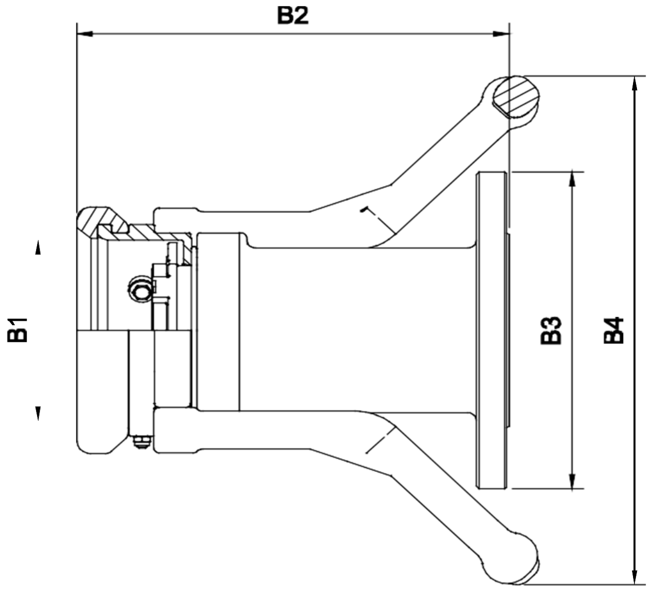
Key

A1	103 mm	B1	144 mm
A2	2 inch NPT internal thread	B2	3 inch NPT internal thread

FIG. D-2 — PRESSURE VESSEL UNIT WITH THREAD



Coupling for vapour line DN 50

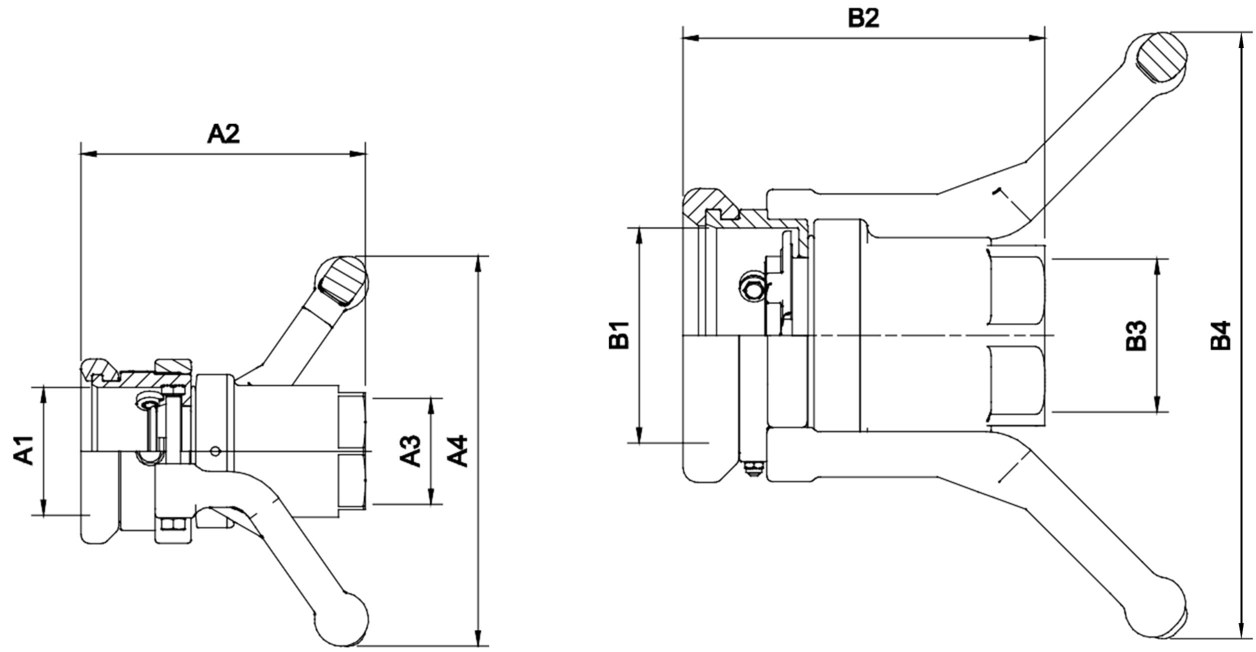


Coupling for liquid line DN 80

Key

A1	71 mm	B1	119 mm
A2	220 mm	B2	262 mm
A3	Flange 2 inch ANSI Class 300	B3	Flange 3 inch ANSI Class 300
A4	maximum 226 mm	B4	maximum 340 mm

FIG. D-3 — HOSE UNIT WITH FLANGE

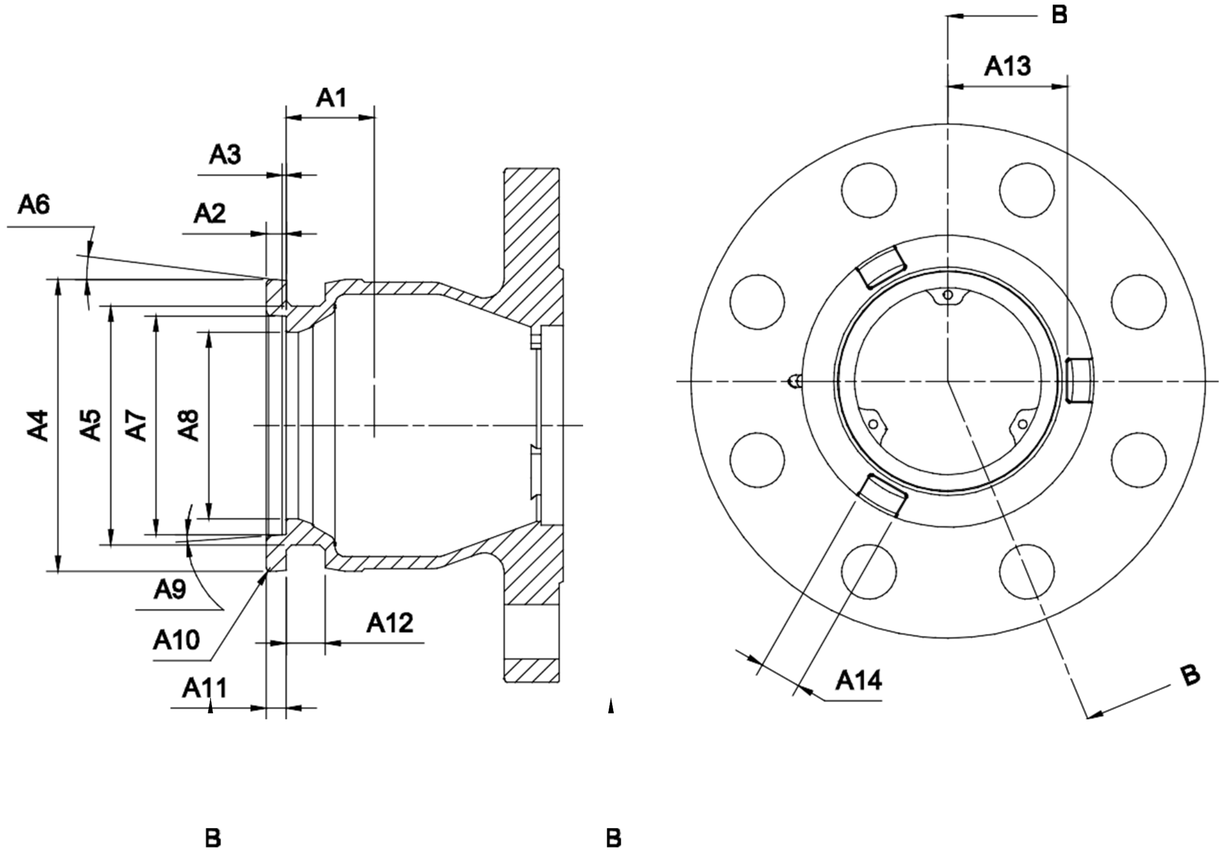


Coupling for vapour line DN 50 | Coupling for liquid line DN 80

Key

A1	71 mm	B1	119 mm
A2	156 mm	B2	202 mm
A3	2 inch NPT internal thread	B3	3 inch NPT internal thread
A4	maximum 226 mm	B4	maximum 340 mm

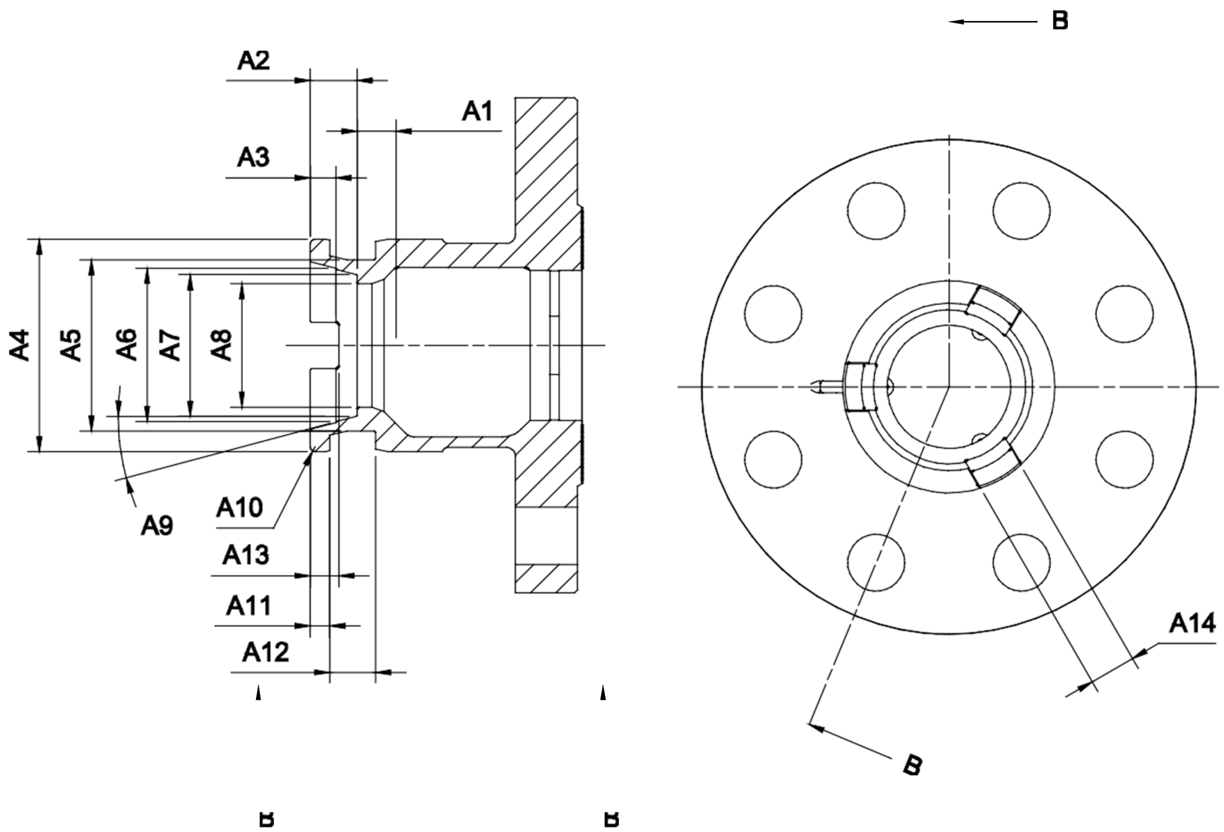
FIG. D-4 — HOSE UNIT WITH THREAD



Key

A1	Minimum piston movement 36 mm
A2	7,865 mm ± 0,015 mm
A3	0,8 mm ± 0,8 mm
A4	Ø 118,95 mm ± 0,05 mm
A5	Ø 97,5 mm ± 0,25 mm
A6	6° ± 1°
A7	Ø 89,2 mm ± 0,3 mm
A8	Ø 76,25 ± 0,05 mm
A9	2° ± 2°
A10	R 2,0 mm ± 0,5 mm
A11	7,95 mm ± 0,03 mm
A12	16,25 mm ± 0,25 mm
A13	48,375 mm ± 0,375 mm
A14	16,75 mm ± 0,25 mm

FIG. D-5 — COUPLING DN 80 FOR PRODUCT LINE



Key	
A1	Minimum piston movement 13 mm
A2	15,6 mm ± 0,1 mm
A3	8,5 mm ± 0,1 mm
A4	Ø 70,75 mm ± 0,05 mm
A5	Ø 57,1 mm ± 0,1 mm
A6	Ø 51,4 mm ± 0,2 mm
A7	Ø 47,2 mm ± 0,1 mm
A8	Ø 41,2 ± 0,2 mm
A9	15°
A10	R 1,5 mm ± 0,25 mm
A11	6,475 mm ± 0,025 mm
A12	15,325 mm ± 0,025 mm
A13	9,6 mm ± 0,1 mm
A14	15,5 mm ± 0,2 mm

FIG. D.-6 — COUPLING DN 50 FOR VAPOUR LINE

ANNEX E

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
16484 : 2017	Liquid off-take valve fitting to gas cylinders or tanks (mobile or static) for liquid petroleum gas (LPG) Specifications.
319 : 2007	Free cutting leaded brass bars, rods and sections—specification (*fifth revision*)
1598 : 1977	Methods for izod impact test metals (*first revision*)
1608 : 2005	methods of tensile testing of metals **(WITHDRAWN)**
2102 (Part 1) : 1993	General tolerances: Part 1 Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)
2305 : 1988	Method for mercurous nitrate test for copper and copper alloys (*first revision*)
3400 (Part 1) : 2012	Methods of test for vulcanized rubber: Part 1 Tensile Stress-strain properties (*third revision*)
3400 (Part 2) : 2014	Methods of test for vulcanized rubber : Part 2 : Rubber, vulcanized or thermoplastic — determination of hardness (hardness between 10 irhd and 100 irhd) (*fourth revision*)
3400 (Part 4) : 2012	Methods of test for vulcanized rubbers — Part 4 Accelerated ageing and heat resistance (*third revision*)
3400 (Part 10): 1977	Method of test for vulcanized rubbers Part 10 : Compression set at constant strain (*first revision*)
3400 (Part 20) : 2018	Methods of test for vulcanized rubbers — Part 20 : Resistance to ozone cracking — static strain test (*second revision*)
4454 (Part 4):: 2001	Steel wires for mechanical springs Part 4 Stainless steel wire (*second revision*)
4905 : 2015	Random sampling and randomization procedures (*first revision*)
6912 : 2005	Copper and copper alloys forging stocks — Specification (*second revision*)
7202 : 2017	Inspection gauges for checking type 4 (size 1,2,3) taper threads of gas cylinder valves and cylinder necks specification (*first revision*)
8737 : 2017	valve fittings for use with liquefied petroleum gas (LPG) cylinders of more than 5 litres capacity—specification (*second revision*)
9798 : 2013	Low pressure regulators for use with liquefied petroleum gas (LPG) — Specification (*second revision*)
ANSI/ASME B1.5 – 1990	Acme screw threads
ANSI/ASME B1.20.1 - 1983	Pipe threads, general purpose

ANNEX F

(*Clause* 4.2.4)

F-1 SCALE OF SAMPLING

F- 1.1 Lot

All the valve blanks of the same material size and produced under similar conditions of manufacture shall grouped together to constitute a lot.

F-1.1.1 Valve blanks shall be selected from each lot separately and then tested, for ascertaining their conformity to the requirements of mechanical properties.

F-1.1.2 The number of valve blanks to be selected from a lot shall depend upon the size of the lot and shall be in accordance with col 1 and col2 of Table 6. All the samples shall be taken randomly from the lot and for this purpose; reference should be made to IS 4905.

F-2 NUMBER OF TEST AND CRITERIA FOR CONFORMITY

F-2.1 All the valve blanks selected according to col 2 of Table 6 shall be divided in to two equal halves. Each of the samples in the first half shall be tested for tensile and elongation in the second half for izod impact strength.

F-2.2 The lot shall be declared as conforming to the requirements of mechanical properties, if it has been found satisfactory when tested according to **F-2.1** and found to be meeting the requirements of mechanical properties as per **4.2.2** and **4.2.3**. If any test samples fail to meet the requirements of **4.2.2** and **4.2.3**, additional specimens equaling twice the number of samples 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 6 Scale of Sampling

(*Clauses* A-1.1.2 and A-2.1)

Sl. No.	Number of Valve Blanks in the Lot	Samples Size for Izod Impact Strength and Tensile Strength and Elongation
(1)	(2)	(3)
i)	Up to 500	10
ii)	501 to 3 200	14
iii)	3 201 to 10 000	20
iv)	10 001 to 35 000	32
v)	35 001 and above	50

ANNEX G

(Informative)

PRODUCTION TESTING AND INSPECTION

G-1

The manufacturer should implement a conformity assessment procedure to ensure that the quality and performance of the manufactured valves comply with the quality and performance of the valves subjected to type test.

G-2 Every valve should be tested for,

a) external tightness and internal tightness;
b) safety valve working (start to leak and release pressure);
c) working of excess flow device; and
d) visual check.

G-3 Batch sample should be taken in accordance with IS 2500 (Part 1) level S4 and the following tests and inspections carried out:

a) External tightness;
b) Internal tightness;
c) Dimensional verification;
d) Material suitability;
e) Safety valve working;
f) Excess flow device working; and
g) Marking.

G-4 REJECTION CRITERIA

a) Valve not meeting the requirements of C-2 should be rejected; and
b) Batches of valves not meeting the requirement of C-3 should follow the rejection criteria of IS 2500 (Part 1).

G-5 DOCUMENTATION

Result of production testing should be recorded and retained.

ANNEX H

(Clause 4.3.7)

IMMERSION TEST (RESISTANCE TO HYDROCARBONS)

H-1 GENERAL

The test is designed to evaluate the rubber material, namely its resistance to hydrocarbons.

H-2 PROCEDURE

Weight the sample, W_0 prior to test. Immerse the same in pentane or test gas maintained at a temperature of 20 ± 5°C for 72 h. Remove the sample and expose it to atmosphere. After 5 min, weigh the sample W_1. Next, let it stay exposed to atmosphere for 24 h and reweigh W_2 and calculate the following:

a) Percentage of test gas absorbed

$$= \frac{W1-W2}{Wo} x100$$

b) Percentage of matter extracted

$$= \frac{Wo-W2}{Wo} x100$$

H-3 The results of the above test shall be in accordance with as given below:

Component	Extractable Percent	Absorbed Percent
Valve Seat	5	10
Seal, O Ring and Rubber Washer	20	20

NOTE – It is permitted to wipe clean the component after removal immersion.