

Detail Specification for PVC Pipe & DWC Pipe

ITEM NO. 1 P.V.C. Pipes (RIGID) - 6 Kg.

1. Providing & Fixing P.V.C. Pipes (RIGID) - 6 Kg. ISI marked 110 MM DIA.& 90 MM DIA including fittings make or equivalent as approved by engineer-in-charge . Pipe shall be fixed on the help of clamp at every two meter C/C or shall be concealed as directed including necessary fittings etc. including testing of pipe and joints and fixing the same with adhesive solvent ,including cost of all materials including hydraulic testing as directed by engineer-in-charge

(A) 110 mm dia. (B) 90 mm etc. dia.

The P.V.C. pipe shall be approved quality and make of as per IS 13592 : 1992 of appropriate class for sewage, rain water and waste water and shall got approved before use by consultant / Engineer in charge. They shall be fixed by means of approved claims or embedded in the structure as instructed by Consultant. The rates inclusive all necessary special such as bends YS,TS, Plug, bends, off sets, shoes, cowl etc. all special fittings shall be of standard make of first class quality and shall in all respect comply with relevant ISS. Nothing extra shall be paid for cutting the pipes for required length or for collar. The overlap of pipes will not be paid. The joints of the pipe shall be filled by properly and it should be watertight.

INSTALLATION

General

- (a) All pipe and accessories shall be handled in such manner as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure pipe coating, if coating or lining of any type of pipe or fitting is damaged, repair shall be made prior to installation. No other pipe or material shall be placed inside of a pipe or fitting after coating has been applied. Pipe shall be placed inside of a pipe or fitting after coating has been applied. Pipe shall be carried into immediately shall be stored in cool, dark place and out of the sun. installation procedures shall provide for safe conduct of the work, careful removal and disposition of materials, protection of property, which is to remain undisturbed, coordination with other work in progress, and protection of utility services.
- (b) Joints shall not be covered until approved. Pipe, pipefitting or appurtenances found defective after installation shall be replaced. Pipe shall be laid true to line and grade to form a close concentric joint with adjoining pipe and to prevent offsets of the flow line. Sections of pipe shall be so laid and fitted together that when complete, the sewer shall have a smooth and uniform invert. As the work progresses, the interior of the sewer shall be cleaned of all dirt and superfluous materials, where cleaning after laying is difficult because of small pipe size, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after the jointing has been completed. Pipe cutting where necessary shall be done neatly, without damage to the pipe. Unless otherwise authorized, cutting shall be done by means of an approved type of mechanical cutter.
- (c) Each pipe and fitting shall be carefully inspected before and after installation and those found defective shall be rejected. Proper facilities shall be provided for lowering sections of pipe into trenches. Any pipe or fitting that does not allow sufficient space

for proper caulking or installation of joint material shall be closed temporarily with wood blocks.

- (d) For rain water / waste water pipes shall be covered through masonry wall of brick partition and 20 mm thick sand faced cement plaster.

Tests

- (a) Tests of completed piping systems shall be conducted in strict accordance with testing procedures and requirements of ASTM C8282 or AWWA C600 as applicable.
- (b) Do not backfill piping (more than minimum required to hold in place for testing) prior to receipt of acceptance from Owner's Representative for results of tests.
- (c) Conduct repair and retests when required to UN accepted test results at no cost to Owner.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One Mtr.

ITEM NO 2. DOUBLE WALL CORRUGATED PIPE

Providing & laying approved make Double walled corrugated pipes (DWC) of polyethylene(conforming to IS 14930 II)with necessary connecting accessories of same material at required depth for laying of cable. below ground / road surface for enclosing cable and back filling the same to make ground as per original.

FOREWORD

This specification is issued under the fixed serial number followed by the year of adoption as standard or in case of revision, the year of latest revision.

This specification requires reference to the following specifications.

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| (i) IS:14930 Pt.-I | : General requirements of Conduit system for Electrical and Communication installation |
| (ii) IS:14930 Pt.-II | : Particular requirements of Conduit system for Electrical and Communication installation |
| (iii) IS:2530 | : Method for test for Polyethylene moulding materials and polyethylene compounds. |
| (iv) IS:7328 | : HDPE materials for moulding and extrusion |
| (v) IS:12063 | : Classification of degrees of protection provided by enclosures of electrical equipment |
| (vi) IS:11000(Pt2/Sec1) | : Glow-Wire Test and Guidance, Test Methods for Fire Hazard Testing |
| (vii) ASTM D 1693 | : Test method for environmental stress – cracking of ethylene plastics |
| (viii) ASTM D 638 | : Standard test method for tensile properties of plastic |
| (ix) ASTM D 790 | : Test method for flexural properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials. |
| (x) ASTM D 2240 | : Standard Test method for Rubber property. |

(xi) ASTM D 648 : Standard Test method for deflection temperature of plastic under flexure load in the Edgewise Position.

Whenever reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

1.0 SCOPE

This document specifies the requirement and testing for Double Walled Corrugated (DWC) HDPE Ducts buried underground including ducts & duct fittings for protection wherever required for all types Cables.

2.0 TERMINOLOGY

Terminology as defined in IS: 14930 shall be followed.

3.0 ABBREVIATIONS

- ASTM : American Society for Testing & Materials.
- CC : Cubic Centimeter.
- DSC : Differential Scanning Calorimeter
- DTA : Differential Thermal Analyzer
- DWC : Double Walled Corrugated
- ESCR : Environmental Stress Crack Resistance
- FTIR : Fourier Transform Infrared Spectroscopy
- g : Gram • HDPE : High Density Polyethylene.
- Hr : Hour
- IS : Indian Standard.
- Kg : Kilograms
- MFI : Melt Flow Index.
- mm : Millimeter
- OIT : Oxidation Induction Test
- SPN : Specification Provisional Number.
- UV : Ultra Violet.

4.0 GENERAL REQUIREMENTS

4.1 The DWC Duct shall consist of two layers, the outer layer will be corrugated and the inner layer shall be plain and smooth.

4.2 DWC Duct and conduit fittings within the scope of this specification shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or surroundings.

4.3 When assembled in accordance with manufacturer's instruction as part of a conduit system, they shall provide mechanical protection to Cables contained therein.

4.4 Within the conduit system there shall be no sharp edge, burrs or surface projections which are likely to damage insulated conductors or cables or inflict injury to the installer or user.

4.5 The protective properties of the joint between conduit and conduit fittings shall be not less than that declared for the conduit system.

4.6 The DWC Duct and fittings shall withstand the stresses likely to occur during transport, storage, recommended installation practice and application.

4.7 The DWC duct shall be supplied in continuous length in coil form or straight length, suitable for shipping and handling purpose.

4.8 For conduit systems that are assembled by means other than threads, the manufacturer shall indicate whether the system can be disassembled and if, so, how this can be achieved.

5.0 REQUIREMENTS OF RAW MATERIALS USED FOR THE DWC HDPE DUCTS

5.1 The base HDPE resin used for the outer and inner layer of the DWC HDPE Duct shall conform to any designation of IS:7328 or to any equivalent standard meeting the requirements given in Table No. 1, when tested as per the standards given therein. However, the manufacturers shall furnish the designation for the HDPE resin as per IS: 7328 as applicable.

5.2 The anti-oxidants used shall be physiologically harmless.

5.3 None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.

5.4 Single pass rework material of the same composition produced from the manufacturer's own production may be used and it shall not exceed 10% in any case.

5.5 The raw material used for extrusion shall be dried to bring the moisture content to less than 0.1%. 5.6 Suitable UV stabilizers shall be used only for manufacture of the non black coloured HDPE duct to protect against UV degradation, when stored in open. The purchaser may ask for UV content test. The test result for UV Content test by FTIR method from any recognized laboratory shall be accepted and the Hindered Amine Light Stabiliser shall be minimum 0.15 %. UV Content test need not to be conducted in case of UV Stabilized raw material is used.

6.0 REQUIREMENT OF DWC HDPE DUCTS

6.1 Visual Requirement: The ducts shall be checked visually for ensuring good workmanship that the ducts shall be free from holes, breaks and other defects. The ends shall be cleanly cut and shall be square with axis of the ducts.

6.2 Colour: The colour of the duct viz. Black, Red, Green, Blue, Orange, Violet, Grey, Brown and Yellow. The purchaser shall specify the colour of the duct at the time of ordering.

6.3 Dimensions: The dimensions of the DWC HDPE Ducts shall be as given in table- 2. Any other sizes other than those mentioned in Table- 2 shall be as per the agreement between the buyer and the seller. Compliance shall be checked as per procedure given in Annexure- A

6.4 Standards Length: Duct up to 50 mm OD nominal size shall be supplied in standard length of 100 mtr. $\pm 1\%$ or 6 mtr $\pm 1\%$ and all other sizes will be supplied in standard length of 6 mtr. $\pm 1\%$

6.5 Compression Strength: The conduit system shall have adequate mechanical strength. Conduits when bent or compressed either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. Compliance may be checked with the application of force which shall be at least 450 N, when reaching the deflection of 5%. Test shall be conducted in accordance to the method given in Annexure- B

6.6 Impact Strength: The conduit system shall have adequate mechanical strength. Conduits when exposed to impact either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. Compliance may be checked by ensuring there shall be no crack allowing the ingress of light or water between the inside and outside after the test. Test shall be conducted in accordance to the method given in Annexure- C

6.7 Bending Strength: The conduit system shall have adequate mechanical strength. Conduits when bend either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. During the test sample shall not flatten. Compliance shall be checked by passing a ball having a diameter equal to 95% minimum inner diameter of the sample declared by the manufacturer, through the sample whilst it is bent around the test apparatus. Test shall be conducted in accordance to the method given in Annexure- D

6.8 Oxidation Induction Test (OIT): The OIT is a qualitative assessment of the level (or degree) of stabilization of material. The induction time in oxygen when tested with an Aluminum pan as per method given in Annexure- E shall not be less than 30 minutes.

6.9 Resistance To Flame Propagation: Non flame propagating ducts shall have adequate resistance to flame propagation. Samples of DWC HDPE Ducts shall be checked by applying a 1KW flame. Test shall be conducted in accordance to the method given in Annexure- F. Combustion shall stop within 30 Seconds.

6.10 Carbon Black Content: In case of black coloured duct Carbon Black Content by weight should be between 2 % and 3 %. Test shall be conducted in accordance to the IS: 2530

6.11 Anti Rodent Properties: Safety of ducts from the direct attack of subterranean organism anti rodent material is of utmost importance. These ducts shall be evaluated for their safety against rodents before laying them in the fields. Test shall be conducted in accordance to the method given in Annexure- G

6.12 Resistance to External Influences on DWC HDPE Duct Accessories: The accessories in Clause 7.0 shall be tested for external influences as per IS-12063 for ingress of dust & ingress of water. DWC Duct systems when assembled in accordance with the manufacturer's instructions shall have adequate resistance to external influences according to the classification declared by the manufacturer with a requirement of IP 67. Test shall be conducted in accordance to the method given in Annexure- H

6.13 Marking Identification: The conduit shall be prominently marked at regular intervals along their length of preferably 1m but not longer than 3m using indelible ink with following.

- Manufacturers name
- Specification No.
- Name of the duct with size
- Lot No. of the Product
- Date of manufacture
- Product Length
- Purchaser's Name/ symbol

7.0 DWC DUCT ACCESSORIES

7.1 The following accessories are required for jointing the ducts and shall be supplied along with the ducts against specific orders. The manufacturers shall provide complete procedure and method for installation of the accessories. The required quantities of accessories are to be mentioned by the purchasing authority in the purchase order.

7.1.1 Plastic Coupler: The coupler shall be of Push-fit type with O-ring. It is used for jointing two or more ducts. The design of this shall be simple, easy to install and shall provide air tight and water tight joint between the two ducts. The coupler shall insure that the two ducts are butted smoothly without any step formation in the inner surface. The coupler may be straight, bands, T-joints type as per requirements of purchaser.

7.1.2 End Cap: This cap made of suitable plastic material shall be fitted on the both ends of duct, coil after manufacturing the duct. This shall avoid entry of dust, mud and rainwater into the duct during the transit & storage.

7.2 The dimensions of accessories shall be suitable for joining the ducts of dimension as per Cl: 6.3

8.0 PACKING REQUIREMENT

Stores shall be supplied in standard size for delivery and shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage.

9.0 TYPE TESTS

9.1 Complete DWC Duct systems for each offered size of the duct on fresh samples shall be subjected to following tests minimum after 240 hrs of manufacture.

- | | |
|-----------------------|---------------|
| a) Visual Requirement | (Cl. No. 6.1) |
| b) Color | (Cl. No. 6.2) |

c) Dimension	(Cl. No. 6.3)
d) Standards length	(Cl. No. 6.4)
e) Compression Strength	(Cl. No. 6.5)
f) Impact Strength	(Cl. No. 6.6)
g) Bending Strength	(Cl. No. 6.7)
h) Oxidation Induction Test	(Cl. No. 6.8)
i) Resistance to Flame Propagation	(Cl. No. 6.9)
j) Carbon Black Content	(Cl. No. 6.10)
k) Anti rodent	(Cl. No. 6.11)
l) Resistance to External Influences on DWC HDPE Duct accessories	(Cl. No. 6.12)

9.2 The Oxidation Induction Test, Resistance to Flame Propagating Test, Carbon Black Content Test, Anti Rodent Test on the DWC duct and Resistance to External Influences on DWC HDPE Duct accessories given in Cl. No. 6.8, 6.9, 6.10, 6.11 & 6.12 respectively may be conducted at the manufacturer's laboratory by inspecting authority or at any recognized laboratory.

9.3 The raw material tests of the DWC duct given in Cl. No. 5.0 Table-1 for each grade of raw material shall be conducted. Test may be conducted at the manufacturer's laboratory by inspecting authority or at any recognized laboratory.

9.4 Unless otherwise specified each tests shall be made on three new samples.

10.0 ACCEPTANCE TESTS

10.1 The following test shall be carried after 240 hrs of manufacture on samples selected from the lot as per sampling plan given in Cl 13.0

a) Visual Requirement	(Cl. No. 6.1)
b) Color	(Cl. No. 6.2)
c) Dimension	(Cl. No. 6.3)
d) Standards length	(Cl. No. 6.4)
e) Compression test	(Cl. No. 6.5)
f) Impact test	(Cl. No. 6.6)
g) Bending test	(Cl. No. 6.7)
h) Resistance to Flame Propagation	(Cl. No. 6.9)

10.2 The Resistance to Flame Propagating Test on DWC HDPE Duct given in Cl. No. 6.9 may be conducted at the manufacturer's laboratory by inspecting authority or at any recognized laboratory.

10.3 Unless otherwise specified each tests shall be made on three new samples.

11.0 ROUTINE TESTS

11.1 The following tests be carried out by the manufacturer after 240 hrs of manufacture:-

a) Visual Requirement	(Cl. No. 6.1)
b) Color	(Cl. No. 6.2)

- c) Dimension (Cl. No. 6.3)
- d) Standards length (Cl. No. 6.4)
- e) Compression test (Cl. No. 6.5)
- f) Impact test (Cl. No. 6.6)
- g) Bending test (Cl. No. 6.7)
- h) Resistance to Flame Propagation (Cl. No. 6.9)

11.2 The Resistance to Flame Propagating Test on DWC HDPE Duct given in Cl. No. 6.9 may be conducted at the manufacturer's laboratory by inspecting authority or at any recognized laboratory.

11.3 The Density and Melt Flow Index tests on raw material of the DWC duct given in Cl. No. 5.0 Table-1 for each grade of raw material shall be conducted.

12.0 INSPECTION

12.1 All the gauges/ test & measuring instruments shall be under calibration control at the time of inspection and proof to this office shall be produced.

12.2 Inspection and testing shall be carried out by the inspecting authority nominated by the purchaser to ensure that all the requirements of this specification are complied with for the acceptance of the materials offered by the supplier for inspection.

12.3 The purchaser or his nominee shall have free access to the works of the manufacturer and to be present at all reasonable times and shall be given facilities by the manufacturer to inspect the manufacturing of the duct at any stage of manufacture. He shall have the right to reject whole or part of any work or material that does not conform to the terms of this specification or any equivalent specification or requirement applicable and may order the same to be removed / replaced or altered at the expense of the manufacturer. All reasonable/complete facilities considered necessary by the inspecting authorities for the inspection of the ducts shall be supplied by the manufacturer free of cost.

12.4 The manufacturer shall supply the duct samples and samples of the raw materials free of charge as required by the inspecting authority and shall at his own cost prepare and furnish the necessary test pieces and appliances for such testing as may be carried out at his own premises in accordance with this specification. Failing the existence of facilities at his own premises for the prescribed tests, the manufacturer shall bear the cost of carrying out the tests in an approved laboratory, workshop or test house.

13.0 SAMPLING

13.1 All the length of same nominal size, similar construction and class manufactured from the same material under essentially similar conditions of production shall be grouped together to constitute a lot.

13.2 For judging the conformity of a lot to the requirements of the acceptance tests, sampling shall be done for each lot separately. For this purpose, the number of lengths to be selected at random from the lot shall be in accordance with Table 3.

13.3 These lengths will be selected at random from the lot for taking samples. From each of these lengths, sample of duct shall be taken. The length of the sample shall be sufficient so as to provide test pieces of required lengths as laid down in various test clauses.

14.0 WARRANTY

The manufacturer shall warrant the material covered by this specification to be free from defects in design, material and workmanship under ordinary use and service, his obligation under this warranty being limited to replace free of cost those parts which shall be found defective.

15.0 REJECTION

In case the duct tested and inspected in accordance with this specification, fail to pass the tests or comply with the requirement of the specification, the whole consignment shall be rejected subject to the discretion of the purchaser or his nominee.

16.0 INFORMATION TO BE SUPPLIED BY THE PURCHASER

16.1 Normally the duct will be supplied as per the standard dimensions and length as mentioned in this document. However purchaser may specify his own dimensions/lengths/packing requirements etc. In such cases necessary tolerance shall also be specified by the purchaser.

16.2 Adequate quantity & type of duct accessories shall be supplied along with each lot. Purchasers may specify additional requirement.

16.3 Inspecting agency for acceptance of material. 16.4 Colour of the Duct.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One Mtr.

ANNEXURE – A

DIMENSION OF THE DWC DUCT

1.0 Compliance of the outside diameter shall be checked using a ring gauge or vernier caliper or any suitable method.

1.1 Compliance of the minimum inside diameter shall be checked by measurement according to two perpendicular diameters on the same section and calculating the average value.

1.2 Outside diameter specified are nominal dimensions.

1.3 Outside diameter maximum is nominal outside diameter + (0.018 x nominal outside diameter values) rounded off to + 0.1 mm.

1.4 For sizes other than specified in table-2 minimum inside diameter is nominal outside diameter divided by 1.33

ANNEXURE - B

COMPRESSION TEST

1.0 Conduits are subjected to a compression test as per IS: 14930 (Pt-II). The tests for conduits shall not be started until 240 hrs after manufacture.

1.1 Samples shall be 200 ± 5 mm long.

1.2 Before the test the outside and inside diameters of the samples shall be measure as described in clause 6.3

1.3 The samples shall be compressed between two flat steel plates having minimum dimensions (100x200x15mm), the length 200 mm being along the length of the sample. The sample shall be compressed at a rate of 15 ± 0.5 mm/min and the load recorded at the vertical deflection equivalent to 5% of the average value of the original inside diameter of the sample.

1.4 When reaching the deflection of 5%, the applied force shall be at least 450 N

1.5 After the test there shall be no crack allowing the ingress of light or water between the inside and the outside.

1.6 The deflection is calculated with the inner diameter but the measurement of the outside diameter may be sufficient. In case of doubt, it will be necessary to measure the inner diameter.

ANNEXURE – C

IMPACT TEST

1.0 Twelve samples of the duct each 200 ± 5 mm in length or fittings are subjected to an impact test as per IS: 14930 (Pt-II).

1.1 The test apparatus shall be placed on a firm flat surface. The samples shall be conditioned in a cold chamber at a temperature of $-5 \pm 1^\circ\text{C}$ for 2 h. The samples shall be removed from the cold chamber and placed on the v-block holder of the impact tester.

1.2 The striker shall fall once on each sample. The time between removal of the sample from the cold chamber and completion of impact shall not exceed 10 seconds. The impact height and mass shall be as follows.

Nominal Size of Conduit	Mass of Striker (+1% /-0%) kg	Fall Height (+0% /- 1%) (mm)	Energy Joules
Up to 60 mm	5	300	15
61 to 90 mm	5	400	20
91 to 140 mm	5	570	28
Above 140 mm	5	800	40

1.3 The test sample shall be made on the weakest part of the Duct fittings except that it shall not be applied within 5 mm of any sample entry. Samples of ducts are tested on the center of their length.

1.4 After the test, at least in nine of the samples, there shall be no crack allowing the ingress of light or water between the inside and the outside.

ANNEXURE – D

BENDING TEST

1.0 This test shall be carried out on pliable conduits.

2.0 The test is made on six samples having an appropriate length as per IS: 14930 (Pt-II). Three samples shall be tested at room temperature; the other three shall be tested at $-5 \pm 1^\circ\text{C}$. For the test at -5°C , the sample shall be conditioned in a cold chamber for 2 hours. The test apparatus as shown in Figure-2 shall allow to bend the duct with a bending radius equal to the

minimum bending radius values specified by the manufacturer. One of the ends of the samples shall be fixed on the test apparatus by means of an appropriate device. The sample is then bent to approximately 90 degree (right angle) and hold.

2.1 During the test, the sample shall not flatten. Compliance shall be checked by passing a ball having a diameter equal to 95% minimum inner diameter of the sample declared by the manufacturer, through the sample whilst it is bent around the test apparatus.

ANNEXURE – E

OXIDATION INDUCTION TEST PROCEDURE

1.0 A short length of completed duct (approximately 30 cm) shall be sealed at the ends and placed in an oven at temperature of 68 ± 1 °C for 8 hours. The sample shall then be allowed to cool at room temperature for at least 16 hrs. The samples shall be clean and dry. The sample shall then be tested by means of a Differential Scanning Calorimeter (DSC) or by Differential Thermal Analyzer (DTA).

2.0 Instrument Test Procedure:

2.1 Cell Cleaning: The cell shall be held at approximately 400 °C for 10 minutes in Nitrogen. The cell shall be cleaned after standing over night and between testing of different formulations.

2.2 Temperature Calibration: This has to be done according to the instrument manual. The temperature scale should be adjusted until the determined melting point of pure Indium metal is 156.6 °C at a heat rate of 5°C per minute or any other heat rate as indicated in the manual of the equipment is permitted.

2.3 Aluminum Pan Preparation: Standard aluminum DSC pans as per ASTM D 4565 are required to hold specimens during testing. A fresh pan shall be used for each test.

2.4 Sample preparation: Take the sample weighing about 5 mg from the duct conditioned as indicated above. Position the sample in the center of the pan.

2.5 Nitrogen Purge: Place the sample pan and reference pan in instrument cell. Flush for 5 minutes with cylinder of nitrogen (99.6% extra dry grade) at 60 ± 10 cc per minute.

2.6 Oxidation Test: Rapidly increase the temperature of the sample (20 °C/min or greater) from 100 °C or lower initial temperature to 199 ± 1 °C. After thermal equilibrium is obtained (steady recorder signal) switch to 80 ± 20 cc per minute oxygen flow and simultaneously start time-base recording. The oxygen used for the test should be equivalent to or better than 99.6% extra dry grade.

2.7 Induction Period: The oxygen induction point shall be recorded as time zero, and the chart speed shall be sufficient to provide a clearly discernible slope at the start of the exothermic reaction. The test in the pure dry oxygen atmosphere shall continue until the exothermic peak is produced. The intersection of the tangent of the exothermic sloped line

with the extended base line will be drawn. The time from time zero to its intersection point is read from the base line and recorded as the oxidative induction time.

ANNEXURE – F

RESISTANCE TO FLAME PROPAGATION TEST PROCEDURE

1.0 Samples of DWC HDPE Ducts shall be checked by applying a 1KW flame.

1.1 A sample of length 675 ± 10 mm is mounted vertically in a rectangular metal enclosure with one open face, as shown in Figure-3-2 in an area substantially free from draughts. The general arrangements is shown in Figure-3 Mounting is by means of two metal clamps approximately 25mm wide spaced 550 ± 10 mm apart and approximately equidistance from the ends of the sample. A steel rod of 16 ± 0.1 mm is passed through the sample. It is rigidly and independently mounted and clamped at upper end to maintain the sample in a straight and vertical position. The means of mounting is such as not to obstruct drops from falling onto the tissue paper. A suitable piece of white pinewood board, approximately 10 mm thick, covered with single layer of white tissue paper is positioned on the lower surface of the enclosure. The assembly of sample, rod and clamping apparatus is mounted vertically in the center of the enclosure, the upper extremity of the lower clamp being 500 ± 10 mm above the internal lower surface of the enclosure.

1.2 The burner is supported so that its axis is $45 \pm 2^\circ$ to the vertical. The flame is applied to the sample so that the distance from the top of the burner tube to the sample measured along the axis of the flame is 100 ± 10 mm and the axis of the flame intersects with the surface of the samples at a point 100 ± 5 mm from the upper extremity of the lower clamp, and so that the axis of the flame intersects with the axis of the sample.

1.3 The test is carried out on three samples. The flame is applied to the sample for the period specified in Table -4 and is then removed. During the application of the flame, it shall not be moved except to remove it at the conclusion of the period of the test. After the conclusion of the test and after any burning of the sample has ceased, the surface of the sample is wiped clean by rubbing with a piece of cloth soaked with water.

1.4 All three samples shall pass the test. If the sample is not ignited by the flame, it shall be deemed to have passed the test.

If the sample burns, or is consumed without burning, the sample shall be deemed to have passed the test if after burning has ceased, and after the sample has been wiped in accordance with , there is no evidence of burning or charring within 50 mm of the lower extremity of the upper and also within 50 mm of the upper extremity of the lower clamp.

If the sample burns, it shall be deemed to have failed the test if combustion is still in progress 30 seconds after removal of the flame.

If the tissue paper ignites, the sample shall be deemed to have failed the test. For the parts of the same below the burner, the presence of molten material on the internal or external surfaces shall not entail failure if the sample itself is not burned or charred.

2.0 Compliance of DWC HDPE Duct fittings is checked by using the glow wire test IS:11000 (Part 2/Sec 1). The glow wire shall be applied once to each sample in the most unfavorable position of its intended use, with the surface tested in vertical position, at a temperature of 750°C. The sample is deemed to have passed this test if there is no visible flame or sustained glowing or if flames or glowing extinguishes within 30s of the removal of the glow wire.

ANNEXURE – G

ANTI RODENT TEST PROCEDURE:

The test against rodent may be conducted as per following procedures:

The ducts are to be laid underground in fields and also near urban or rural settlements. Therefore they should be exposed to 3-4 most predominant rodent species inhabiting these locations. The test rodent species may include the lesser bandicoot rat, *Bandicota bengalensis*, The Indian gerbils, *tatera indica*, the soft furred field rats, *Millardia meltada* and the house rats, *Rattus rattus*.

The test ducts should be exposed to these rodent species housed individually in iron mesh cages under laboratory conditions. Only freshly capture rodent are to be utilized for the study. The rodents are first acclimatized in laboratory cages for 7-10 days and then the tests be initiated. For each trial, 3-4 rodents of uniform body weight are to be used for the trial. Two different types of testes may be undertaken for all the ducts.

Choice Tests: In this trial the ducts of 15-30 cm length (one sample each of treated and untreated /control sample) are exposed to the test rodents along with food, thus the rodent had a choice between the food and the test duct. This test may be run for longer periods (30-45 days). Tap water should be provided ad libitum to the rodents.

NO Choice Test: The rodents are exposed to the test ducts only and no food is given to the rodents during the period of trial. The test ducts (one sample each of treated and untreated /control sample) are to the exposed to the test rodents. This trail may be run for 5-7 days depending upon the health status of starved test rodents. Tap water should be provided ad libitum to the rodents.

Observation on tooth marks, rodent behavior toward exposed ducts, relative extent of damage in treated and untreated samples should be computed for both types of ducts. Health status of test animals in choice and no choice test must also be monitored for the record any ill effect of exposure of treated / control ducts on these animals. Number of cases and the extent of rodent bites / scratch marks in control and anti rodent treated ducts may indicate the relative deterrent/repellent properties of the test ducts.

ANNEXURE – H

EXTERNAL INFLUENCES TEST PROCEDURE

1.0 The accessories in Clause 7.0 shall be tested for external influences as per IS-12063 for ingress of dust & ingress of water. DWC Pipes systems when assembled in accordance with the manufacturer's instructions shall have adequate resistance to external influences according to the classification declared by the manufacturer with a requirement of IP 67.

2.0 Degree of Protection – Ingress of Foreign Solid Objects.

2.1 An assembly is made of DWC Pipes fittings with a short length of DWC Pipes assembled in each entry. Where necessary, the open ends of the assembly are plugged or are not part of the test.

2.2 The assembly shall be tested in accordance with the appropriate test of IS 12063. 2.3 The assembly tested for numeral 6, shall be deemed to have passed the test if there is no ingress of dust visible to normal or corrected vision without magnification.

3.0 Degree of Protection – Ingress of Water.

3.1 An assembly is made of a DWC Pipe fittings with a short length of DWC Pipes assembled in each conduit entry. Where necessary, the open end of the DWC Pipe is plugged, or is not part of the test.

3.2 The assembly shall be tested in accordance with the appropriate test of IS 12063.

3.3 The assembly tested for numeral 7 shall be deemed to have passed the test, if there is not sufficient ingress of water to form a drop visible to normal or corrected vision without magnification.

Table-1
RAW MATERIAL REQUIREMENT
(Cl. 5.0)

S. No.	Parameter	Specified Limit	Test Method
1.	Density	0.940 to 0.958 g/cc at 27°C	IS:2530 or IS:7328 2.
2.	Melt Flow Index	0.2 to 1.1 g/10 min at 190°C, 5 kg load	IS:2530
3.	Tensile Strength at Yield	20 N/mm ² Minimum	ASTM D 638-IV
4.	Elongation at Break	600 % Minimum	ASTM D 638-IV
5.	Hardness Shore D	Between 60 and 65 units	ASTM D 2240
6.	Environmental Stress Crack Resistance	No cracking after 96 hrs.	ASTM D 1693
7.	Flexural modulus at 1 % strain	690 N/mm ² minimum	ASTM D 790
8.	Heat Deflection Temperature at 45 g/mm ²	650C minimum	ASTM D 648
9.	OIT (in Aluminum Pan)	30 minutes minimum	As per Annexure-E

Table-2
DIMENSIONS
(Cl. 6.3)

Sr. No	DWC PIPE ELECTRIES SIZES IN MM			
	Duct Size	Nominal OD	Nominal ID	Nominal Delivery Length (Mtrs)
1	40/32	40	32	100
2	50/39	50	39	100
3	63/50	63	50	100
4	78/63	78	63	6
5	90/76	90	76	6
6	110/96	110	96	6
7	120/103.5	120	103.5	6
8	160/136	160	136	6

9	180/152	180	152	6
10	200/175	200	175	6
11	250/217	250	217	6
12	300/260	300	260	6
13	315/275	315	275	6

Table-3
SCALE OF SAMPLING
(Clause-13.0)

Lot Size	For dimensional requirements		Other Acceptance tests
	Sample size	Permissible Number of Defectives of Defectives	
(1)	(2)	(3)	(4)
Up to 300	13	0	2
301 to 500	20	0	3
501 to 1000	32	1	4
1001 to 3000	50	2	5
3001 and above	80	3	7

Table-4
TIME OF EXPOSURE OF THE SAMPLE TO THE FLAME
(Clause-6.9)

Material	Thickness (mm)	Flame Application (Tolerances +1 sec.)
Over	Up to	
(1)	(2)	(3)
-	0.5	15
0.5	1.0	20
1.0	1.5	25
1.5	2.0	35
2.0	2.5	45
2.5	3.0	55
3.0	3.5	65
3.5	4.0	75
4.0	4.5	85

4.5	5.0	130
5.0	5.5	200
5.5	6.0	300
6.0	6.5	500

Application : Telecom, Electrical Industry