

# **Technical Specification of HDPE DWC Pipe**

## **1 Scope**

This Specification covers design, manufacturing, testing, packing, supply of DWC HDPE Pipe.

## **2 Service Conditions:**

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- l) Maximum ambient temperature of air: 50°C
- m) Maximum temperature of air in shade: 4°C
- n) Maximum daily average ambient temperature: 40°C
- o) Maximum yearly average ambient temperature: 30°C
- p) Relative Humidity: up to 95%
- q) Average number of thunder storm days per annum: 15
- r) Maximum annual Rainfall: 150cm
- s) Maximum Altitude above mean sea level: 1000Meter
- t) Maximum Wind Pressure: 150 Kg/cm<sup>2</sup> (As per IS 802 latest code)
- u) Maximum soil temperature at cable depth: 30°C
- v) Maximum soil thermal resistivity: 150°C cm/watt

## **3 Technical Parameters:**

- (a) DWC high density Polyethylene pipe shall have corrugation on outer wall but inner wall shall be plain conforming to IS – 14930 Part I and II amended from time to time.
- (b) Terminology as defined in IS: 14930 shall be followed
- (c) DWC HDPE pipe to be supplied shall be 'ISI' marked.
- (d) Accessories like HDPE snap fit coupler with neoprene 'O' ring shall be part of supply to make the joints water / damp proof.

## **4 Code & Standards:**

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: Codes, standards, etc.) referred to herein, the former shall prevail.

- a) IS:14930Pt.-I: General requirements of Conduit System for Electrical and Communication installation
- b) IS:14930Pt.-II: Particular requirements of Conduit system for Electrical and Communication installation
- c) IS: 2530: Method for test for Polyethylene moulding material and polyethylene compounds.
- d) IS:7328: HDPE materials for moulding and extrusion
- e) IS:12063 : Classification of degrees of protection provided by Enclosures of electrical equipment
- f) ASTM D 1693: Test method for environmental stress–Cracking of ethylene plastics
- g) ASTM D638: Standard test method for tensile properties of plastic
- h) ASTM D790: Test method for flexural properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials.

- i) ASTM D 2240: Standard Test method for Rubber property.
- j) ASTM D 648: Standard Test method for deflection temperature of Plastic under flexure load in the Edge Wise Position.
- k) IS:11000(Pt-2): Glow-wire Test and guidance test methods for fire /Sec-1) Hazard Testing.

## **5 General Requirement:**

### **General:**

- i. The DWC HDPE pipe shall consist of two layers, the outer layer will be corrugated and the inner layer shall be plain and smooth.
- ii. DWC HDPE pipe shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or surroundings.
- iii. When assembled in accordance with manufacturer's instruction as part of a conduit system, they shall provide mechanical protection to Signaling Cables' on tained therein.
- iv. Within the conduit system there shall be no hardedge, burrs or surface projections which are likely to damage insulated conductors or cables or inflict injury to the installer or user.
- v. The protective properties of the joint between conduit and conduit fittings shall be not less than that declared for the conduit system.
- vi. The DWC HDPE pipe and fittings shall withstand the stresses likely to occur during transport, storage, recommended installation and application.
- vii. The DWC HDPE pipe shall be supplied in continuous length in coil for more straight length, suitable for shipping and handling purpose.
- viii. 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.

### **REQUIREMENTS OF RAW MATERIALS USED FOR THE DWC HDPE PIPE**

- i. The base HDPE resin used for the outer and inner layer of the DWCHDPE Pipe 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.
- ii. The anti-oxidants used shall be physiologically harmless.
- iii. None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.
- iv. 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.
- v. The raw material used for extrusion shall be dried to bring the moisture content to less than 0.1%.
- vi. Suitable UV stabilizers shall be used only for manufacture of the nonblack colored HDPE duct to protect against UV degradation, when stored in open for minimum 8 months' period. 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 Stabilizer shall be minimum 0.15 %. UV Content test need not to be conducted in case of UV Stabilized raw material is used.

#### **REQUIREMENT OF DWC HDPE PIPE**

- i. Visual Requirement: The Pipe 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.
- ii. Colour: The colour of the pipe viz. Green, Orange, Blue, Yellow, Brown, Violet, Grey and Red. The purchaser shall specify the colour of the duct at the time of ordering.
- iii. Dimensions: The dimensions of the DWC HDPE pipe shall be as per requirement / BOQ.
- iv. 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.  $\pm 1\%$
- v. 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%.
- vi. Impact Strength: The conduit system shall have adequate mechanical strength.
- vii. 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.
- viii. 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.
- ix. Oxidation Induction Test (OIT): The OIT in a qualitative assessment of the level (or degree) of stabilization of material.
- x. 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.
- xi. 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.
- xii. Resistance to External Influences on DWC HDPE Duct Accessories: The accessories in Clause 11.5.4 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.

- xiii. 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

## **DWC HDPE PIPE ACCESSORIES**

- i. 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.

- a. 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.

- b. 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 rain water into the duct during the transit & storage.

### **Selection of pipe for different sizes Cables**

Following guide of the pipe fill shall be used for sizing the pipe Size:

- a. 1 cable in pipe - 53% full
- b. 2 cable in pipe - 31% full
- c. 3 or more cables - 43% full
- d. 4 Multiple cables - 40% full

## **6 Tests**

The following tests shall be carried out in accordance with IS or the latest version thereof:

- a. **TYPE TESTS**

- i) Visual.
- ii) Requirement of Colour.
- iii) Dimension

- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Oxidation Induction Test
- ix) Resistance to Flame Propagation
- x) Anti-Rodent
- xi) Resistance to External influence on DWC HDPE Pipe

**b. ACCEPTANCE TESTS**

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

- 
- i) Visual Requirement
- ii) Requirement of Colour.
- iii) Dimension
- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Resistance to Flame Propagation

**c. ROUTINE TESTS**

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

- 
- i) Visual Requirement
- ii) Requirement of Colour.
- iii) Dimension
- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Resistance to Flame Propagation

## **7 Tests Procedure**

**a) COMPRESSION TEST**

- i. Conduits are subjected to a compression test as per IS: 14930 (Pt-II). The tests for conduits shall not be rated until 240 hrs after manufacture.
- ii. Samples shall be 200 ± 5mm long.
- iii. Before the test the outside and inside diameters of the samples shall be measured as described in clause above.
- iv. The samples shall be compressed between two flat steel plates having minimum dimensions (100x200x15mm), the length 200mm being along the length of the sample. The sample shall be compressed at a rate of 15 ± 0.5mm/min and the load recorded at the vertical deflection equivalent to 5% of the average value of the original inside diameter of the sample.

- v. When reaching the deflection of 5 %, the applied force shall be at least 450N
- vi. After the test there shall be no crack allowing the ingress of light or water between the inside and the outside.
- vii. The deflection is calculated with the inner dia meter but the measurement of the outside diameter may be sufficient. In case of doubt, it will be necessary to measure the inner diameter.

**b) IMPACT TEST**

- i. Twelve samples of the duct each 200±5mm in length or fittings are subjected to an impact test as per IS: 14930(Pt-II) by means of the apparatus shown Figure-1.
- ii. 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±1°C for 2h. The samples shall be removed from the cold chamber and placed on the vee block holder of the impact tester as shown in figure 1.
- iii. 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 10seconds. The impact height and mass shall be as follows.

Nominal Size of Conduit	Mass of Striker	Fall Height (+0%/-1%)(mm)	Energy Joules
Upto 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

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

**c) BENDING TEST**

- i. This test shall be carried out on pliable conduits.
- ii. 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±1°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 bending 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. The sample is then bent to approximately 90 degrees (right angle) and held.
- iii. During the test, the sample shall not flatten. Compliance shall be checked by passing a ball having 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.

**d) OXIDATION INDUCTION TEST PROCEDURE**

- i. A short length of completed duct (approximately 30cm) shall be sealed at the end

sand placed in an oven at temperature of  $68 \pm 1^\circ\text{C}$  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).

ii. Instrument Test Procedure:

- Cell Cleaning: The cell shall be held at approximately  $400^\circ\text{C}$  for 10 minutes in Nitrogen. The cell shall be cleaned after standing over night and between testing of different formulations.
- 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  $156.6^\circ\text{C}$  at a heat rate of  $5^\circ\text{C}$  per minute or any other heat rate as indicated in the manual of the equipment is permitted.
- 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.
- Sample preparation: Take the sample weighing about 5mg from the duct conditioned as indicated above. Position the sample in the center of the pan.
- 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  $60 \pm 10$  cc per minute.
- Oxidation Test: Rapidly increase the temperature of the sample ( $20^\circ\text{C}/\text{min}$  or greater) from  $100^\circ\text{C}$  or lower initial temperature to  $199 \pm 1^\circ\text{C}$ . After thermal equilibrium is obtained (steady recorder signal) switch to  $80 \pm 20$  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.
- Induction Period: The oxygen induction point shall be recorded as time zero, and the chart speed shall be sufficient to provide a clearly discernible loop 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 this intersection point is read from the base line and recorded as the oxidative induction time.

e) **RESISTANCE OF FLAME PROPAGATION TEST PROCEDURE**

- i. Samples of DWV HDPE Ducts shall be checked by applying 1KW flame.
- ii. A sample of length  $675 \pm 10$  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 arrangement is shown in Figure-3. Mounting is by means of two metal clamps approximately 25mm wide spaced  $550 \pm 10$  mm apart and approximately equal distance from the ends of the sample. A steel rod of  $16 \pm 0.1$  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 on to the tissue paper. A suitable piece of white pine wood board, approximately 10 mm thick, covered with single layer of white tissue paper is positioned on the lower surface of the enclosure.

- iii. 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+10mm above the internal allowed surface of the enclosure.
- iv. The burner is supported so that its axis is 45+20° to the vertical. The flame is applied to the samples that the distance from the top of the burner tube to the sample measured along the axis of the flame is 100+10mm 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.
- v. The test is carried out on three samples. 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.
- vi. 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 1.3 there is no evidence of burning or charring within 50mm of the lower extremity of the upper and also within 50mm 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.

- vii. Compliance of DWG 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 inflames or glowing extinguishes within 30 seconds after removal of the glow wire.

**f) 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 in habiting these locations. The test rodent species may include the lesser bandi cootrat, Bandi cotabengalensis, The Indian gerbils, tatera indica, the soft furred field rats, Millar diamelt ada and the house rats, Rattusrattus.

The test ducts should be exposed to the rodent species housed individually in iron mesh cages under laboratory conditions. Only freshly capture rodent are to be



utilized for the study. The rodent sare 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 under taken for all the ducts.

**Choice Tests:** In this trial the ducts of 15-30 cm length (ones ample each of treated and untreated/ control sample) are exposed to the test rodents along with food, thus the roden thada choice between the food and the test duct. This test may be run for longer periods (30-45days). Tap water should be provided adlibitum 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 providing dad labium other rodents.

Observation on tooth marks, rodent behavior toward exposed ducts, and 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 their cordanyill 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.

#### **GTP of HDPE DWC Pipe**

<b>SR.</b>	<b>DESCRIPTION / PARAMETERS</b>	<b>OFFERED BY THE BIDDER</b>
1	Make	
2	Applicable Standard	
3	Grade	
4	Pressure rating (Kg/Sqcm.)	
5	Outside Diameter (mm)	
6	Inside Diameter (mm)	
7	Recommended For (Mention Maximum Armoured cable Type and Size)	