भारतीय मानक

Indian Standard

IS 1970 : 2024

फसल संरक्षण उपस्कर — हस्त-चालित कम्प्रेशन पीठ पर लादा जाने वाला फुहारा — विशिष्टि

(छठा पुनरीक्षण)

Crop Protection Equipment — Hand-Operated Compression Knapsack Sprayer — Specification

(Sixth Revision)

ICS 65.060.40

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Agricultural Machinery and Equipment Sectional Committee, FAD 11

FOREWORD

This Indian Standard (Sixth Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Agricultural Machinery and Equipment Sectional Committee had been approved by the Food and Agriculture Division Council.

This standard was first published in 1961 and subsequently revised in 1965, 1971, 1974 and 1982. A need was felt again to revise the standard in line with the revision of other sprayer standards. The fifth revision was done in the year 1995, whereby, materials of construction were modified and chemical composition of brass casting components as per relevant Indian Standard were given to ensure conformity, provision of supply of cut-off device was given. Also, test for tank fatigue and test for piston made of synthetic rubber were added.

In this revision the following modifications have been done:

a) Technical data has been elaborated and explained through respective figures and clauses.
b) Performance test methods and test for components have been incorporated which were earlier covered in IS 10134 'Methods of test for manually-operated sprayers (*first revision*)' .
c) Addition of further details as Annex B (hand operated cut-off device), Annex C (spray lance) and Annex D (hydraulic spray nozzle) and Annex E (hydraulic spray gun) has been made which were earlier covered in IS 3652 'Crop protection equipment — Foot sprayer — Specification (*fourth revision*)'.
d) Necessary editorial changes have been made including updating of referred Indian Standards and schematic diagrams given in the standard.

This standard contains **9.3** which call for agreement between the purchaser and the supplier. For the guidance of the purchaser, information to be supplied by the manufacturer is given in Annex A.

The composition of the Committee, responsible for the formulation of this standard is given at Annex F.

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

CROP PROTECTION EQUIPMENT — HAND-OPERATED COMPRESSION KNAPSACK SPRAYER — SPECIFICATION

(Sixth Revision)

1 SCOPE

1.1 This standard specifies material, performance, constructional and other requirements of hand-operated compression knapsack sprayer (also called as mechanical sprayer), non-pressure retaining type used for spraying plant protection substances (for example pesticides).

1.2 The maximum working pressure of this type of sprayers is 400 kPa (100 kPa = 1.019 7 kgf/cm^2 =1 bar).

2 REFERENCES

The standards given below contain provisions, which through reference in this text, constitute provision 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 is encouraged to investigate the possibility of applying the most recent edition of these standards:

IS No.	*Title*
IS 292 : 1983	Specification for leaded brass ingots and castings (*second revision*)
IS 3624 : 1987	Specification for pressure and vacuum gauges (*second revision*)
IS 2643 : 2005/ ISO 228-1 : 2000	Pipe threads where pressure-tight joints are not made on the threads — Dimensions, tolerances and designation (*third revision*)
IS 7201 (Part 1) : 1987	Methods of sampling for agricultural machinery and equipment: Part 1 Hand tools and hand-operated animal-drawn equipment (*first revision*)
IS 8480 : 2023/ ISO 5681 : 2020	Equipment for crop protection — Vocabulary (*second revision*)
IS 10216 : 1988/ ISO 228-2 : 1987	Pipe threads where pressure-tight joints are not made on the threads — Verification by means of limit gauges (*first revision*)
IS 11429 : 1985	Methods for calibration of sprayers

3 TERMINOLOGY

For the purpose of this standard, the following, definitions in addition to IS 8480 shall apply (*see* Fig. 1, Fig. 2, Fig. 3 and Fig. 4).

3.1 Clean-out Port — A component for draining and cleaning the tank.

3.2 Compression Sprayer — A mechanical sprayer, the tank of which is a pressure vessel, and the air pressure is created either by inbuilt pump or from outside.

3.3 Drain Plug — A plug provided in the clean-out port.

3.4 Filler Bung — A device for closing the opening of the filtering.

3.5 Filler Ring — A ring provided on the tank with a hole in centre for filling the liquid.

3.6 Gasket — A compressible insert placed between two surfaces to obtain a liquid or gas tight sealing.

3.7 Guide — A component for guiding the movement of the piston rod.

3.8 Handle — A component to actuate the piston rod.

3.9 Hose Connection — Device for connecting the delivery hose with the discharge outlet and the cut-off device.

3.10 Knapsack Sprayer — A sprayer which can be mounted on the back of an operator for spraying.

3.11 Mass — The mass of the sprayer without any liquid in the tank and without discharge line (that is hose, cut- off device, lance, and nozzle).

3.12 Non-Pressure Retaining Type Sprayer — A sprayer in which the tank acts as a pressure vessel and the working pressure does not remain constant during spraying.

3.13 Piston — A component for creating pressure or suction and pressure.

3.14 Piston Rod — A rod or tube to help the movement of piston.

3.15 Pump Cylinder — A component to guide the movement of piston.

3.16 Skirt — A support to prevent the bottom of the tank from damage.

3.17 Spreader — A component for holding the piston in its shape and position.

3.18 Stroke — The maximum travel of the piston rod in one direction when the handle moves from its lowest possible position to highest possible position.

3.19 Tank Nominal Volume — Volume indicated by the maximum filling level marked on the spray tank when placed on a level horizontal surface.

3.20 Nominal Tank Capacity — The volume of tank when liquid is filled to its neck level, provided the tank is equipped with all its internal mountings.

3.21 Valve Assembly — A device provided to check or to allow the flow of the fluid.

4 MATERIALS

4.1 The material of construction of various components of the sprayer shall be selected from col (3) of Table 1. The brass casting components shall conform to the chemical composition of any of the grade specified in IS 292 (Grade to be declared by the manufacturer). Materials other than brass casting should conform to the relevant Indian Standard, wherever available.

4.2 The material for spray lance, nozzle, cut-off device, spray gun and its components shall be as given in Table 1.

4.3 All metallic parts coming in contact with the pesticides should preferably be of the same material to minimize bimetallic corrosion.

4.4 The material used for various parts shall be declared by the manufacturer in the manual (*see* **7.1**).

4.5 The engineering plastics used for manufacturing various components as given in Table 1.

5 PERFORMANCE REQUIREMENTS

5.1 Discharge Rate

When tested in accordance with the method given in **11.1**, the pump shall be able to develop a pressure of minimum 400 kPa in the tank.

6 CONSTRUCTIONAL REQUIREMENT

6.1 Tank and Skirt

The tank capacity (*see* **3.20**) shall be as agreed to between the purchaser and the manufacturer. The tank capacity shall be with a tolerance of ± 0.5 litres on the declared value.

6.1.1 The tank shall be provided with a skirt which shall project a minimum of 12 mm beyond the lowest portion of the bottom of the tank.

6.1.2 The tank fitted with skirt shall withstand the test prescribed in **12.6**.

6.2 Straps

Two straps of not less than 800 mm when adjusted to maximum possible length and 38 mm in width shall be provided in order to help carriage of the sprayer. In case of the sprayer having capacity up to 9 litres, only one strap of minimum 38 mm width may be provided. Provision for adjustment of the length of each strap shall also be provided.

6.2.1 The straps and their assembly shall withstand the test prescribed in **11.3**.

6.2.2 In case of sprayers having two straps, a back rest shall be provided.

6.3 Filler Ring

A filler ring having a hole of minimum 30 mm in diameter shall be provided.

6.3.1 *Filler Bung*

The hole shall be covered with a spill-proof filler bung. The bung may be threaded with a pressure releasing hole on the side.

6.3.2 *Strainer*

A removable strainer on the filling hole or a separate filling funnel with strainer shall be provided to filter the liquid while filling in the tank. The average size of any side or diameter of the apertures of the strainer shall not be more than 625 µm.

NOTE — For measuring size of apertures, select 10 consecutive apertures in the strainer and measure each side or diameter as case may be. Average the measured value and report.

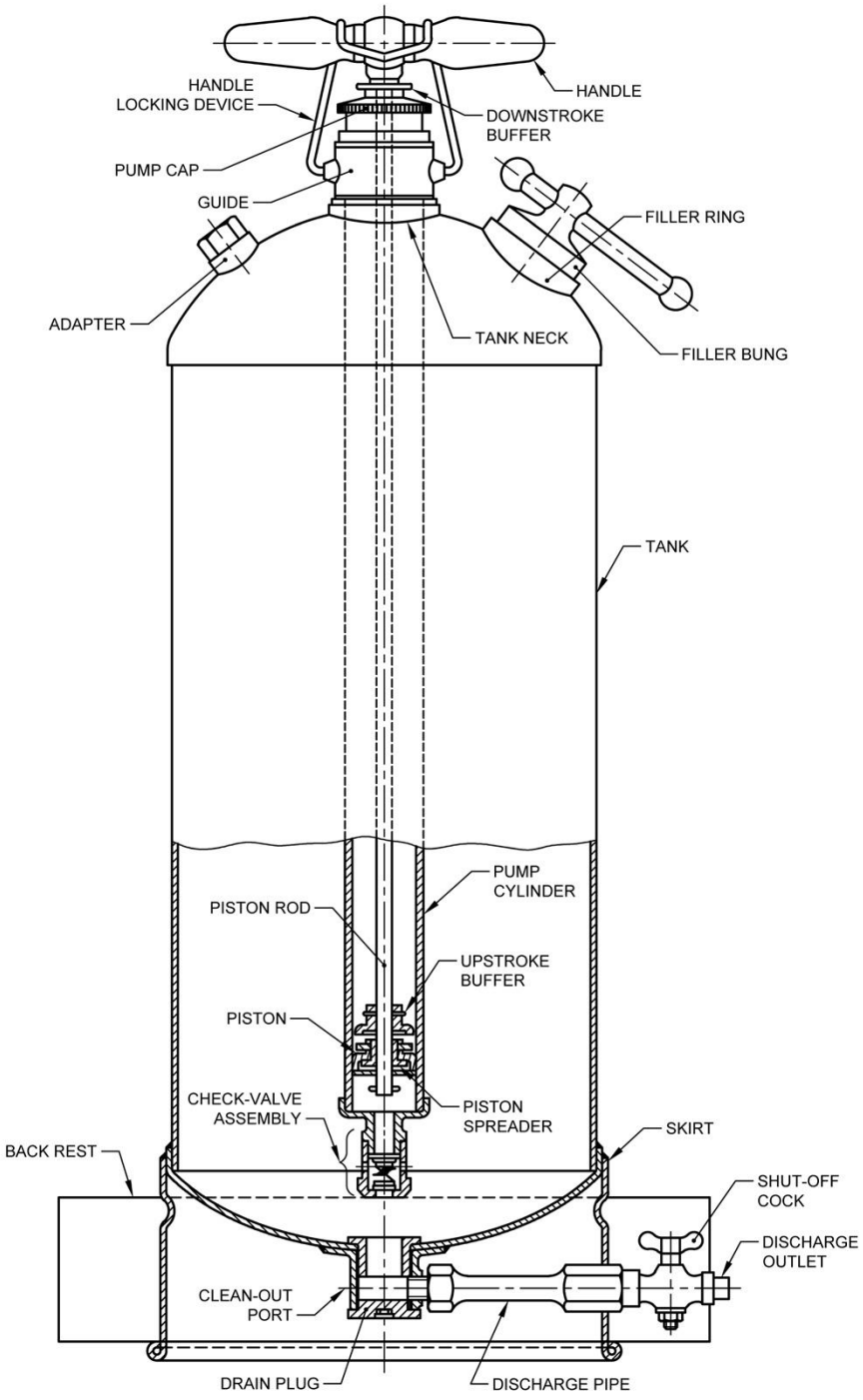

FIG. 1 HAND-OPERATED COMPRESSION KNAPSACK SPRAYER, NON-PRESSURE RETAINING TYPE WITH T-HANDLE

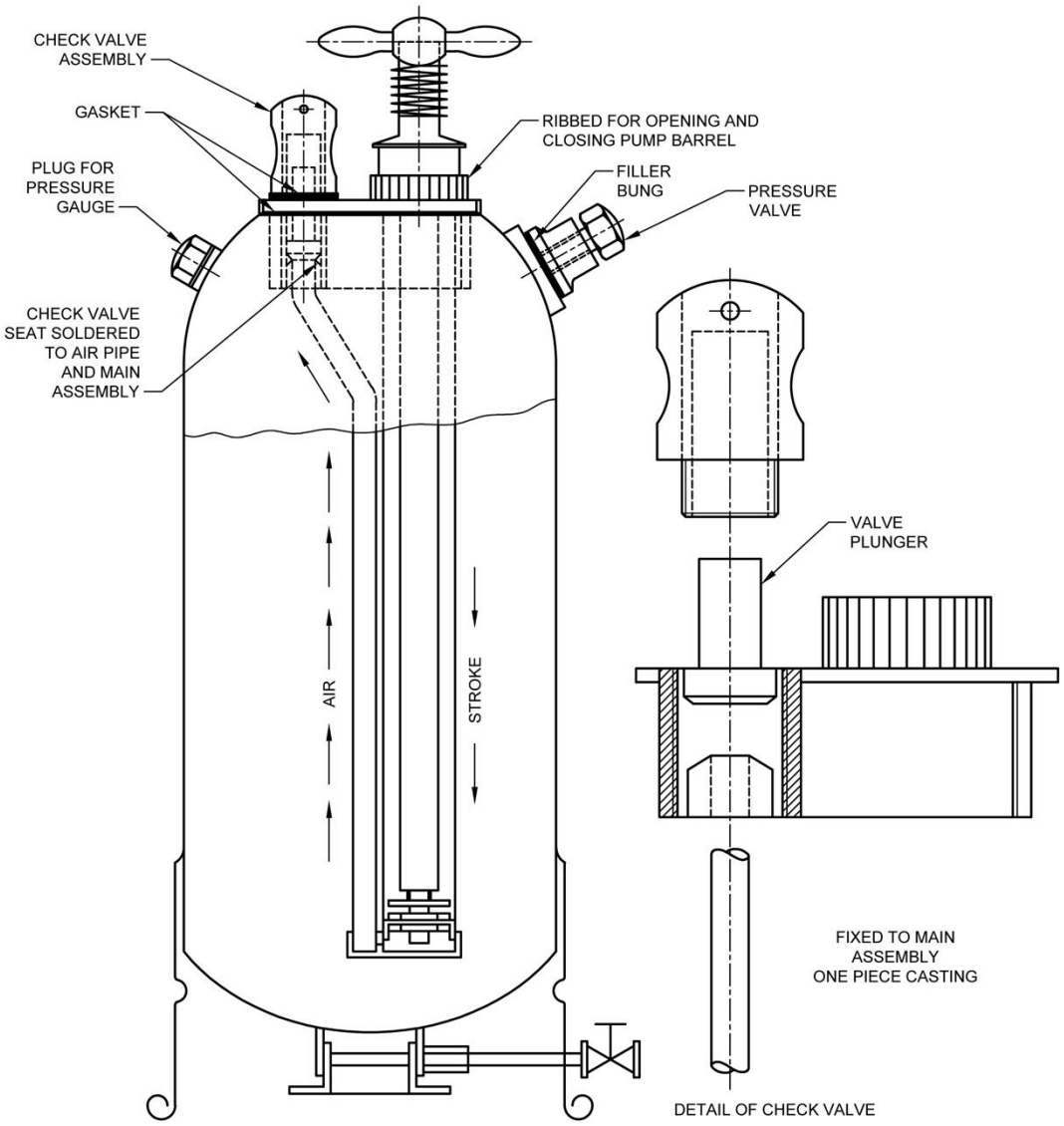

FIG. 2 HAND-OPERATED COMPRESSION KNAPSACK SPRAYER, NON-PRESSURE RETAINING TYPE WITH VALVE ASSEMBLY AT TOP

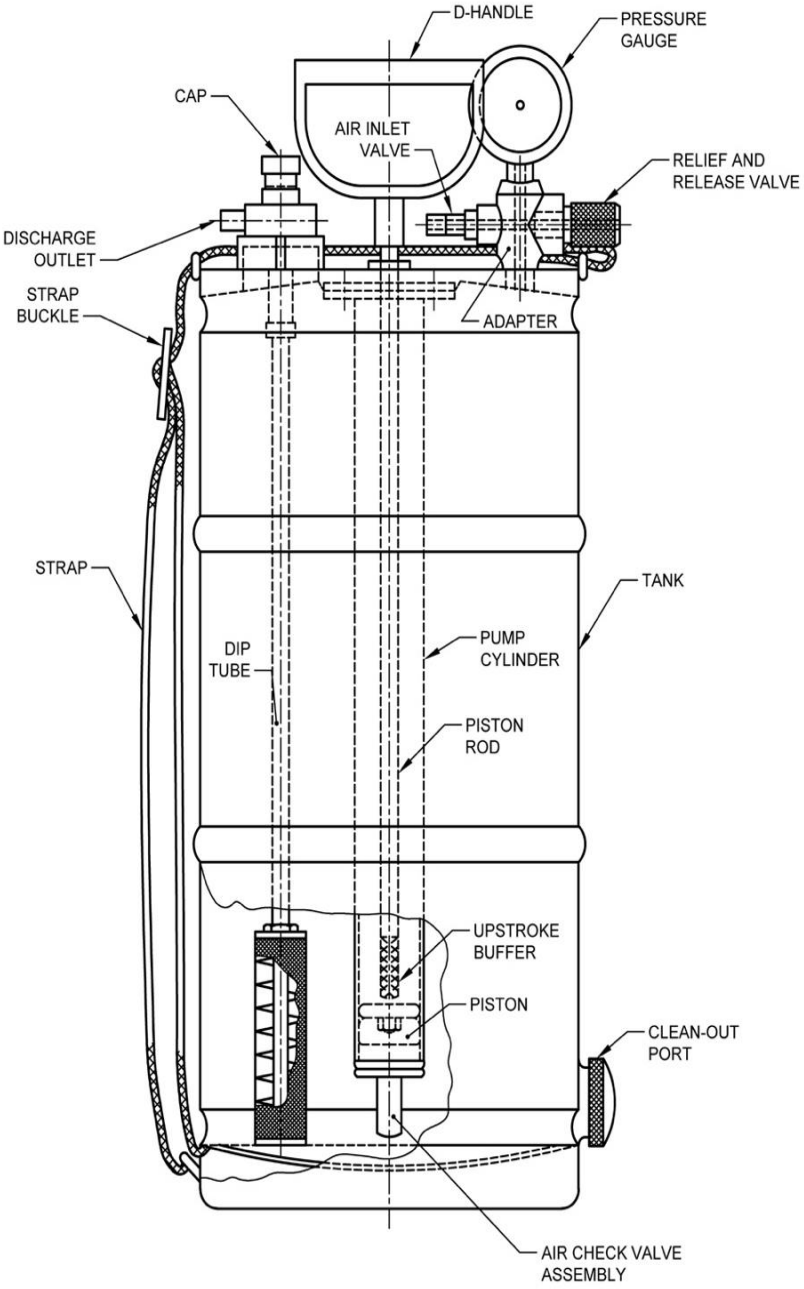

FIG. 3 HAND-OPERATED COMPRESSION KNAPSACK SPRAYER, NON-PRESSURE RETAINING TYPE WITH D-HANDLE

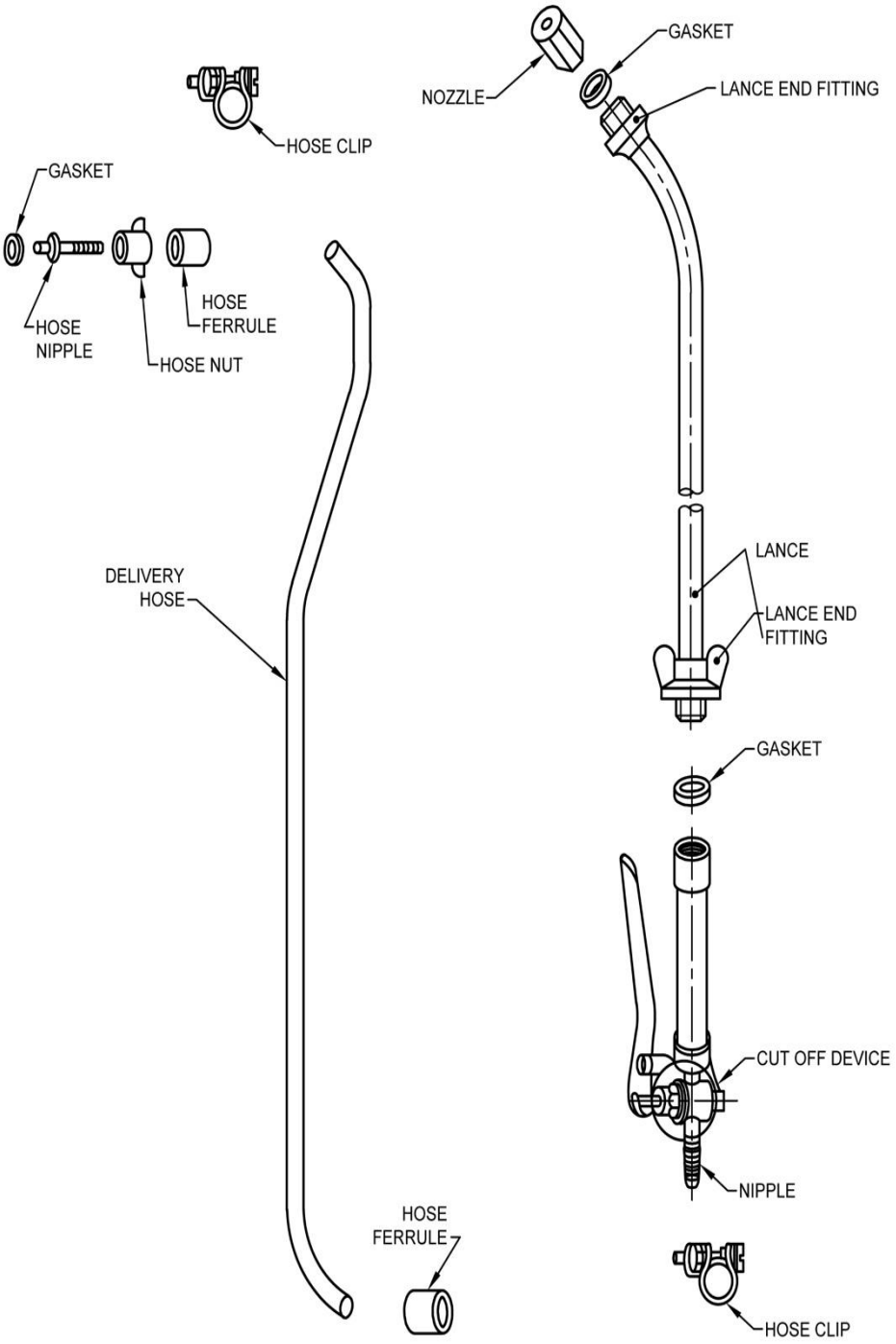

FIG. 4 DISCHARGE LINE OF SPRAYER

Table 1 Materials of Construction of Various

Components (*Clause* 4 *and* 4.2)

Sl No.	Component	Material
(1)	(2)	(3)
i)	Tank	Stainless steel/plastic/brass
ii)	Filler ring	Stainless steel/plastic
iii)	Filler bung	Stainless steel/plastic
iv)	Pump cylinder	Stainless steel/plastic/brass
v)	Guide	Stainless steel/plastic/brass
vi)	Clean-out port	Stainless steel/plastic
vii)	Drain plug	Stainless steel
viii)	Discharge pipe	Stainless steel/plastic
ix)	Pump cap	Stainless steel/plastic
x)	Hose nut	Stainless steel/Plastic
xi)	Hose nipple	Engineering plastic/brass/aluminium alloy
xii)	Strainer	Engineering plastic/brass/aluminium alloy
xiii)	Piston rod	Mild steel
xiv)	Hose ferrule/clip	Stainless steel
xv)	Handle locking device	Galvanize iron
xvi)	Handle	Stainless steel
xvii)	Piston	Chrome taned leather/synthetic rubber/PVC
xviii)	Spreader	Stainless steel/mild steel
xix)	Buffer	Spring steel
xx)	Strap	Synthetic yarn
xxi)	Hose	Braided rubber/PVC
xxii)	Gasket	Synthetic rubber/PVC/Fibre
xxiii)	Valve seat	Stainless steel/engineering plastic
xxiv)	Valve	Stainless steel/engineering plastic
xxv)	Shut-off cock	Stainless steel
xxvi)	Skirt	Stainless steel/mild steel/plastic
xxvii)	Back rest	Alloy steel/engineering plastic
xxviii)	Strap buckle	Mild steel /engineering plastic
xxix)	Cushion	Plastic
xxx)	Foot rest	Mild steel
xxxi)	Spray lance	Brass Plastic, stainless steel
xxxii)	Nozzle components	
	a) Body and cap	Brass, engineering plastic, stainless steel
	b) Swirl core	Brass, engineering plastic stainless steel,
	c) Disc tip	Brass, ceramic, stainless steel
	d) Spindle, coupling nut and gland nut	Brass, engineering plastic stainless steel
xxxiii)	Cut-off device components	
	a) Body, valve stem, valve seat, gland, nut, cap and collar, nipple	Brass, engineering plastic, stainless steel
	b) Valve	Brass, synthetic rubber, stainless steel, plastic
	c) Operating knob/lever	Brass, engineering plastic
	d) Operating trigger	Stainless steel, engineering plastic

Table 1(*Concluded*)

Sl No. (1)	Component (2)	Material (3)
	e) Spring	Stainless steel
	f) Gasket	Synthetic rubber, fibre, PVC
	g) Gland seal	PVC
	h) Gland packing	Asbestos rope
xxxiv)	Spray gun components	
	a) Barrel, connecting rod, connecting guide, connections for extension, holder and inlet collector, lock nuts, gland out and rigid washer	Brass, engineering plastics, stainless steel
	b) Swirl rotor, nozzle cap and body	Brass, engineering plastic, stainless steel
	c) Spring	Stainless steel
	d) Nozzle disc	Brass, stainless steel, ceramic
	e) Grip	Plastic
	f) Trigger, trigger lock or screw	Brass steel
	g) Packing gland	Asbestos rope
	h) Gland seal	PVC
	j) Split pin/pivot pin	Steel

6.4 Pump Cylinder

The inner diameter of the pump cylinder shall not be more than 40 mm. It shall withstand the test prescribed in 12.1.

6.5 Piston

The height of the piston shall be minimum 13 mm. In case the piston is made out of synthetic rubber, it shall withstand the test prescribed in 12.3.

6.5.1 *Spreader*

If provided it shall be able to hold the piston in its shape and position without distortion against the wall of the pump cylinder.

6.6 Piston Rod

The piston-rod shall not be less than 9.0 mm in diameter.

6.6.1 *Buffer*

A buffer device shall be provided on the piston rod in order to prevent the direct impact of the handle on the pump body.

6.6.2 *Guide*

A guide at the top of the pump cylinder with the provision of fixing handle locking device shall be provided.

6.7 Handle

The handle shall be of a ‘D’ or ‘T’ shape. If of the ‘D’ shape, it shall have an inside grip not less than 130 mm long with an inside vertical clearance of not less than 35 mm. The grip shall be attached with handle support. If of ‘T’ shape the length of the either side from the centre of piston rod shall not be less than 100 mm. The diameter of the handle grip in both the types shall not be less than 25 mm.

6.7.1 *Handle Locking Device*

The sprayer shall be fitted with a convenient quick action locking device for locking the handle. If wire is used, it shall not be less than 3 mm in diameter. The device shall be able to hold the handle properly when the handle is brought to its lowest possible position.

6.8 Valve Assembly

The valve assembly shall withstand the test prescribed in 12.8.

6.9 Discharge Pipe

A discharge pipe shall be provided to take out the liquid from the tank.

NOTE — In some designs a dip tube is provided in place of discharge pipe. If fitted, it shall be emerged from top of the tank and shall be easily detachable from the tank.

6.10 Threaded Connections

All metallic threaded connections of the sprayer and its components shall conform to IS 2643. The size designation and type of threads are as given in Table 2. For all the joining components with internal or external threaded connections, the engaged length of the threads shall not be less than 6 mm.

NOTE — The measurement of thread size shall be done by gauges and not by measuring absolute dimensions (*see* IS 10216).

6.11 Discharge Outlet

The discharge outlet shall be nipple type or threaded type. The length of the nipple shall not be less than 20 mm.

6.12 Gaskets

The gaskets of synthetic rubber, wherever provided, shall withstand the test prescribed in **12.3**.

6.13 Delivery Hose

A delivery hose of suitable diameter and at least one meter in length shall be provided as agreed to between the purchaser and the supplier. The hose shall be connected with the discharge outlet and the cut-off device through hose connection.

6.13.1 *Hose Connection*

The hose connection for threaded type and nipple type connection shall be nut-nipple and clamp type and clamp type respectively. The clamp shall be in the form of ferrule or clip.

6.13.2 The hose and hose connection shall withstand the test prescribed in **12.4**.

6.14 Cut-off Device and Lance/Spray Gun

Each sprayer shall be provided with a cut-off device and spray lance conforming to the requirements given in Annex B and Annex C or a spray gun conforming to the requirements given in Annex E.

NOTE — In case of cut-off device and spray lance of a type other than that specified in Annex B and Annex C is required by the purchaser, for the special purpose, its requirement shall be as agreed between purchaser and supplier.

Table 2 Threaded Connections

(*Clause* 6.10)

Sl No. (1)	Component (2)	Type (3)	Size Designation (4)
i)	Suction spout	External	Minimum G1/2B or similar metric thread
ii)	Delivery spout	External	Minimum G1/4B or similar metric thread
iii)	Hose connection		
	a) For suction spout	Internal	Minimum G1/2 or similar metric thread
	b) For delivery spout	Internal	Minimum G1/4 or similar metric thread
	c) For cut-off device	Internal	Minimum G1/4 or similar metric thread
iv)	Cut-off device		
	a) Inlet end	External	Minimum G1/4B or similar metric thread
	b) Outlet end	Internal	Minimum G1/4 or G1/4 similar metric thread
v)	Spray lance		
	a) Nozzle end	External	Minimum G1/4B or similar metric thread
	b) Cut-off device end	Internal	Minimum G1/4B or similar metric thread
	c) Bent portion for connection with straight portion (in case of type B2)	Internal	Minimum G1/4 or similar metric thread
vi)	Spray gun inlet	External	Minimum G1/4B or similar metric thread
vii)	Nozzle body	Internal	Minimum G1/4 or Similar Metric thread

6.15 Nozzles

The nozzle shall be either hollow cone type or fan type and shall conform to the requirements as given in Annex D.

6.16 Adopter and Cap

An adopter shall be provided in the sprayer for fixing the pressure gauge, even if the pressure gauge is not required by the purchaser. The adopter shall have internal thread size G l/8 (*see* IS 2643) and shall be covered with a leak proof cap.

NOTE — The cap shall be provided even if the pressure gauge is required by the purchaser.

6.17 Height

The height from the base of the skirt of the tank to the centre of the handle grip, when the handle is moved to its highest and lowest possible positions, shall not be more than 1.1 m and not less than 0.6 m respectively.

NOTE — The sprayer having tank capacity less than 12 litres, the requirements given in **6.17** may not apply.

6.18 Mass

The mass (*see* **3.11**) of the sprayer shall not be more than 8 kg and total weight with liquid shall not be more than 25 kg with all accessories.

6.19 Endurance

The sprayer shall withstand the test prescribed in **11.4**.

7 OTHER REQUIREMENTS

7.1 Manual

The manual shall include technical specification of the sprayer, material of construction of various component shown in the exploded view of the sprayer, instructions for operations, calibration and maintenance, common faults and their remedies and safety precautions. Reference of IS 11429 shall also be given for the purpose of calibration of the sprayer.

7.2 Spare Parts

Spare parts, separately packed for each sprayer according to the number required by the purchaser shall be provided. If no demand for spare parts has been made, a set of gaskets shall be provided with each sprayer.

7.3 Optional Items

At the option of the purchaser, the following items, with the requirements indicated against each, shall be provided in the sprayer. Any other optional items required by the purchaser shall be supplied, the requirements for the same shall be as agreed to between the purchaser and the supplier.

7.3.1 *Strap Cushion*

A cushion of minimum 40 mm width and 20 mm thickness may be provided with each strap at least on the portion that rests on the shoulder of the operator. The cushion, if provided, shall be covered with suitable covering material, such as canvas, rexine and PVC or plastic-coated fabrics.

7.3.2 *Back Rest Cushion*

The back-rest cushion may be provided. The cushion, if provided, shall be covered with suitable covering material, such as canvas, rexine and PVC or plastic-coated fabrics.

7.3.3 *Shut-off Cock*

It shall be provided in the discharge pipe. The cock shall be capable of allowing free flow of liquid, when open, without stoppage and leakage.

7.3.4 *Pressure Gauge*

A pressure gauge of 50 mm nominal size (*see* IS 3624) shall be provided. It should be graduated between 0 and not exceeding 2.5 times but not less than one and a half times of the normal working pressure of the sprayer. The gauge shall have external thread size of minimum/suitable G1/8B (*see* IS 2643) for connection. The dial and cover should preferably be of shatter-proof plastic.

7.3.5 *Pressure-relief Valve*

A pressure relief valve, which shall not allow the increase of pressure in the tank by more than 1.5 times of the normal working pressure, shall be provided. The normal working pressures developed in the tank shall not drop if discharge outlet closed. The valve shal1 be fitted on the tank by external thread of size of minimum/suitable G1/8B designation.

7.3.6 *Foot Rest*

A folding foot rest attached at the lower side of the skirt of tank shall be provided.

7.3.7 *Lance Brackets*

Two brackets or clamps, one at the bottom and other at the top side of the tank shall be provided to keep lance and nozzle folded when the sprayer is not in use.

7.3.8 *Air-inlet Valve*

For the purpose of supplying air pressure to the tank from an outside source, an air inlet valve may be provided.

7.3.9 *Clean-out Port*

A clean-out port may be provided. If provided, it shall be fitted with a drain plug. The opening in the port shall not be less than 18 mm in diameter.

7.4 Safety

Each sprayer shall be provided with a set of masks, hand gloves, apron and safety goggles.

8 WORKMANSHIP AND FINISH

8.1 The components of the sprayer shall have smooth surface finish and shall be free from burrs, sharp edges and other visual defects that may be detrimental for their use.

8.2 Exposed steel parts shall have a protective coating to prevent surface deterioration. The steel used for hose ferrule/clip, piston rod and buffer shall be plated with cadmium, zinc or nickel-chrome. Exposed brass parts may be given a suitable protective finish with clear transparent lacquer.

9 MARKING AND PACKING

9.1 Marking

Each sprayer shall be marked with the following particulars:

a) Manufacturer's name or recognized trade-mark;

b) Batch or serial number;

c) Tank nominal capacity; and

d) Proper safety signs shall be provided.

9.2 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 products may be marked with the Standard Mark.

9.3 Packing

The sprayer shall be packed, as agreed to between the purchaser and the supplier, for safe handling in transit.

10 SAMPLING FOR LOT ACCEPTANCE

10.1 Unless otherwise agreed to between the purchaser and the supplier, sampling of the sprayers for lot acceptance shall be done in accordance with **3** of IS 7201 (Part 1).

11 PERFORMANCE TESTS

11.1 Test for Discharge Rate

11.1.1 The hole for agitation purpose, in case of hydraulic type agitator, shall be scaled.

11.1.2 The sprayer shall be rigidly mounted on the test bench (*see* Fig. 5) in such a way that its handle shall be operated in the direction it is designed for operation.

11.1.3 The handle of the sprayer shall be connected to an adjustable crank mechanism operated by a motor through a speed-step-down drive so as to give movement of (16 ± 1) cycles per minute, in such a manner as to maintain proper alignment between the piston rod and pump cylinder.

11.1.4 One end of the hose of 2 m length shall be connected to the discharge outlet of the sprayer and the other end to the inlet end of a straight rigid tube of 75 cm in length and 6 mm internal diameter.

11.1.5 A pressure regulator shall be fitted at the outlet end of the rigid tube to adjust the pressure.

11.1.6 An extension tube of suitable shape may be fitted at the outlet end of the pressure regulator for collecting the discharge of water in a container.

11.1.7 A pressure gauge (*see* IS 3624) having full scale reading from 0 to not exceeding 2.5 times and not less than 1.5 times the average working pressure of the sprayer, shall be fitted in the rigid tube at a distance of 15 cm from the inlet end of the pressure regulator on its upstream side.

11.1.8 The rigid tube with the pressure gauge and the pressure regulator shall be mounted on a separate test bench, other than the one having driving unit, in order to eliminate vibration.

11.1.9 The crank mechanism shall be adjusted so as to utilize the full stroke of the sprayer.

11.1.10 The tank of the sprayer shall be filled up to its specified capacity with clean water and the piston rod or pressure chamber (as the case may be) shall be operated at a constant speed of (16 ± l) cycles per minute.

11.1.11 The pressure regulator shall be adjusted to develop a pressure of 300 kPa within a fluctuation of ± 20 percent.

11.1.12 The discharge of water in one minute shall be collected and measured.

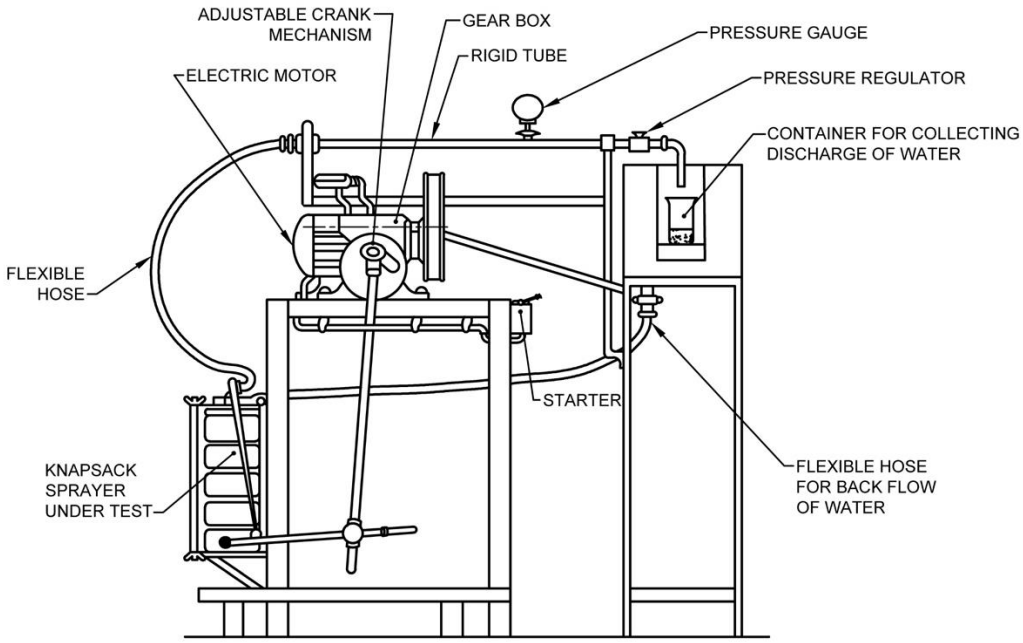

FIG. 5 RIG FOR CONDUCTING PUMP PERFORMANCE AND ENDURANCE TEST ON KNAPSACK SPRAYER (SCHEMATIC)

11.1.13 The above test shall be repeated four times and the average value of the measured discharge shall be calculated.

11.2 Test for Volumetric Efficiency

11.2.1 The discharge of water in one minute or 10 successive strokes shall be collected and measured in accordance with **11.1** for the sprayer. Repeat the test four times and calculate average value of the measured discharge. Calculate the volume of water in one cycle, that is, in one discharge stroke from the average measured discharge.

11.2.2 Calculate the piston displacement by measuring the inner diameter of the pump cylinder and the actual length or one stroke. The inner diameter of the pump cylinder shall be measured below the bell mouth of the cylinder.

11.2.2.1 The length of one stroke shall be measured by subjecting the pump t o a pressure of 300 kPa within a fluctuation of ± 20 percent.

11.2.3 Divide the value obtained in **11.2.1** by the value obtained in **11.2.2** and express the result in percentage.

11.2.4 The volumetric efficiency shall be recorded in the test report.

11.3 Test for Strap and its Assembly

11.3.1 The tank shall be filled with clean water to its specified capacity.

11.3.2 The sprayer (without discharge line) shall be hung from a solid support by its strap(s) simulating its carriage on the shoulder of an operator.

11.3.3 Raise the tank vertically to a height of 300 mm and allow to drop freely and hang by the strap(s).

11.3.4 Repeat the operation given in **11.3.3** for 24 times.

11.3.5 Parts (straps, brackets, etc.) of the assembly shall not break during the test.

11.4 TEST FOR ENDURANCE

11.4.1 For Compression Knapsack Sprayer, Non-Pressure Retaining Type

The tank of the sprayer shall be filled with clean water up to two-thirds of its capacity. A pressure of minimum 400 kPa but not exceeding 600 kPa shall be created by operating the pump at its full stroke either manually or mechanically. The pressure shall then be released to atmospheric pressure by opening the cut-off device and by discharging the liquid through nozzle or spray lance. The test shall be repeated to a minimum of 100 times.

11.4.2 The sprayer shall not show any leakage, deformation, or breakdown during the test.

NOTES

1 For acceptance test, the sprayer shall be subjected to the above test for a minimum of 5 times instead of 100 times.

2 For routine check, each sprayer shall be subjected to this test for a minimum period of 5 minutes by discharging water through the nozzle. During this period no part or joint of the sprayer shall show the leakage.

12 TESTS FOR COMPONENTS

12.1 Test for Leakage and Deformation of Pressure Chamber, Pump Cylinder and Pressure Tank

12.1.1 *Pneumatic Test*

A hose shall be attached to the opening of the pressure chamber or pump cylinder or tank. In case there are a number of openings, other than the one to which the hose is attached, those openings shall be sealed. The pressure chamber or pump cylinder or tank shall then be pneumatically pressurized to a minimum of one and a half times the normal working pressure of the sprayer and the pressure shall be retained for a period of one minute. The component shall be disconnected, immersed in water and examined for any leakage and deformation.

12.1.1.1 The pressure chamber or pump cylinder or tank shall not show any leakage or deformation during this lest.

12.1.2 *Hydraulic Test*

With the similar connection as that of **12.1.1**, the pressure chamber or pump cylinder or tank shall be pressurized to a static hydraulic pressure of a minimum of two and a half times the normal working pressure of the sprayer and the pressure shall be retained for a period of one minute. The pressure cha tuber or pump cylinder or tank shall be examined for any leakage or deformation.

12.1.2.1 The pressure chamber or pump cylinder or tank shall not show any leakage or deformation during this lest.

12.2 Test for operating lever, Handle and Piston Rod

The test shall be conducted in case of knapsack sprayer, piston type.

12.2.1 The discharge outlet of the spray shall be closed that is, no discharge shall be operated to develop the pressure and the handle shall be operated to develop the pressure in the sprayer until a pressure of minimum two and a half times the normal working pressure is developed. (In case it is not possible to develop the minimum pressure of two and a half times the normal working pressure by the operation or handle, the pressure shall be developed in the sprayer from any other source).

12.2.2 When the handle, operating lever and piston rod are operated at this pressure these shall not distort, crack or break.

12.3 Test for Gasket and Piston Made up of Synthetic Material

12.3.1 All the gaskets/piston in the sprayer shall be immersed in it test mixture of 60 percent kerosene, 5 percent benzene, 20 percent toluene and 15 percent xylene for a period of 72 hours at a temperature of 27 °C to 33 °C and then dried in air at the same temperature range for 24 hours. The gaskets/pistons then be placed in their original positions.

12.3.2 The sprayer complete with its discharge line shall be operated at its normal working conditions for one hour.

12.3.3 The gaskets/piston fitted at the points shall not show any leakage during the test.

NOTE — This test shall be conducted at the end of all the tests with new set of gaskets/ pistons.

12.4 Test for Hose and Hose Connection

The inlet of the hose shall be connected to a hydraulic pump through hose connection. The other end of the hose shall be connected to the appropriate cut-off device. The outlet of the cut-off device shall be dosed, that is, no discharge is allowed. A minimum hydrostatic pressure of 1.5 MPa, using

water as a liquid, shall be developed in the host assembly and the pressure shall be retained for a period of 1 minute.

12.4.1 The hose and hose connection shall not show any leakage, crack or breakage during the test.

NOTES

1 Test for hose and hose connection, cut-off device and lance may be conducted at a time.

2 The gaskets and piston test shall be conducted with a new set of gaskets and piston provided with sprayer.

12.5 Test for Pressure Development

This test shall be conducted for compression knapsack sprayer non-pressure retaining type.

12.5.1 The discharge outlet of the sprayer shall be plugged.

12.5.2 The tank shall be filled up to two-thirds of its capacity with dean water.

12.5.3 A pressure gauge (*see* IS 3624) having full scale reading from 0 to not exceeding 2.5 times and not less than 1.5 times the pressure (normal working pressure of the sprayer) to be read shall be fitted on the tank.

12.5.4 The handle of the sprayer shall be operated continuously up to maximum of 100 strokes.

12.5.5 The pressure developed in the tank shall be read in the pressure gauge and recorded.

12.5.6 The above test shall be repeated for a minimum of four times and average value reported.

12.6 Test for Tank and Skirt Impact

12.6.1 This test shall be conducted in case of compression knapsack sprayer.

12.6.2 The tank shall be filled with clean water up to two-third of its capacity and pressurized pneumatically to the normal working pressure of the sprayer.

12.6.3 The tank shall be allowed to drop for total number of 25 times from a height of 600 mm in following positions as shown in Fig. 6:

a) Seven times with its longest axis horizontal and the lance brackets, if fitted, positioned to break the fall;
b) Six times with the long axis vertical and the skirt positioned to break the fall;
c) Six times with the long axis inclined at 75° to the horizontal and a section of skirt positioned to break the fall; and
d) As in (c) above with the position of impact diametrically opposite.

12.6.4 The platform on which the tank is dropped shall consist of a plain solid teak or similar hard wood plank or 60 mm thickness, placed on a hard level surface.

12.6.5 Caution shall be exercised in performing this test to avoid possible injury due to explosion of the tank. A metal cage shall be constructed to enclose the tank during drop.

12.6.6 During and after the above test, the following shall not occur:

a) Neither the bottom of the tank nor any other part or the sprayer shall extend below the bottom of the skirt; and
b) The tank shall not burst.

12.7 Test for Tank Fatigue

12.7.1 This test shall be conducted for tank of compression knapsack sprayer.

12.7.2 The pump assembly and the discharge line shall be taken out from the sprayer.

12.7.3 An opening of the tank shall be connected to the manifold through a hose and a shut-off cock (*see* Fig. 7).

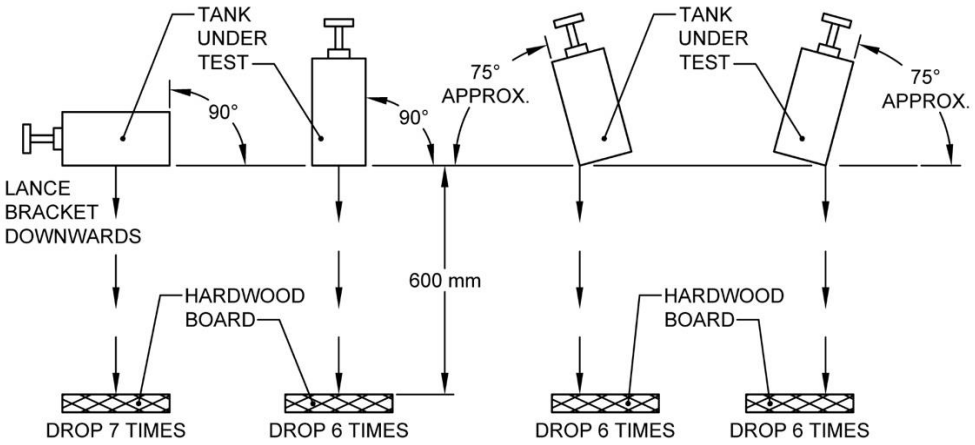

FIG. 6 IMPACT (DROP) TEST

12.7.4 The tank under test shall be completely filled with clean water.

12.7.5 The opening of the tank, other than the one to which hose is connected, shall be sealed.

12.7.6 The manifold shall be filled with clean water through the filler hole to a point within approximately 20 cm of the filler hole. The water level in the manifold may be checked by observing the flow of water from the linings. The filler hole and the vent fittings of the manifold shall be plugged.

12.7.7 Air pressure, from a power-driven compressor and reservoir, equal to the normal working pressure of the sprayer within a range of ± 10 percent shall be applied to the top of the manifold through an air filter or pressure regulating valve or air lubricator and an electrically operated three way valve (*see* Fig. 7).

12.7.8 A timer switch shall also be connected in the circuit to open and close the three way valve within a range of 3 times to 5 times a minute.

12.7.9 When electric energy is applied to the three way valve, compressed air flows from the source into the manifold at a pressure determined by the setting of the regulating valve. When the valve is de-energized, the air flows out of the manifold to the atmosphere.

12.7.10 The tank shall be subjected to 1 200 such pressure cycles. A counter may be connected in the circuit to indicate the number of pressure cycles.

12.7.11 The tank shall not show any leakage, cracks or deformation during the test.

12.8 Test for Valve Assembly

This test shall be conducted for compression non-pressure retaining type knapsack sprayers.

12.8.1 The piston rod with piston assembly shall be taken out.

12.8.2 The discharge outlet shall be connected to a hydraulic pump through hose connection (*see* Fig. 8).

12.8.3 The opening other than the discharge outlet shall be sealed.

12.8.4 The tank shall be pressurized to a static hydraulic pressure of minimum two and a half times the normal working pressure of the sprayer and the pressure is retained for a period of 2 minutes.

12.8.5 The valve assembly shall not show any drop-in pressure observed during the test.

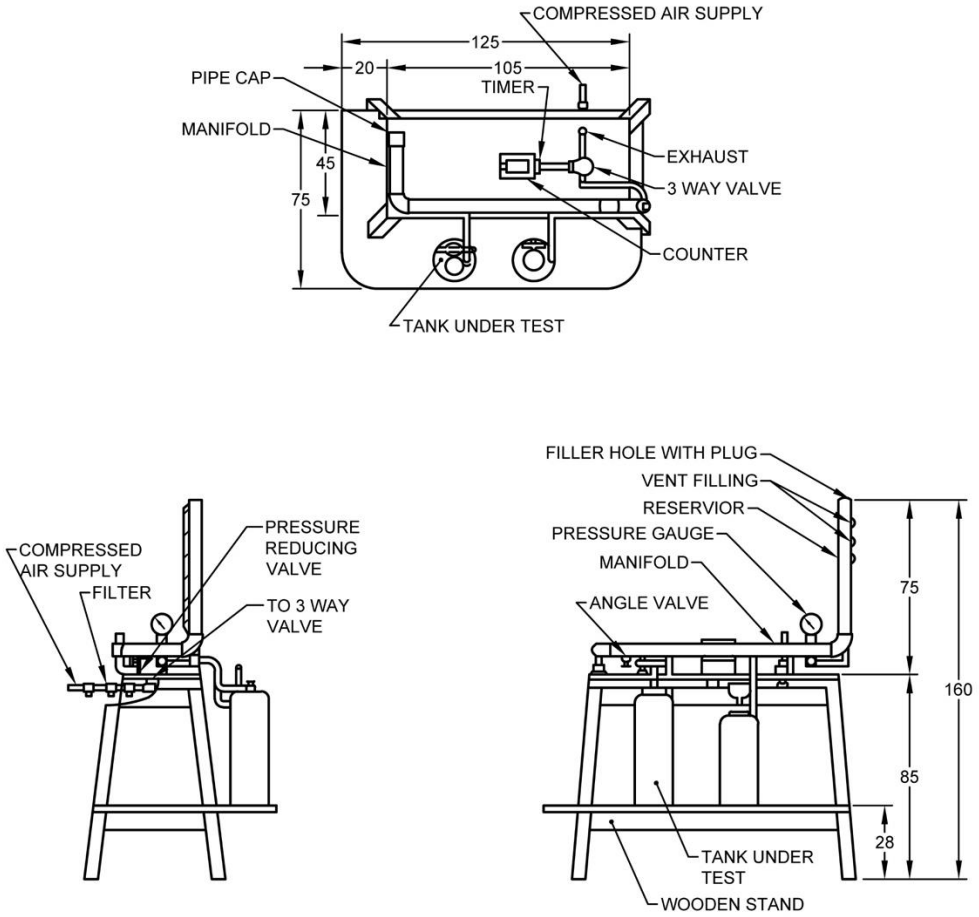

FIG. 7 TEST APPARATUS FOR DETERMINATION OF FATIGUE FAILURES IN COMPRESSION — SPRAYER TANKS

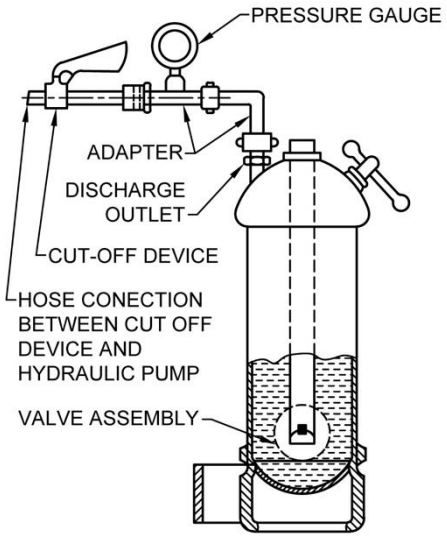

FIG. 8 VALVE ASSEMBLY LEAKAGE TEST

ANNEX A

(*Foreword*)

SPECIFICATION SHEET

a) Name of the manufacturer/importer (*see* **4**)

b) Preference of material for various comportments (*see* **4.1** and Table 1)

c) Tank capacity (*see* **6.1**)

d) Type of cut-off device (*see* **6.14**)

e) Type of lance (*see* **6.14**)

f) Type of nozzle (*see* **6.15**)

g) Length of delivery hose (*see* **6.13**)

h) Filling funnel (*see* **6.3.2**)

j) Spare parts (*see* **7.2**)

m) Optional items (*see* **7.3**)

ANNEX B

(*Clause* 6.14)

HAND-OPERATED CUT-OFF DEVICE

B-l TYPES

The cut-off device shall be of the following types (*see* Fig. 9 and Fig.10):

a) Trigger type (Type A); and
b) Knob type (Type B).

B-2 DIMENSIONS

B-2.1 The cross-sectional area of passage in valve body for liquid shall not be less than 12.0 mm^2.

B.2.2 The diameter of the valve stem shall be minimum 5 mm.

B-2.3 The length of the operating trigger, in Type A cut-off device, from the pivot axis shall be minimum 100 mm.

B-3 STRAINER

B-3.1 The cut-off device may be provided with a strainer on its outlet side, the flow of the liquid through strainer shall be from outward to inward.

B-3.2 The strainer area shall not be less than 1 000 mm^2.

B-3.2.1 The average size of any sides or diameter of apertures of the strainer shall not be more than 450 µm.

NOTE — For measuring the size of apertures, select 10 consecutive apertures in the strainer and measure each side or diameter as the case may be. Average the measured value and report.

B-4 END-FITTINGS

B-4.1 The inlet end-fitting of the cut-off device for connecting the delivery hose, shall be nipple type or thread type. The length of the nipple shall not be less than 20 mm.

B-4.2 The outlet end-fitting of the cut-off device for connecting the lance shall be of thread type.

B-5 GASKETS

B-5.1 End fitting of thread type shall be provided with gaskets. If fitted to the external thread, it shall be recessed for at least one third of its thickness. Where fitted to internal thread, it shall at no time obstruct the passage of the liquid.

B-6 OPERATING TRIGGER/KNOB

B-6.1 The operating trigger in Type A cut-off device

shall be attached with valve stem. A locking device shall be fitted which may be in the form of ring sliding over the trigger when the valve is in open position.

B-6.2 When tested in accordance with the method given in **B-6.2.1** the maximum torque required for trigger actuation shall not be more than 3.5 Nm (35 kgf.cm).

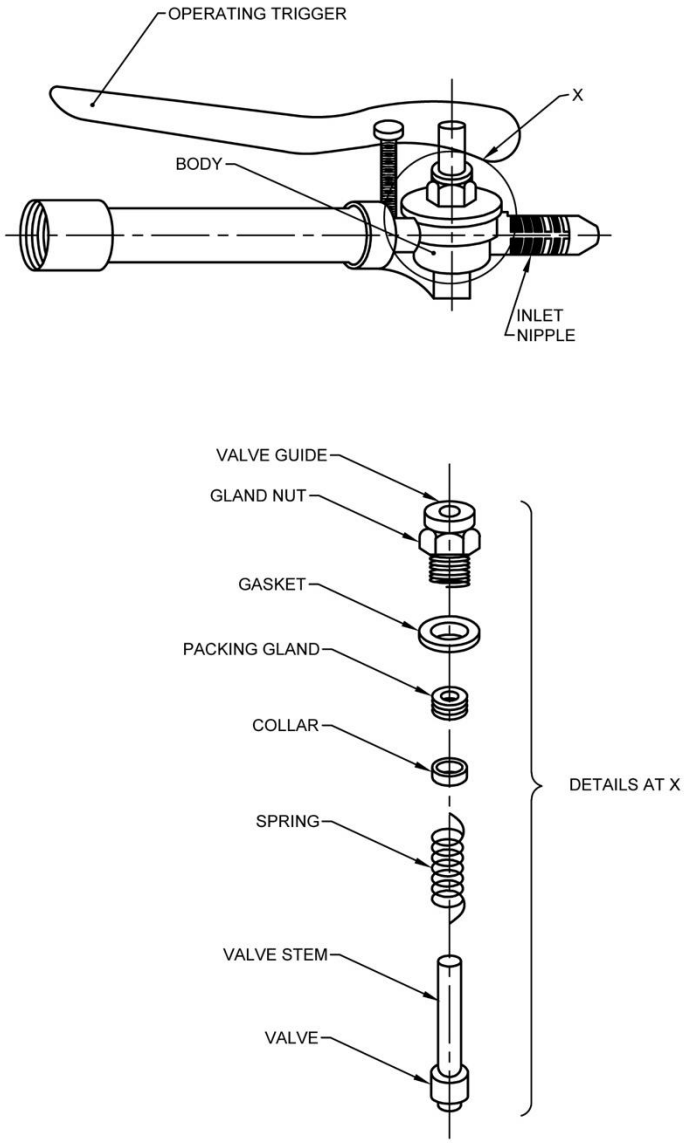

FIG. 9 TRIGGER TYPE (TYPE A) CUT-OFF DEVICE

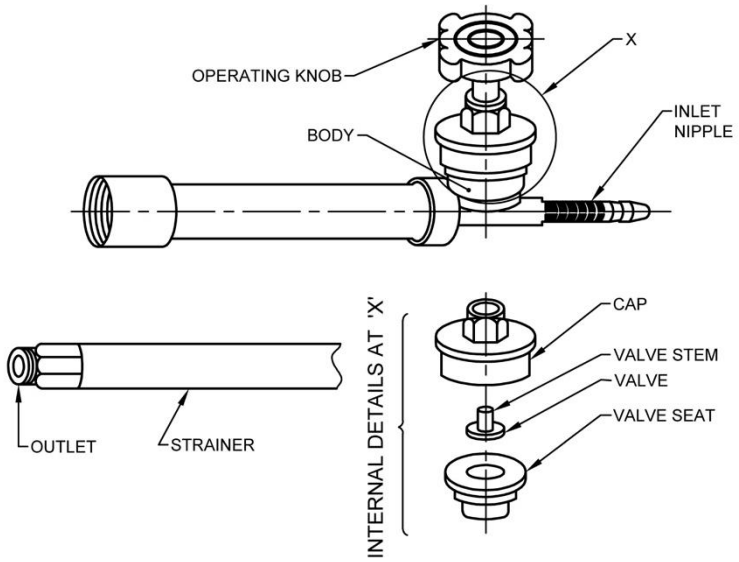

FIG. 10 KNOB TYPE (TYPE B) CUT-OFF DEVICE

B-6.2.1 A suggestive arrangement for measuring the torque required to activate the cut-off device is shown in Fig. 11. The procedure for measurement is as given below:

a) The cut-off device shall be mounted on a support rigidly.

b) A U bolt or other arrangement should be made for putting the weight at the rear most free end of the trigger.

c) The distance (D) between the pivot point and the point of hanging or bolt or similar arrangement shall be measured.

d) The weight of known mass shall be applied gradually till the point of application of trigger reaches from its highest position to the lowest possible position. Carefully observe the actions while reaching the lowest possible position. Calculate the total weight (W) by adding the mass of the weights and the mass of the bolt or arrangement on which the weights were added.

e) The torque shall be calculated by multiplying D and W.

f) The test shall be repeated and the average value in Nm (kgf.cm), shall be reported.

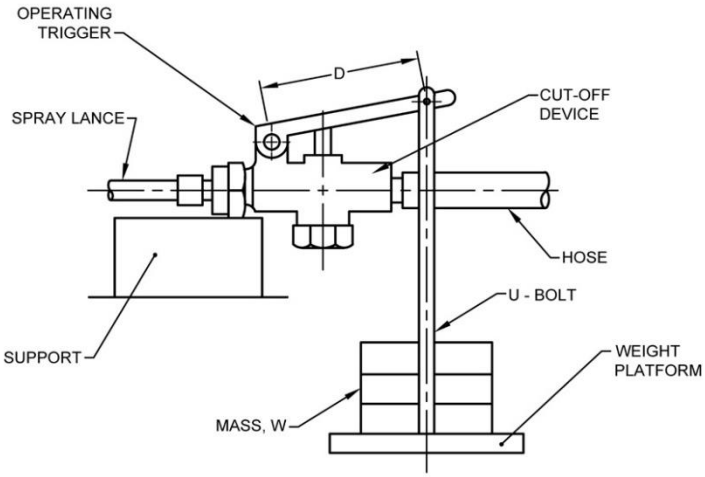

FIG. 11 ARRANGEMENT OF TRIGGER ACTUATION TEST

B-6.3 The operating knob in Type B cut-off device shall be suitably shaped for convenient handling.

B-7 TESTS

The cut-off device shall withstand the strength, leakage and reliability test as given in **B-7.1** and **B-7.2**.

B-7.1 Strength Test of Cut-off Device

B-7. l.1 The inlet of the cut-off device shall be attached with a delivery hole and shall be coupled to a hydraulic pump.

B-7.1.2 The outlet of the cut-off device shall be closed, that is, no discharge shall be allowed from the device.

B-7.1.3 A hydraulic pressure of minimum 750 kPa shall be applied at the inlet of the device. The pressure shall be maintained for a period of 5 minutes.

B-7.1.4 During this test, the cut-off device shall not crack or burst.

B-7.2 Leakage and Reliability Test

B-7.2.1 *Test Apparatus*

The test apparatus shall be vibration free and shall be so arranged that the valve of cut-off device can be activated at a speed of not more than 15 cycle per minute.

B-7.2.1.1 A typical test apparatus for trigger type cut-off device is given in Fig. 12 and Fig. 13. The dimensional and other details of cam follower and cam follower assembly except for cams given in Fig. 13 are for guidance purpose only. The Cam 1 in Fig. 13 shall be used for operating the cut-off device. Cam 2, it provided on it may be used to operate a timing switch for counting the number of cycles.

B-7.2.1.2 A typical test apparatus for knob type cut-off device is given in Fig. 14.

B-7.2.2 *Test Liquid*

The test liquid shall consist of a 5 percent suspension of any commercially available water dispersible powder.

B-7.2.2.1 The test liquid shall be changed after every 6 months of use.

B-7.2.3 *Test Method*

B-7.2.3.1 The cut-off device or spray gun shall be rigidly mounted on the appropriate test apparatus.

B-7.2.3.2 A spray nozzle or an orifice plate designed to deliver liquid approximately 0.75 litre per minute at a pressure of 300 kPa ± 30 kPa shall be attached at the outlet of the device. The nozzle or orifice may discharge the liquid directly or through appropriate piping into reservoir from which the liquid is recycled.

B-7.2.3.3 The test liquid shall be applied to the inlet of the cut-off device or spray gun under a static pressure of 300 kPa ± 30 kPa or 600 kPa ± 60 kPa respectively. The cut-off device or spray gun shall be operated for 5 000 cycles at a speed of approximately 15 cycles per minute.

B-7.2.3.4 After operating for 5 000 cycles, the test shall be repeated for 500 cycles at a pressure of 600 kPa ± 60 kPa for cut-off device and at 1 200 kPa ± 120 kPa for spray gun.

B-7.2.3.5 The cut-off device or spray gun shall not drip or leak through the valve during the test.

B-8 MARKING

Each cut-off device shall be marked with the following particulars:

a) Manufacturer’s name or recognized trademark; and

b) Batch or code number.

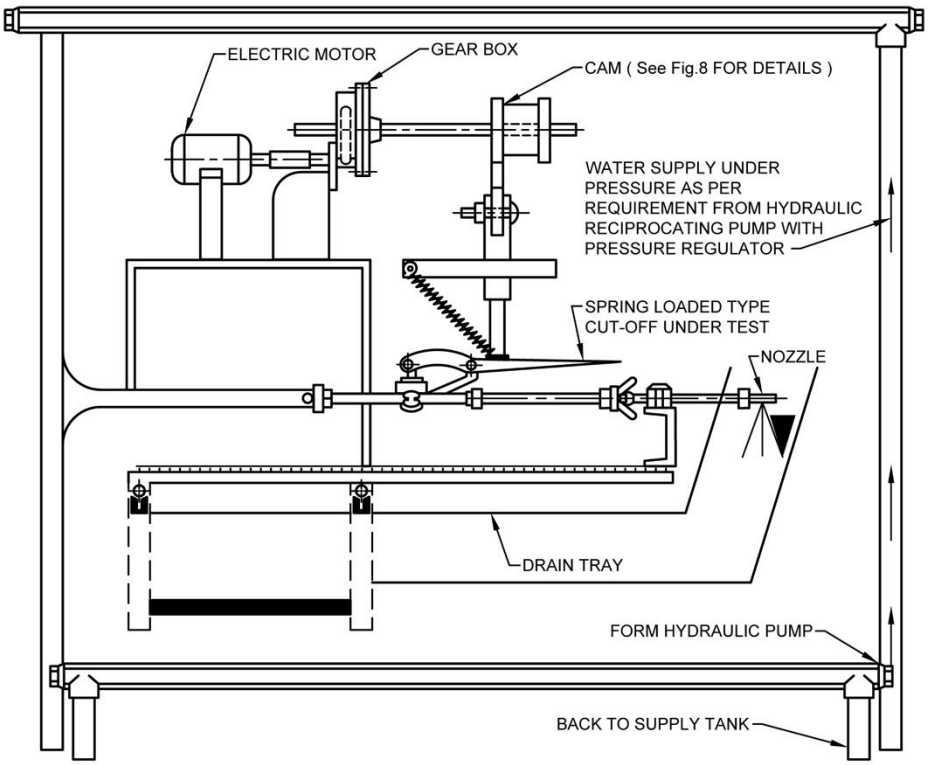

FIG. 12 TRIGGER TYPE CUT-OFF DEVICE DURABILITY TESTER (SCHEMATIC)

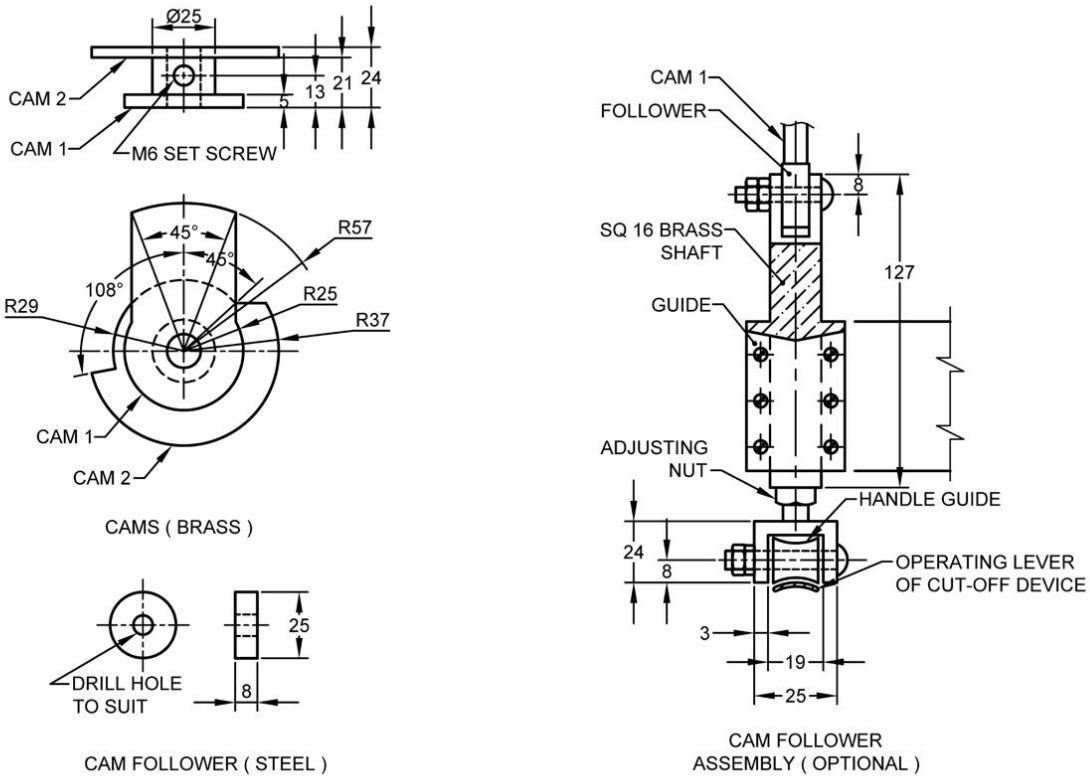

FIG. 13 DETAILS OF CAMS AND CAM FOLLOWER OF DURABILITY TESTER FOR TRIGGER TYPE CUT-OFF DEVICE

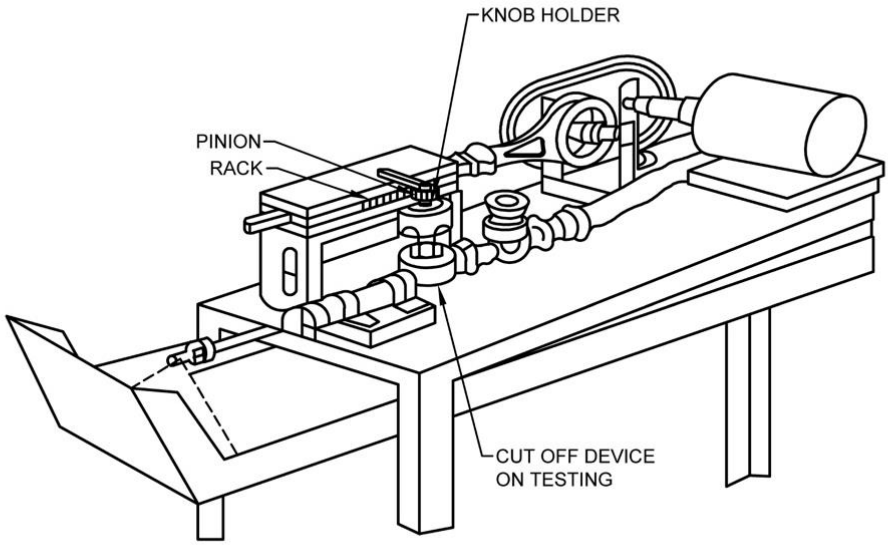

FIG. 14 KNOB TYPE CUT-OFF DEVICE DURABILITY TESTER (SCHEMATIC)

ANNEX C

(*Clause* 6.14)

SPRAY LANCE

C-1 TYPES

The lance shall be of following types (*see* Fig.15):

a) Straight type (Type A); and
b) Gooseneck type (Type B):
   1) Single piece (Type B_1); and
   2) Two piece (Type B_2)

C-2 MATERIALS

C-2.1 Brass or stainless steel or plastic tube shall be used. The material for end-fittings shall be the same as that of the tube.

C-3 DIMENSIONS

C-3.1 Minimum thickness of the wall of the tube forming the lance shall be as given below:

a) Brass tube – 0.60 mm; and
b) Plastic tube – 3.0 mm.

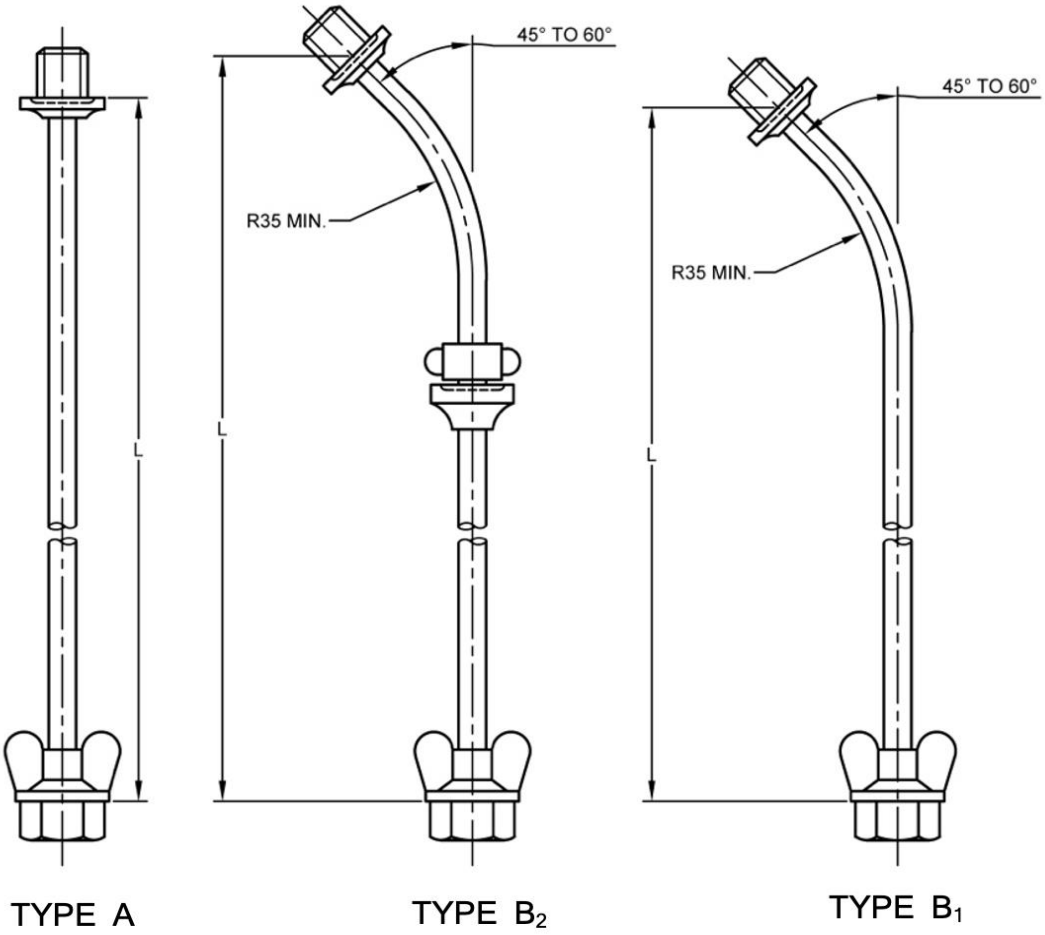

FIG. 15 LANCE

C-3.2 Internal diameter of the tube shall not be less than 6 mm.

C-3.3 When measured vertically from sealing face to sealing face, as shown in Fig. 15 the nominal length of the lance shall be in between 500 mm and 900 mm ± 2.5 percent.

C-3.4 At least three-quarter length of Type B lance shall be straight and then provide a bent to the remaining length, a radius of not less than 35mm at an angle of 45º to 60º (*see* Fig. 15).

C-4 OTHER REQUIREMENTS

C-4.1 The lance shall be of a seamless construction. The both end-fittings shall be attached to the lance tube.

C-4.2 The sealing face of the end-fittings shall be flat. In case of straight lance, the end-fitting on the cut-off device side shall have hexagonal or flattened faces; knurled faces or wing-nuts of adequate shape and size may also be provided.

C-4.3 The lance shall withstand the test given in **C-4.3.1**.

C-4.3.1 The inlet of the spray lance shall be attached to a hydraulic pump directly or through a delivery hose. The outlet of the lance shall be closed, that is, no discharge shall be allowed from the lance. A hydraulic pressure of 1 MPa or two-and-half times of the normal working pressure of the sprayer (for which the lance is meant), whichever is more, shall be applied to the lance up to a period of 5 minutes. During this test, the lance shall not leak, crack or burst.

NOTE — In case of the information about the sprayer for which the lance is not known, the pressure of 1 MPa shall be applied.

C-5 MARKING

The lance shall be marked with the following particulars:

a) Manufacturer's name or recognized trade-mark; and
b) Nominal length.

ANNEX D

([*Clause* 6.15 *and* D-3.3])

HYDRAULIC SPRAY NOZZLE

D-1 TYPES

D-1.1 On the basis of spray distribution, the nozzles shall be of the following types:

a) Hollow Cone Type (*see* Fig. 16);
b) Fan Type (*see* Fig. 17); and
c) Adjustable type:
   1) Double action type (*see* Fig. 18); and
   2) Triple action type (*see* Fig. 19).

D-1.2 On the basis of the method of attachment, the nozzles shall be of the following types:

a) Fixed type; and
b) Swivel type.

D-2 DESCRIPTION

D-2.1 The nozzle may consist of various components as shown in their respective figures.

D-2.1.1 A tangential velocity in the liquid emerging from cone nozzle orifice could be obtained either by passing it through a tangential or a helical slot in a swirl core or by sending it tangentially in the swirl chamber. Liquid is discharged from the orifice as a hollow cone of spray drops (*see* Fig. 19). Some nozzles of this type are adjustable producing any spray patterns from straight jet to wide angle hollow cone. The degree of atomization is governed by the relative sizes or swirl core and nozzle orifice.

D-2.1.2 Fan nozzles produce a spray pattern in the form of the flat sheet. Generally, the nozzle tip has a narrow hole, which is especially shaped to curve inward towards its axis thus narrowing in immediately behind the orifice. The hole in nozzle is either rectangular or more commonly ventricular in shape. The size of the orifice governs the discharge rate at may give pressure.

D-2.1.3 In case of an adjustable nozzle the liquid if discharged from the nozzle orifice in the form of cone spray or jet spray of any pattern upon the axial adjustment of the spindle or body. The swirl core may be integral part of the tip or separately attached.

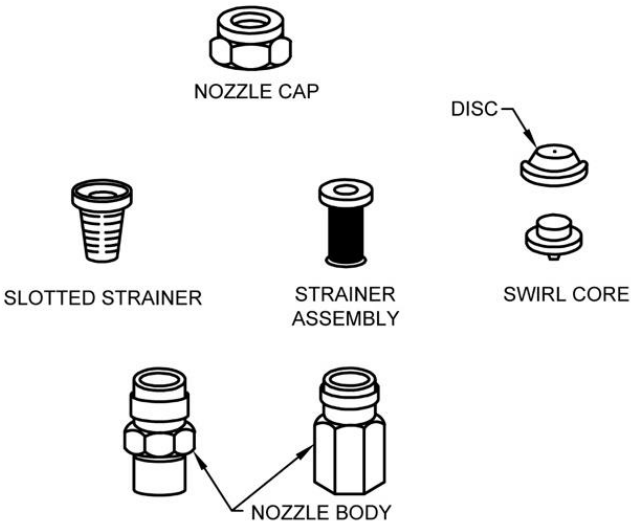

FIG. 16 CONE NOZZLE SHOWING PARTS

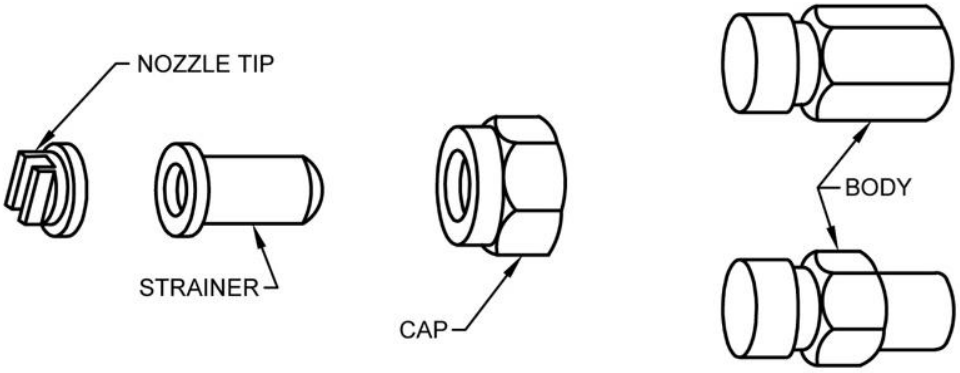

FIG. 17 FAN NOZZLE SHOWING PARTS

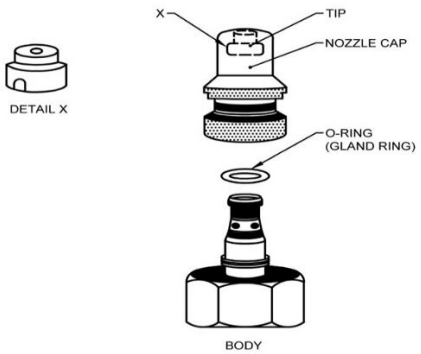

FIG. 18 DOUBLE ACTION NOZZLE

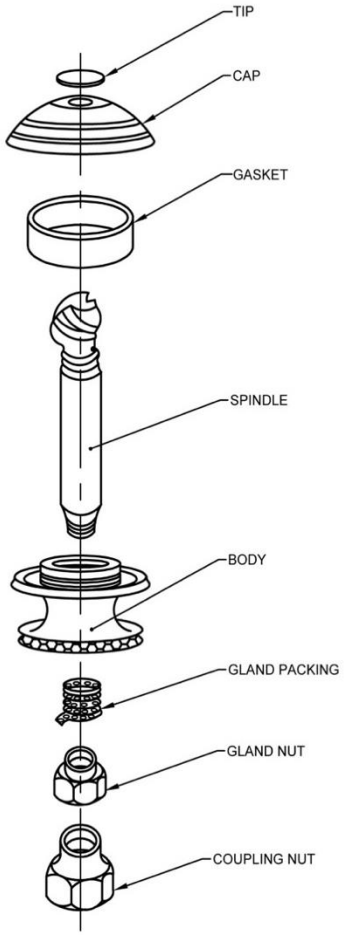

FIG. 19 TRIPLE ACTION NOZZLE

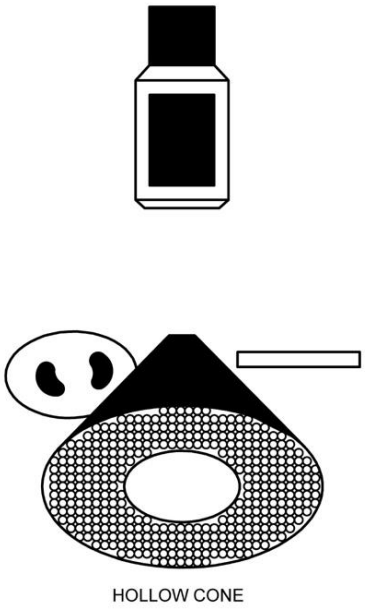

FIG. 19 CONE OR SWIRL NOZZLE

D-3 PERFORMANCE REQUIREMENTS

D-3.1 Rate of Discharge

D-3.1.1 The discharge rate of the nozzle shall be declared by manufacturer. In case of an adjustable nozzle, the declared value shall be for extreme adjustment for cone and jet spray pattern at a pressure of 300 kPa.

D-3.1.2 When tested in accordance with D-7, the nozzle shall provide a rate of discharge as given in Table 3. The rate of discharge shall be within ± 5 percent for fixed type and ± 10 percent for adjustable type nozzles of the declared value.

D-3.2 Spray Angle

The spray angle of the nozzle shall be declared by the manufacturer. The angle when tested in accordance with the method given in D-9 shall not differ by ± 3° for fixed type and ± 5° for adjustable type nozzles from the declared value.

D-3.3 Endurance Test

The hydraulic spray nozzle when tested in accordance with D-8 and D-9 at a pressure of 300 kPa ± 30 kPa after operating for 48 h duration with continuous stretches of 6 h, variation in discharge rate and spray angle from initial values should not be more than 5 percent and 3° respectively.

D- 4 OTHER REQUIREMENTS

D-4.1 If strainer is provided the average size of any side or diameter of the apertures shall not be more than 450 µm.

NOTE — For measuring the size of apertures, select 10 consecutive apertures in the strainer and measure each side or diameter as the case may be. Consider average of the measured values and report.

Table 3 Rate of Discharge of Nozzles

(*Clause* D-3.1.2 *and* D-5.1)

Sl No.	Normal Discharge Rate in ml/min at Pressure of	
	75 kPa	300 kPa
(1)	(2)	(3)
i)	150	225
ii)	200	300
iii)	225	337
iv)	300	400
v)	337	450
vi)	400	600
vii)	450	675
viii)	600	800
ix)	675	900
x)	900	1 200
xi)	1 200	1 350
xii)	1 350	1 800
xiii)	1 800	2 400
xiv)	2 700	2 700
xv)	3 600	3 600
xvi)	4 500	4 500

NOTE — The nozzle for public health purpose and agricultural purpose would be tested at 75 and 300 kPa respectively.

D-4.2 At the option of the purchaser, the provision shall be made for rotating of nozzle by hand to make it swivel type.

NOTE — With swivel arrangement, it is possible to adjust the nozzle to spray in any direction without changing the position of lance or boom (*see* Fig. 20).

D-5 DESIGNATION

D-5.1 The cone and fan nozzle shall be designated by its identification mark [A for agricultural use and B for public health use (*see* NOTE in Table 3)], spray angle and discharge rate. An adjustable nozzle shall be designated by identification mark AN–C–J for cone and jet spray pattern and discharge rate at a controlled pressure of 300 kPa.

Examples:

A nozzle for agricultural use giving 90° spray angle with discharge rate of 300 ml/min shall be designated as: A 90 300.

A nozzle for public health use living 80 ° spray angle with discharge rate of 900 ml/min shall be designated as: B 80 900.

An adjustable nozzle capable of giving 60° spray angle with discharge rate of 600 ml/min during extreme adjustment of cone spray and discharge rate of 1 800 ml/min during jet spray at a controlled pressure of 300 kPa shall be designed as: AN–C 60 600–J 1 800.

D-6 WORKMANSHIP AND FINISH

D-6.1 The components of the spray nozzle shall be free from burrs and other defects; this applies particularly to the internal surfaces and especially to the orifice.

D-6.2 The mating faces of the cap, tip and nozzle body or boss shall be finished flat so as to seal on the end face of the nozzle body or boss; a gasket may be used, if necessary.

D-6.3 The screw threads shall be well formed and the crests of the threads shall be free from burrs or any other defects which may prevent free engagement.

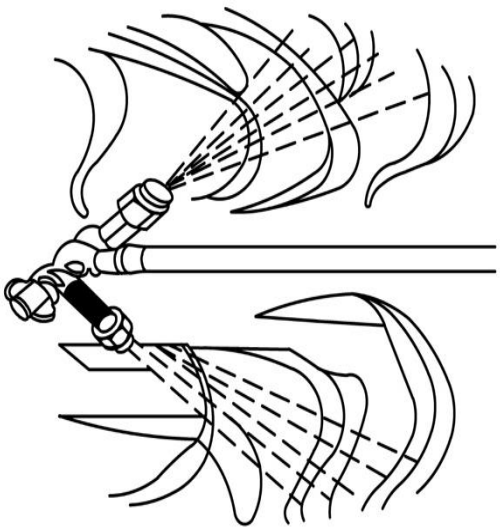

FIG. 20 NOZZLE WITH SWIRL ARRANGEMENT SPRAYING UNDER LEAF

D-7 METHOD OF TEST FOR DISCHARGE RATE

D-7.1 The nozzle under test, shall be connected to a supply of clean water or spray materials which are equal in density, surface tension and viscosity of water. The water or spray material shall be under a controlled pressure of 75 kPa or 300 kPa or 600 kPa (as the case may be) with the pressure gauge (*see* IS 3624). The pressure gauge shall be positioned immediately before the nozzle and shall have full scale reading of pressure from 0 to not exceeding 2.5 times, not less than one time, that is to be read. The fluctuation of the pressure during the test shall not be more than 10 percent from the controlled pressure.

D-7.2 Turn on the supply and adjust the pressure and direct the spray for a period timed by stopwatch, into receiving vessel so designed as to collect whole of the spray from the nozzle. The period shall not be less than 60 seconds or not less than the time required to discharge 500 ml, whichever is higher.

D-7.3 Direct the spray away from the vessel and turn off the supply. Measure the volume of the water or the spray material collected and calculate the discharge rate per minute.

D-7.4 Repeat the above test for at least four times and obtain average rate of discharge per minute.

D-8 METHOD OF TEST FOR SPRAY DISTRIBUTION

D- 8.1 Apparatus

D-8.1.1 *Patternator*

The Patternator (*see* Fig. 21) normally consist of 16 channels each 25 mm ± 0.5 mm wide and of any convenient length provided that it encompasses the area of the spray. The number of channels may be increased or decreased so that the whole of the spray falls within the patternator. The channels guide the liquid directly to the measuring tube with maximum bore diameter of 24 mm and be long enough to hold minimum of 200 ml test liquid. The depth of channels shall be at least 50 mm and shall have provision to avoid rebound of the spray droplets. The top edge of the trough dividers shall be round (tapered to 2.0 mm ± 0.5 mm on the top edge) and straight in the horizontal plane, so that no point along with the edge lies more than 1 mm from the straight line joining the corresponding point at each end. The top edges of the dividers shall be positioned so that when a straight edge is laid across the full width of the front and back of the troughs no edge lies more than 1 mm below this. Each divider shall be straight in the vertical plane to within ± 0.5 mm.

NOTE — The surface of patternator should be such that the droplets should not stick on it.

D-8.1.2 A compressed air supply or small pump giving a steady output, with a liquid supply line from the reservoir of capacity two litres or more.

D- 8.1.3 A constant pressure regulator and a pressure gauge should be installed as close to the nozzle as possible.

D-8.1.4 Establish a suitable means of holding the nozzle at the appropriate height with the required facilities for adjustments.

D-8.1.5 A test tube rack so made that the collecting tube can be inserted in the flow when constant flow has been achieved, and retracted after a predetermined period.

D-8.2. Method

D-8.2.1 Carry out the test directing spray, at standard rate of discharge and standard pressure, from the nozzle on the patternator protected by screens from draughts.

D-8.2.2 In the case of fan spray nozzles, mount the nozzle so that the axis of spray sheet is right angle to the upper surface of the trough divisions on the patternator and the nozzle tip at a height of 545 mm above the trough division. In case of cone nozzle, mount the nozzles so that axis of its spray cone is at right angles to the upper surface of the trough division on the patternator and the nozzle tip at a height of 545 mm above trough divisions.

D-8.2.3 Test the cone spray nozzle in three different positions of nozzles, namely, 90°, 180° and 270° (*see* Fig. 22).

D-8.2.4 The total amount of liquid sprayed for each individual test shall be about one litre.

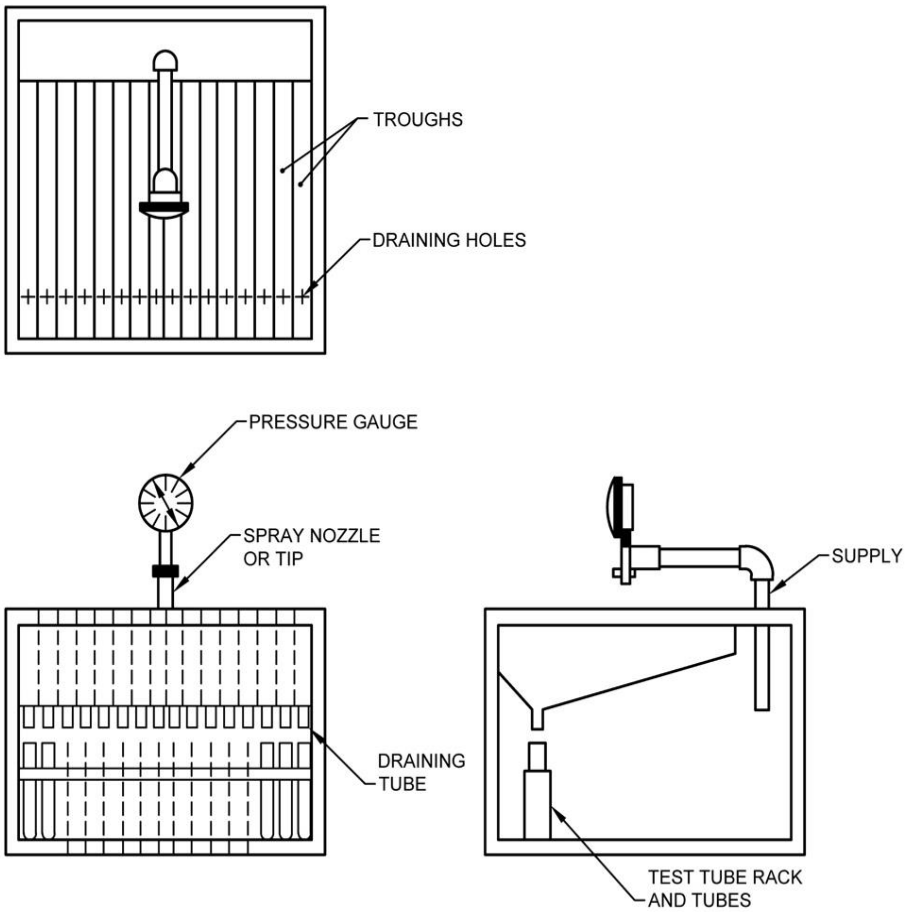

FIG. 21 PATTERNATOR FOR SPRAY DISTRIBUTION TEST

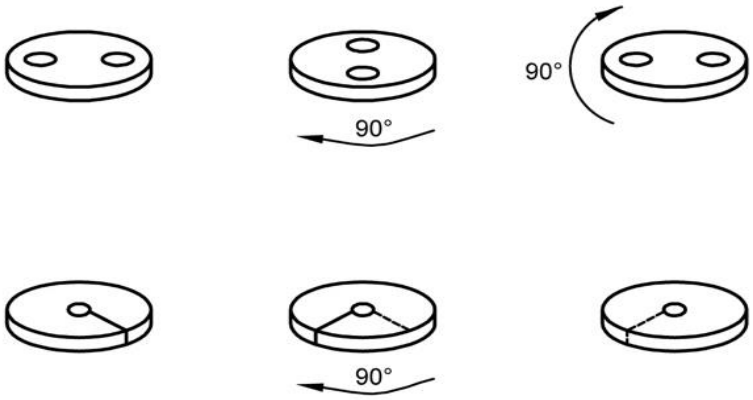

FIG. 22 TEST POSITION FOR CONE SPRAY NOZZLE

D-8.2.5 As soon as the amount collected in any of measuring tube has reached 180 ml, collection is discontinued taking care that no water from the patternator fall into any of measuring tubes.

D-8.2.6 The volume of the water in each measuring tube shall be determined and a graph prepared by plotting the volume of water in each tube against its position in the patternator (*see* Fig. 23 and Fig. 24).

D-9 METHOD OF TEST FOR SPRAY ANGLE

D-9.1 Carry out test at a place protected from draughts. Mount the nozzle on the test rig as shown in Fig. 25. Connect the nozzle to supply of clean water. A pressure gauge having full scale reading of pressure not exceeding 2.5 times or not less than 1.5 times of the pressure to be read, shall be connected immediately before the nozzle.

D-9.2 Commence the spray at a controlled pressure of 75 kPa or 300 kPa or 600 kPa (as the case may be) within the fluctuation of ± 10 percent. Adjust the arms of the protector as shown in test rig (*see* Fig. 25) so as to coincide with the clearly visible straight boundary lines of the nozzle spray pattern as shown in Fig. 26. Read the spray angle directly on the protractor and round it off in whole degree.

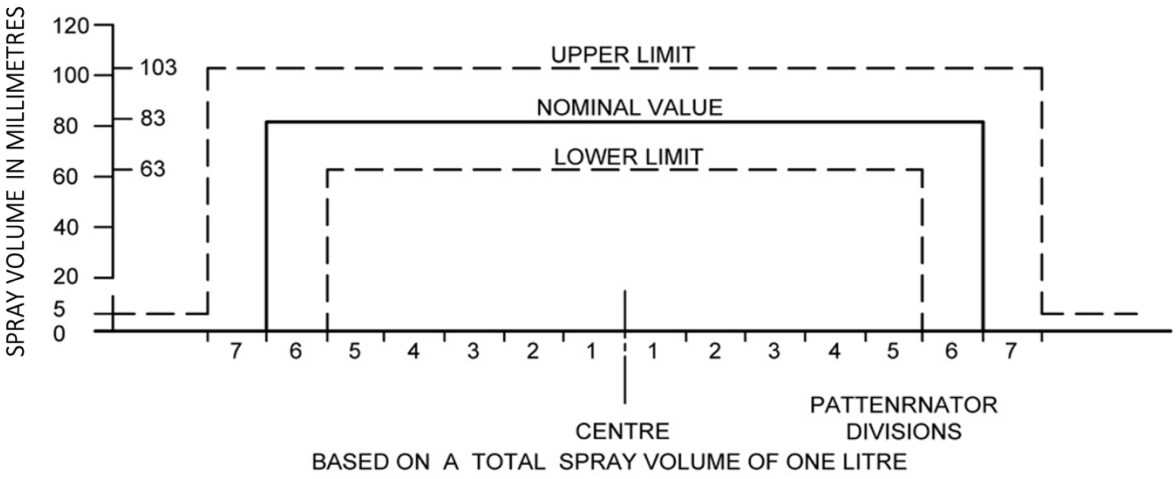

FIG. 23 RECTANGULAR DISTRIBUTION LIMITS

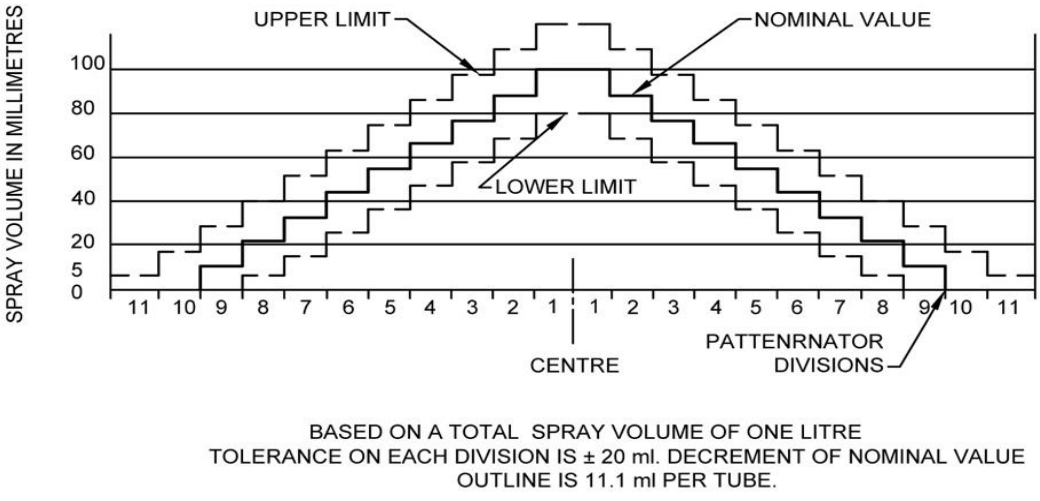

FIG. 24 TRIANGULAR DISTRIBUTION LIMIT

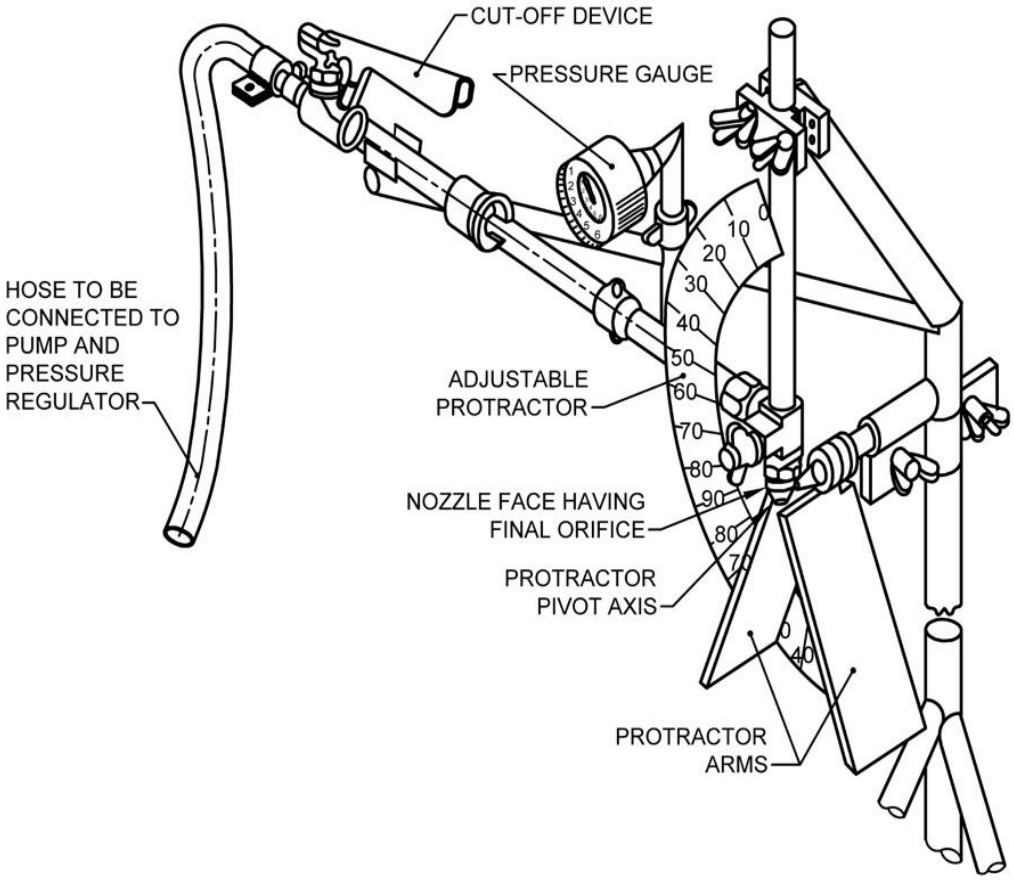

FIG. 25 TEST RIG FOR MEASUREMENT OF NOZZLE SPRAY ANGLE (SCHEMATIC)

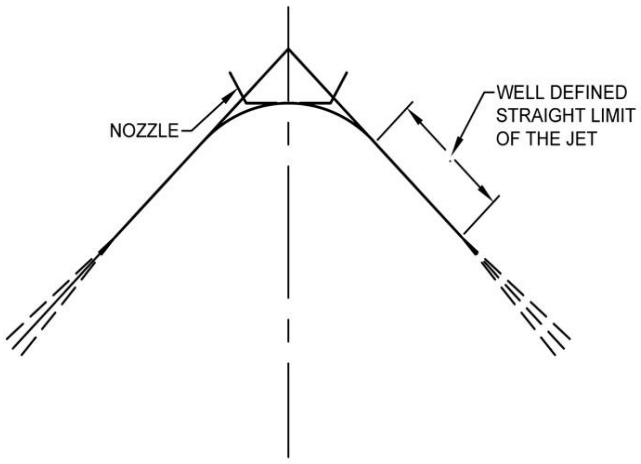

FIG. 26 DIAGRAM OF THE PRINCIPLE FOR MEASURING SPRAY ANGLE

D-10 METHOD OF TEST FOR VARIATION IN DISCHARGE AND DISTRIBUTION DUE TO ABRASION AND CORROSION

D-10.0 This test does not prejudge the life of a nozzle in the actual conditions of use, but is used to compare the resistance of wear of the nozzle and result of deterioration in the distribution.

D-10.1 Test Liquid

D-10.1.1 Clean water with the addition of 20 g/l of abrasive or corrosive material shall be used as a test liquid. The abrasive material may be a synthetic silica powder of following chemical and physical properties:

D-10.1.2 Ensure that the abrasive material is always well dispersed throughout the liquid. This may be done by means of controlled escape of compressed air with such a pressure so that after 5 minute of operation, no deposit of abrasive material is left at bottom of tank.

D-10.1.3 Ensure if needed by preliminary tests that the liquid retains its effectiveness in relation to the material of nozzle throughout the duration of the test defined in D-10.2. If it does not, replace the abrasive liquid as often as necessary.

NOTE — It is possible to proceed using identical metering orifices from the same batch made from a suitable material in relation to nozzle being tested, measuring the increase in discharge rate after passing through a given volume of the test liquid at a specified pressure.

D-10.1.4 The temperature of the test liquid as all be 20 ºC ± 3 ºC throughout the test.

D-10.2 Method

D-10.2.1 Measure the discharge rate at the beginning of the test at a controlled pressure (the fluctuation shall not be more than ± 10 percent) and then every hour or at a regular interval chosen according to the speed of wear out of nozzle or at discharge of 4 litre intervals. It shall be continued until the nozzle is abraded to the point where the flow increases beyond the allowable limit of 6 percent.

D-10.2.2 Carry out the spray distribution test (*see* D-8) at the beginning and the at the end of the test for about 10 percent, 15 percent and 20 percent of increase in discharge rate if these values are reached.

D-10.3. Result

D-10.3.1 State in the test report the increase in discharge rate thus obtained, shall be expressed as a percentage of the initial discharge rate and as function of test period.

D-10.3.2 Also give spray distribution observed at the various degree of wear indicated in D-10.2.2.

D-11 MARKING

Each nozzle shall be marked with the following particulars:

a) Manufacturer's name or recognized trademark;
b) Nozzle designation (*see* D-5); and
c) Batch or serial number and date.

Sl No.	*Property*	*Requirement*
(1)	*(2)*	*(3)*
i)	Bulk density	160 kg/m^3
ii)	Specific gravity	1.95
iii)	Average particle size	0.02 2 µm
iv)	Colour	White
v)	Refractive index	135-165
vi)	Surface area	140 m^2/g to 160 m^2/g
vii)	*p*H (5 percent water suspension)	7.3
viii)	Loss at 105 °C	5 percent
ix)	Loss at 1 200 °C	10 percent
x)	SO_2 content	87 percent
xi)	CaO content	0.5 percent
xii)	Fe_2O_3 content	0.2 percent
xiii)	Al_2O_3 content	0.6 percent
xiv)	NaCl content	1.0 percent

ANNEX E

(*Clause* 6.14)

HYDRAULIC SPRAY GUN

E-l TYPES

The spray guns shall be of the following two types:

a) Trigger type (*see* Fig. 27); and
b) Screw type (*see* Fig. 28).

E-l DIMENSIONS

E-2.1 The thickness of the wall of the barrel shall be minimum of 0.60 mm.

E-2.2 The diameter of the connecting rod shall be minimum of 5 mm.

E-2.3 The annular clearance between the barrel and the connecting rod shall not be less than 2.5 mm.

E-2.4 The total length of the spray gun when measured from the top of the nozzle to the tip of the trigger or screw shall be less than 500 mm.

E-3 PERFORMANCE AND STRENGTH REQUIREMENTS

E-3.1 Manufacturer shall declare the discharge rate as well as jet spray patterns of the spray gun at a pressure of 600 kPa ± 60 kPa with extreme adjustment for getting fine cone spray.

The discharge rate when tested in accordance with **D-7**, shall be within ± 10 percent of the declared value.

E-3.2 The spray angle of the spray gun at a pressure of 600 kPa ± 60 kPa for extreme adjustment of fine cone spray pattern shall be declared by the manufacturer. The angle, when tested in accordance with the method given in **D-9**, by mounting the gun on test bench, shall not differ by ± 5° from the declared value.

E-3.3 When tested in accordance with the method given in **B-6.2** the maximum torque required in case of trigger type spray gun for triage actuation shall not be more than 7.0 Nm (70 kgf.cm).

E-3.4 The gun shall withstand the tests given in **E 3.4.1** and **E-3.4.2**.

E.3.4.1 *Test for Jet Spray*

A circular area faced with blotting paper, or any other suitable paper shall be kept in a vertical place at a distance of 6 m from the tip of the gun. The place of the testing shall be free from drought. The gun shall be firmly secured horizontally at a height of about 1 m above the ground and it shall be operated at its working pressure (600 kPa ± 60 kPa). The jet spray from gun shall reach the paper.

E-3.4.2 *Test for Strength*

The spray gun shall be connected to a hydraulic pump. Nozzle tip shall be closed, that is no discharge shall be allowed through the nozzle. A hydraulic pressure of 1 500 kPa shall be applied to the gun up to a period of 5 minutes. During this test, the gun shall not leak, crack or bent.

E.3.5 When tested in accordance with the method liven in **B-7.2** no leakage or breakdown shall occur in the spray gun.

E-3.6 Endurance Test

When tested in accordance with **D-7** and **D-9** at the pressure of 600 kPa ± 60 kPa after operating for 48 h duration with 6 h continuous stretch in each setting of the fine cone spray and jet spray pattern, the discharge rate and spray angle observed shall not vary by more than ± 10 percent and ± 5 degree respectively from the initial values obtained before the test.

E-4 OTHER REQIREMENTS

E.4.1 The farthest point of the trigger in case of the trigger type spray gun, shall be at a distance not exceeding 100 mm (to facilitate convenient grip by hand) when the valve is in closed position. When the trigger is pressed for full discharge, it shall have a minimum clearance of 10 mm from to be barrel tube.

E-4.2 A lock shall be provided for locking the trigger in different positions to attain different' spray patterns.

E.4.3 The total mass of the spray gun having length up to 1 000 mm shall not exceed 1.6 kg.

E-5 DESIGNATION

E-5.1 The gun shall be designated by its identification mark AG-C-J for fine cone spray and jet spray pattern, spray angle and discharge at a

nominal pressure of 600 kPa.

Example:

An adjustable spry gun capable of giving 80° spray angle with the discharge rate of 3 500 ml/min during jet spray at nominal pressure of 600 kPa shall be designated as AG-C 80 1 200-J 3 500

E-6 MARKING

Each gun shall be marked with the following particulars:

a) Manufacturer's name or recognized trademark; and
b) Batch or code number.

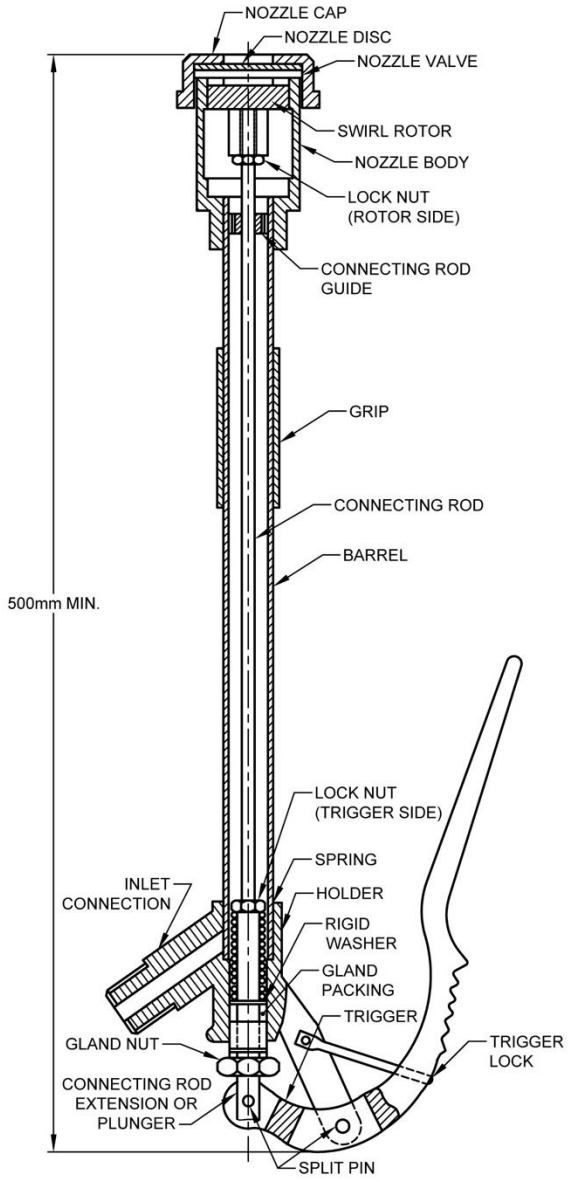

FIG. 27 COMPONENTS OF SPRAY GUN (TRIGGER TYPE)

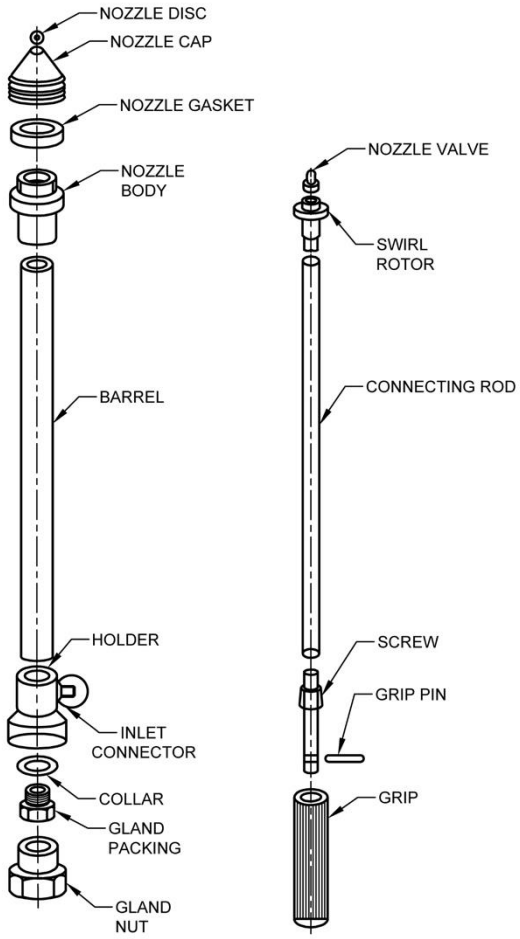

FIG. 28 COMPONENTS OF SPRAY GUN (SCREW TYPE)

ANNEX F

(*Foreword*)

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Amendments Issued Since Publication

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