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Technical Specifications For Laying of underground cable network with terminations

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HEAT SHRINKABLE TYPE INDOOR & OUTDOOR TERMINATIONS KIT FOR 11KV CABLE

1. Scope:

- 5.1 This Section of the Specification covers design, manufacturing, testing, packing, supply & commissioning of heat shrinkable type indoor and outdoor termination kit suitable for 11 kV XLPE cable.
- 5.2 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 5.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 5.4 In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant IEC, IS standards and other statutory provisions.
- 5.5 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant standards. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2. Service Conditions:

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



- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C

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k) Maximum soil thermal resistivity: 150°C cm/watt



3. Technical Parameters:

System details:

S.No	Description	11kV
i	Voltage grade (kV) of Cable	6.35 / 11 kV
ii	Core (Nos.)	3
iii	System Voltage	11kV
iv	Highest Voltage	12kV
v	Earthing system	Effectively earthed
vi	Frequency	50Hz
vii	Variation in supply voltage	" +6% to -9%
viii	Variation in supply frequency	± 3%
ix	A.C. Withstand Voltage (ph/ground) with time duration	35kV, 1min
x	Partial discharge at 2Vo	< 5pc
xi	Impulse Withstand, 1.2/50/Us	75kV
xii	Thermal Withstand Short Circuit current 1Sec	As per IS 13573
xiii	Dynamic short circuit withstand	2.55 x As per IS 13573
xiv	DC Voltage	48kV for 30mins.
xv	Materials of the tubing / molded part	Polyolefin
xvi	Method of Stress Control	High permittivity material

4. Application Standards: -

Title	IS Standard	IEC Standard
Applicable IS Standard	IS 13573-2011	
Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1.2$ kV) up to 30 kV ($U_m = 36$ kV) - ALL PARTS	IS 7098 (Part-II) IS 13573-2011	IEC 60502



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Heat shrinkable moulded shapes - Part 1: Definitions and general requirements	-	IEC 62329-1
Heat-shrinkable moulded shapes - Part 2: Methods of test	-	IEC 62329-2

5. General Technical Parameters:

The purpose of this specification is to specify the performance requirements of termination kits for the use on 50C/S phase system with earthed neutral for working voltage of 11kV. Earthing arrangement shall be as per relevant standard and details of earthing arrangement offered shall be submitted along with the tender.

- 5.1 The cable termination kit shall be suitable for termination of the cable on indoor switchgear or outdoor installation as per requirement. The type of cable will be XLPE insulated. The cable termination jointing kits shall be as per defined as per IS 13573-2011 with latest amendment no. 2 1998, IEEE 48-1990 and shall be Class-1, ESI-09-13 performance specification for high voltage cable accessories.
- 5.2 Termination kit must have stress control mastic, stress control tube and anti-tracking tubes. Detailed drawing of Indoor / Outdoor Termination shall be submitted along with the offer and same drawing has to be part of type test reports. In case of heat shrinkable cable accessories, stress control tubing, shall have volume resistivity of minimum 1, 00, 00,000 Ohms- meter for termination. The supplier should have a test facility for routine testing and the instruments should have a valid calibration.
- 5.3 Impedance of stress control tubing shall not change over a range of temperature from 0°C to 125°C. The impedance also remains constant in spite of the difference in stress, which will exist within the sleeve due to heating effect within the conductors and the temperature of the environment. Bidder must submit graph-showing effect on the impedance value of stress control tubing due to temperature variations and thermal ageing with his offer.
- 5.4 In all type of kits offered, the external leakage insulation between high voltage conductor and ground as specified in I.E.E.E. –48, 1975 amended up to date, shall be of non-tracking erosion resistant and weather resistant flexible sleeve.
- 5.5 The kit offered shall provide for total environmental sealing of the cable crutch and at the lug end.
- 5.6 Termination system shall be suitable for use with standard aluminum conductor fittings [cable lugs and ferrules] of compressed crimping type.
- 5.7 The termination kit of heat shrinkable type kit, the joint shall include heat shrinkable dual wall tubing, which shall be insulating from inside and semiconductor from outside.
- 5.8 Material used for construction of a joint/termination shall perfectly match with the dielectric, chemical and physical characteristics of the associated cable. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and the joints.

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- 5.9 The tenderer shall indicate the required net dimensions of the indoor cable, joints for various cable sizes, in the form of Length X Breadth X Depth in mm.

6. Test & Inspection:

- 6.1 The termination kits offered shall be fully type tested as per the relevant standards and the test certificates are to be provided.
- 6.2 The supplier shall carry out all routine tests as stipulated in the relevant standards.
- 6.3 The termination kits offered shall be fully type tested at CPRI as per the relevant standards. The vendor shall furnish four sets of the type test reports along with the MQP for getting approval on material before placing purchase order to the manufacturer.
- 6.4 Type tests shall be carried out as per the test sequence given in IS:13573-2011 with latest amendment thereof at C.P.R.I. Laboratory as amended from time to time. The test report will have to be submitted for the test carried out.
- 6.5 Test details for Termination Kit should be as follow:

Indoor / Outdoor Kit as per IS 13573-2011 and its latest amendments	
1.	Conductor Resistance Test
2.	AC High Voltage Test (Dry)
3.	AC High Voltage Test (Wet)
4.	Partial Discharge Test
5.	Impulse with stand test
6.	Heating Cycle in Air
7.	Partial Discharge Test (After) (Elevated / Ambient Temp)
8.	Impulse with stand test (After)
9.	A C Voltage Test (After)
10.	Examinations (For cracking, Moisture Path, Corrosion, Erosion, Leakage)
11.	Thermal Endurance Test
12.	FR test & low smoke zero halogen test
13.	Low temperature flexibility
14.	Corrosion resistant and thermal ageing test
15.	Flame retardant test

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7. GTP



Sr. No	Particulars	Unit	Guaranteed values.
1	MANUFACTURER		
2	APPLICABLE STANDARDS		As per IS:13573
3	GUARANTEED PARTICULARS		
3.1	For the nominal (phase to phase) System voltages	KV	11KV
3.2	A.C. withstand voltage Dry (ph./ground) Time duration	KV Mins	35KV 1Min
	A.C. withstand voltage Wet(ph./ground) Time duration	KV Mins	28KV 1Min
3.3	Partial Discharge at 2Vo	pC	<5pC
3.4	Impulse withstand, 1.2/50/Us	kV	75KV
3.5	Load cycle Test a) Each Cycle-Heating Duration Temperature Cooling Duration Number of Cycles b) Continuous phase to ground Voltage Withstand	Hrs. 0C Hrs. kV	5 100 3 117 2.5Uo
3.6	Leak Tightness		9 Cycles.
3.7	Thermal Withstand Short circuit current	ka	As per IS:13573
3.8	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.9	DC Voltage	kV	48kV for 30Mins.
4	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Anti-tracking Tubes.
4.4	Allowable Kit storage Temperature	0C	Normal Ambient Temperature.

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4.5	Shelf life of H.S components	Years	More than 5 Years.
5	Cable Termination Instruction Manuals	Yes/No	Yes

HEAT SHRINKABLE STRAIGHT THROUGH JOINT KIT FOR 11KV CABLE



1. Scope:

- 1.1 This Section of the Specification covers design, manufacturing, testing, packing, supply & commissioning of heat shrinkable type straight through joint kit suitable for 11 kV XLPE cable.
- 1.2 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4 In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant IEC, IS standards and other statutory provisions.
- 1.5 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant standards. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2. Service Conditions:

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

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm

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- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3. Technical Parameters:

System details:

S.No	Description	11kV
i	Voltage grade (kV) of Cable	6.35 / 11 kV
ii	Core (Nos.)	3
iii	System Voltage	11kV
iv	Highest Voltage	12kV
v	Earthing system	Effectively earthed
vi	Frequency	50Hz
vii	Variation in supply voltage	" +6% to -9%
viii	Variation in supply frequency	± 3%
ix	A.C. Withstand Voltage (ph/ground) with time duration	35kV, 1min
x	Partial discharge at 2Vo	< 5pc
xi	Impulse Withstand, 1.2/50/Us	75kV
xii	Thermal Withstand Short Circuit current 1Sec	As per IS 13573
xiii	Dynamic short circuit withstand	2.55 x As per IS 13573
xiv	DC Voltage	48kV for 30mins.
xv	Materials of the tubing / molded part	Polyolefin
xvi	Method of Stress Control	High permittivity materials

Application Standards: -



Title	IS Standard	IEC Standard
Applicable IS Standard	IS 13573	
Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - ALL PARTS	IS 7098 (Part-II) IS 13573,1992	IEC 60502

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Heat shrinkable moulded shapes - Part 1: Definitions and general requirements	-	IEC 62329-1
Heat-shrinkable moulded shapes - Part 2: Methods of test	-	IEC 62329-2

4. General Technical Parameters:

The purpose of this specification is to specify the performance requirements of cable jointing kits for the use on 50C/S phase system with earthed neutral for working voltage of 11kV. Earthing arrangement shall be as per relevant standard and details of earthing arrangement offered shall be submitted along with the tender.



- 4.1 The straight jointing kits shall be as per defined as per IS 13573-2011 with latest amendment no. 2 1998, IEEE 48-1990 and shall be Class-1, ESI-09-13 performance specification for high voltage cable accessories.
- 4.2 Proper stress control, stress grading and non-tracking arrangement in the joint shall be offered by means of proven methods, details of which shall be elaborated in the offer. Detailed sectional views of the assemblies shall be submitted along with the offer. In case of heat shrinkable cable accessories, stress control tubing, shall have volume resistivity of minimum 1, 00, 00,000 Ohms- meter for straight through joints. Also relative permittivity shall be minimum 15.
- 4.3 Impedance of stress control tubing shall not change over a range of temperature from 0°C to 125°C. The impedance also remains constant in spite of the difference in stress, which will exist within the sleeve due to heating effect within the conductors and the temperature of the environment. Bidder must submit graph-showing effect on the impedance value of stress control tubing due to temperature variations and thermal ageing with his offer.
- 4.4 The jointing kit shall be with aluminium crimping ferrules, followed by yellow mastic and heat shrink tubing as per design. The straight through joints should be impervious to the entry of water. The manufacturer shall use the proven technologies and design to ensure a construction, which will prevent entry of water or any other liquid inside the straight joint through joint and cable. Outer sealing of joint will be carried out by means of heat shrink only. No resin / hardner or any other form shall be used.
- 4.5 In all type of jointing kits offered, the external leakage insulation between high voltage conductor and ground as specified in I.E.E.E. –48, 1975 amended up to date, shall be of non-tracking erosion resistant and weather resistant flexible sleeve.
- 4.6 The kit offered shall provide for total environmental sealing of the cable crutch and at the lug end.
- 4.7 Jointing system shall be suitable for use with standard aluminum conductor fittings [cable lugs and ferrules] of compressed crimping type.
- 4.8 For straight joint the kit shall also include tubular sleeve in line connectors for solder less crimping of cable connector. Aluminium connector with electrolytic grade shall be provided in kits.

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- 4.9 Material used for construction of a joint shall perfectly match with the dielectric, chemical and physical characteristics of the associated cable. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and the joints. The tenderer shall indicate the required net dimensions of the indoor cable, joints for various cable sizes, in the form of Length X Breadth X Depth in mm.
- 4.10 Heat shrinking of joints & terminations is a skilled job coupled with cable preparation too. If not adhered to the skill & time, this might result in failure of joints & terminations due to poor workmanship.

5. TEST & INSPECTION:

- 5.1 The jointing kits offered, shall be fully type tested as per the relevant standards and the test certificates are to be provided.
- 5.2 The supplier shall carry out all routine tests as stipulated in the relevant standards.
- 5.3 The jointing kits offered, shall be fully type tested at CPRI as per the relevant standards. The vendor shall furnish four sets of the type test reports along with the MQP for getting approval on material before placing purchase order to the manufacturer.
- 5.4 Type tests shall be carried out as per the test sequence given in I.S.:13573 or VDE-0278 at C.P.R.I. Laboratory as amended from time to time. The test report will have to be submitted for the test carried out.
- 5.5 Test details for Termination Kit should be as follow:

Joint Kit as per IS 13573	
1.	Conductor Resistance Test
2.	AC Withstand Voltage
3.	Partial Discharge Test
4.	Impulse with stand test
5.	Heating Cycle in Air
6.	Partial Discharge Test (After) (Elevated / Ambient Temp)
7.	Impulse with stand test (After)
8.	A C Voltage Test (After)
9.	Examinations (For cracking, Moisture Path, Corrosion, Erosion, Leakage)

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6. GTP



Sr. No.	Particulars	Unit	Guaranteed values.
1.	MANUFACTURER		
2.	APPLICABLE STANDARDS		As per IS:13573
3.	GUARANTEED PARTICULARS For the nominal (phase to phase) System voltages Maximum system voltage	KV	11KV 12KV
3.1	A.C. withstand voltage Dry (ph./ground) Time duration	KV Mins	35KV 1Min.
	A.C. withstand voltage Wet(ph./ground) Time duration	KV Mins	28KV 1Min.
3.2	Partial Discharge at 2U ₀	pC	<5pC
3.3	Impulse withstand, 1.2/50/Us	kV	75KV
3.4	Load cycle Test a) Each Cycle-Heating Duration Temperature Cooling Duration a) Number of Cycles c) Continuous phase to ground Voltage Withstand	Hrs °C Hrs. kV	5 100 3 63 2.5U ₀
	Water tightness test	KV	60Nos. at 2.5 U ₀ . as per above cycles.
3.5	Thermal Withstand Short circuit current 1Sec.	ka	As per IS:13573
3.6	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.7	DC Voltage	kV	48kV for 30Mins
4	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin.
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Black Insulating Tubes.

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4.4	List of items included in the Kit a) For Terminations b) Allowable kit storage temperature c) Kit shelf life	Yes/No 0C Years	Yes Normal Ambient Temperature More than 5 Years
5	Cable Termination Instruction Manuals	Yes/No	Yes

TECHNICAL SPECIFICATION FOR 22 KV XLPE POWER CABLE TERMINATION KIT

1. Termination:

The 22 kV cable termination/joints shall be done by skilled and experienced jointers duly approved by the Engineer in charge. Termination including supply of jointing kit is included in the contractor's scope unless specified otherwise.

Termination kits shall be suitable for termination of the cables to indoor switchgear or to weather proof cable end box of an outdoor mounted transformer an outdoor type for termination at poles. The terminating kits shall preferably be as of the following types.

Heat shrink type of approved make of DGVCL as mentioned in approved make list in section 5.0(Technical specification) using factory molded silicone rubber insulators. For outdoor installations weather shields, shielding ends and any other accessories required should form part of the kit.

Straight through jointing kits shall be suitable for underground installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be preferably of PUSH ON/Heat shrink type as per technical specifications mentioned in tender and as per IS-13753-1992 and its latest amendments.

2. Fixing of end termination & straight through joints.

- I) Contractor should clarify the make of cable end termination and straight through joint. The heat & shrink type end termination & straight through joints shall be utilized for the job.
- II) Dual wall molded type should be available in straight through joint.
- III) After completing work of cable laying end termination straight through joints, following test shall be carried out jointly by engineer in charge of DGVCL and contractor.
- IV) Insulation resistance test before & after with 5 KV insulation tester. (A) Hypo test
- V) Contractor has to furnish Guaranteed Technical Parameters (GTP) type test certificate of various tests conducted at any Govt./ NABL approved laboratory for the joints they intend to supply for this job. The test certificate should not be prior to 7 years from the date of tender. The contractor shall have to submit the same with technical bid and failure in which technical bid will be disqualified & the price bid of that party will not be opened.



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- VI) One competent skilled supervisor shall have to co-ordinate the site authority and he has to do all communication with engineer in charge of DGVCL.
- VII) It is essential to have suppliers certificate of training for cable jointing of cable jointer.
- VIII) Jointer has to ensure safety while making joints so that other nearby cables will not damage.
- IX) Before using Termination Kit & Jointing Kit should be got verified at Corporate office level. The bidder has to get verification certificate from A.C.E. (S.D.&P.), Corporate office, DGVCL, Surat.
- X) Bidder shall offer guarantee for all part of Termination Kit & Jointing Kit for a period of 2 Years from the date of charging the Termination Kit. In the event of failure of Kit due to manufacturing defect or workmanship defect during guarantee period, bidder shall have to replace it at no extra cost within 24 hrs on intimation.
- XI) The bidder shall get each end termination kits & straight through joint kit verified before utilization of the same from the concern D.E. of s/dn office matching with original invoice submitted & sample approved and M.O.M. of verification to that effect shall be submitted while submitting the bills.

The Bidder shall have to supply cable end joint / straight joint kit as per IS 13573-1992 with latest amendment No. 2- 1998, IEEE 48-1990 and shall be Class -1, ESI-09-13 performance specification for high voltage cable accessories.

CLASS OF TERMINATION:

The XLPE 11/22 KV Link Line shall be class 1 termination as per appropriate ISI code nos. i.e. IEEE-48-1990.



3. APPLICABLE STANDARDS:

IS 13573-2011 with latest amendment – Latest amendment No.2- 1998, IEEE 48-1990. The termination shall be Class 1. ESI-09-13 performance specification for high voltage cable accessories. The cable accessories being supplied in the form of kit which has different components to be assembled at site.

4. MATERIALS:

The termination of 22 kV XLPE Cable refers to extruded or Molded Polymeric. Polymeric material which are cross linked by gamma radiation to develop elastic memory and supplied in an expanded or otherwise deformed size and shape. Bidders should submit the proof that the tubes are cross linked by gamma radiations. However chemically cross linked, crotch seal and lug seals are permitted.

For straight joints, the insulation over the ferrules should be reinsulated by dual wall tubing. This should have an inner insulating layer vulcanized to an outer semi-conducting layer. This is required to ensure reconnection of cable insulation screen of the core from one end of the joint to the other. The dual wall tubing ensures that

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there is no entrapment of air pockets between the insulating and semi-conducting layers.

5. FOR JOINTS:

22 kV XLPE underground flexible polymeric tubing, preferably black colored pre coated with adhesive shall be provided for sealing the exposed metallic sheaths and sheath/earth connections.

6. PROVISION OF ADDITIONAL CREEPAGE INDOOR / OUTDOOR TERMINATIONS:

Single piece, 22 KV XLPE underground cable, weather sheds having non-tracking, erosion and weather resistant properties shall be supplied with the kits for application over non-tracking tubing. The quantity of sheds to be supplied shall depend on voltage grade and indoor/outdoor application and shall be indicated along with offer. Each shed shall give an additional creep age length of at least 100mm.

7. INSULATION AND SCREEN REINSTATEMENT FOR JOINTS:

The reinstatement of insulation shall be by means of heat shrinkable, flexible, polymeric tubing made from a discharge resistant polymer, preferably colored red. The tubing after complete recovery shall have a minimum wall thickness to ensure provisions of adequate insulation in step.

8. EARTH & SCREEN CONTINUITY FOR TERMINATION & JOINTS:

Screen continuity by using tinned copper mesh and earth continuity by using tinned copper braids of appropriate size shall be provided for transfer of screen/earth in straight through joints. In termination, tinned copper braids of appropriate size or equivalent current carrying capacity of cable conductor along with copper lugs of appropriate size shall be provided for continuity of screen to armor to the earth.

9. LUGS & FERRULES:

The requisite number and type of aluminum/ copper lugs/ferrules shall be provided for termination/joints. The Lugs and ferrules for XLPE cables shall be crimping type suitable for compacted circular conductor having two nos. of holes.

10. Tests:

Before energizing the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground with 5 KV Megger both before and after backfilling.

- a) Type tests are to be carried out at manufacturer's works for quality approval of termination/jointing kits. Following tests confirming to the latest IS 13573 and or IEC 502.2, 466 and VDE 0278 and C 81 specifications. The report of last seven years type tests result shall be submitted for approval of the Kits. Terminations shall be kept open so that switchgears, transformers etc are not subjected to test voltage.

Tests for termination/jointing kits:



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Indoor & Joint IS 13573



- 1) Conductor Resistance Test
 - 2) Impact Test
 - 3) AC High Voltage Test (Dry)
 - 4) Partial Discharge Test
 - 5) Impulse with stand test
 - 6) AC Voltage life test with cyclic current loading
 - 7) Partial Discharge Test
 - 8) AC Voltage life test with cyclic current loading
 - 9) Thermal Short circuit test
 - 10) AC Voltage life test with cyclic current loading
 - 11) Conductor Resistance Test
 - 12) Impulse with stand test
 - 13) D.C. High Voltage test
- Out Door IS 13573**

- 1) Conductor Resistance Test
- 2) AC High Voltage Test (Dry)
- 3) Wet Power frequency test
- 4) Partial Discharge Test
- 5) Impulse with stand test
- 6) AC Voltage life test with cyclic current loading
- 7) Partial Discharge Test
- 8) AC Voltage life test with cyclic current loading
- 9) Thermal Short circuit test
- 10) AC Voltage life test with cyclic current loading
- 11) Water Tightness Test for Out door
- 12) Conductor Resistance Test
- 13) Impulse with stand test
- 14) D.C. High Voltage test

Indoor as per VDE 0278

- 1) Partial Discharge Test
- 2) Conductor Resistance Test
- 3) AC High Voltage Test (Dry)
- 4) Tan Delta as a Function of Voltage & Capacitance.
- 5) Tan Delta as a Function of temperature
- 6) Impulse with stand test
- 7) AC Voltage life test with cyclic current loading
- 9) Tan Delta as a Function of Voltage & Capacitance.
- 10) AC Voltage life test with cyclic current loading
- 11) Thermal Short circuit test
- 12) AC Voltage life test with cyclic current loading
- 13) Partial Discharge Test

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- 14) Conductor Resistance Test
- 15) Impulse with stand test
- 16) D.C. High Voltage test

Outdoor Termination VDE 0278

- 1) Partial Discharge Test
- 2) Conductor Resistance Test
- 3) Impact Test
- 4) Wet power frequency AC High Voltage Test
- 5) Partial Discharge Test
- 6) Tan Delta as a Function of Voltage & Capacitance.
- 8) Tan Delta as a Function of temperature
- 9) Impulse with stand test
- 10) AC Voltage life test with cyclic current loading
- 11) Tan Delta as a Function of Voltage & Capacitance.
- 12) AC Voltage life test with cyclic current loading
- 13) Short circuit test
- 14) AC Voltage life test with cyclic current loading
- 15) Conductor Resistance Test
- 16) Impulse with stand test
- 17) D.C. High Voltage test
- 18) Dynamic short circuit
- 19) Impulse with stand test
- 20) D.C. High Voltage test

As per C - 81



- 1) Impact Test
- 2) Insulation Resistance Test
- 3) A.C High Voltage Test
- 4) Insulation Resistance Test
- 5) Heat shock Test
- 6) Insulation Resistance Test
- 6) A.C High Voltage Test
- 7) Insulation Resistance Test
- 8) Electric Heat cycle Test
- 9) Evaluation after Electrical heat cycle Test
- 10) Insulation Resistance Test
- 11) A.C High Voltage Test
- 12) Insulation Resistance Test
- 13) After Sheath Damage Test
- 14) Electric Heat cycle Test
- 15) Evaluation after Electrical heat cycle Test & sheath damage
- 14) Insulation Resistance Test
- 15) A.C High Voltage Test

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- 16) Insulation Resistance Test
17) Examination Of Joint

11. TECHNICAL AND GUARANTEED PARTICULARS:

The bidder shall furnish all Guaranteed Technical Particulars, as called for, in Appendix - A of this Specification. Particulars, which are subject to guarantee, shall be clearly identified. Offer not containing these in formations will not be considered for acceptance.

12. PERFORMANCE CERTIFICATE:

Bidders shall also submit performance reports for the specified size of cables supplied to other State Electricity Boards / reputed firms, with the clear indication of the period since when the cables performed satisfactory service.

13. LEGIBLE SUBMISSION:

Only required relevant, legible documents shall be submitted to avoid delay due to back reference.

TECHNICAL SPECIFICATION

HEAT SHRINK OUT DOOR TERMINATION ON 22KV (E) XLPE CABLE

Sr. No	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS		
3.1	For the nominal(phase to phase) System voltages Maximum system voltage	KV	22 KV 24 KV
3.2	A.C. withstand voltage Dry condition (ph/ground)	KV Min	55 KV 1 Min



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	A.C. withstand voltage	KV	50 KV
	Wet condition	Mins	
	Time duration		1 Min
3.3	Partial Discharge at 2 Uo	pC	<20 pC
3.4	Impulse withstand,1.2/50/Us	kV	125KV

3.5	Load cycle Test		
	a) Each Cycle-Heating	Hrs	5
	Temperature	°C.	100
	Cooling Duration	Hrs	3
	b) Number of Cycles		3
	c)Continuous phase to		
	Ground Voltage Withstand	KV	2.5Uo
3.6	Load cycle Test		
	a) Each Cycle-Heating	Hrs	5
	Temperature	°C.	100



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	Cooling Duration	Hrs	3
	b) Number of Cycles		30
	c)Continuous phase to		
	Ground Voltage Withstand	KV	2.5Uo
3.6	Leak Tightness test as per IS-13753-1992		9 Cycles.

3.7	Thermal Withstand Short circuit current 1Sec.	kA	As per IS:13573 & Amendment
3.8	Dynamic short circuit Withstand	KA peak	2.55 x Is As per IS:13573
3.9	DC Voltage	kV	96 KV for 30Mins.
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Anti-tracking Tubes.
4.4	Allowable Kit storage Temperature	0C	Normal Ambient Temperature.
4.5	Shelf life of H.S components	Years	More than 5 Years.



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5.0	Cable Termination Instruction Manuals	Yes/No	Yes
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TECHNICAL SPECIFICATION

HEAT SHRINK STRAIGHT THROUGH JOINT ON 22KV (E) XLPE CABLE

Sr.No	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS For the nominal(phase to phase) System voltages Maximum system voltage	KV	22 KV
3.1	A.C. withstand voltage Dry (ph/ground) Time	KV Mins	55 KV 1 Min.
	A.C. withstand voltage Wet(ph/ground) d) Time	KV Mins	50 KV 1 Min.
3.2	Partial Discharge at 2 U ₀	pC	<20 pC
3.3	Impulse withstand,1.2/50/Us	kV	125KV
3.4	Load cycle Test		



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	a)Each Cycle-Heating Temperature Cooling b)Number of Cycles c)Continuous phase to ground Voltage Withstand	Hrs 0C Hrs. kV	5 100 3 3 2.5Uo
3.5	Load cycle Test a)Each Cycle-Heating Temperature Cooling b)Number of Cycles - c)Continuous phase to ground Voltage Withstand	Hrs 0C Hrs. kV	5 100 3 30 2.5Uo
3.6	Water tightness test	KV	60 cycles at 2.5 Uo. as per IS-13753-1992
3.7	Thermal Withstand Short circuit current 1Sec.	kA	As per IS:13573
3.8	Dynamic short circuit Withstand	KA peak	2.55 x Is As per IS:13573



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3.9	DC Voltage	kV	96Kv for 30Mins
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin.
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Black Insulating Tubes.
4.4	List of items included in the Kit a)For Terminations b)Allowable kit storage temperature c)Kit shelf life	Yes/No 0C	Yes Normal Ambient Temperature
5.0	Cable Termination Instruction Manuals	Yes/No	Yes

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APPENDIX-A

GUARANTEED TECHNICAL PARTICULARS HEATSHRINK OUT DOOR TERMINATION ON 22KV (E)
XLPECABLE

S.No.	Particulars	Unit	Guaranteed Value
1	MANUFACTURER		
2.	APPLICABLE STANDARDS		
3.	GUARANTEED PARTICULARS		
3.1	For the nominal (phase to phase) System voltages Maximum system voltage	KV KV	
3.2	A.C. withstand voltage (ph/ground) Time duration	KV Mins	
3.4	Partial Discharge at 2 Vo	pC	
3.5	Impulse withstand,1.2/50/Us		
3.6	Load cycle Test a)Each Cycle-Heating Duration Temperature Cooling Duration b) . Number of Cycles c). Continuous phase to ground Voltage Withstand	Hrs 0C Hrs. kV	
3.7	Leak Tightness		
3.8	Thermal Withstand Short circuit current 1Sec.	ka	
3.9	Dynamic short circuit Withstand	Ka peak	
3.10	DC Voltage	kV	
4	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		
4.2	Method of stress control		
4.3	Method of environmental seal		
4.4	Allowable Kit storage Temperature	0C	
4.5	Shelf life of H.S components	Years	
5.	Cable Termination Instruction Manuals	Yes/No	

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GUARANTEED TECHNICAL PARTICULARS HEAT SHRINK STRAIGHT THROUGH JOINT ON 22KV (E) XLPE CABLE



S.No.	Particulars	Unit	Guaranteed Value
1.	MANUFACTURER		
2.	APPLICABLE STANDARDS		
3.	GUARANTEED PARTICULARS		
3.1	For the nominal (phase to phase)	KV	
	System voltages		
	Maximum system voltage	KV	
3.2	A.C. withstand voltage Dry (ph/ground)	KV	
	Time duration	Mins	
3.3	A.C. withstand voltage Wet(ph/ground)	KV	
	Time duration	Mins	
3.4	Partial Discharge at 2 Uo	pC	
3.5	Impulse withstand,1.2/50/Us	kV	
3.6	Load cycle Test		
	a) Each Cycle-Heating Duration	Hrs	
	Temperature	0C	
	Cooling Duration	Hrs.	
	b) Number of Cycles		
	c)Continuous phase to ground Voltage Withstand	kV	
3.7	Water tightness test	KV	
3.8	Thermal Withstand Short circuit current 1Sec.	ka	
3.9	Dynamic short circuit Withstand	Ka peak	
3.10	DC Voltage	kV	
4	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		
4.2	Method of stress control		
4.3	Method of environmental seal		
4.4	List of items included in the Kit	Yes/No	
	a) For Terminations		
	b) Allowable kit storage temperature	0C	
	c) Kit shelf life	Years	
5	Cable Termination Instruction Manuals	Yes/No	

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TECHNICAL SPECIFICATION FOR DWC HDPE PIPES

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.

- Maximum ambient temperature of air: 50°C
- Maximum temperature of air in shade: 4°C
- Maximum daily average ambient temperature: 40°C
- Maximum yearly average ambient temperature: 30°C
- Relative Humidity: up to 95%
- Average number of thunder storm days per annum: 15
- Maximum annual Rainfall: 150cm
- Maximum Altitude above mean sea level: 1000Meter
- Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- Maximum soil temperature at cable depth: 30°C
- Maximum soil thermal resistivity: 150°C cm/watt

3 Technical Parameters:

- 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.
- Terminology as defined in IS: 14930 shall be followed
- DWC HDPE pipe to be supplied shall be 'ISI' marked.
- 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.

- IS:14930Pt.-I: General requirements of Conduit System for Electrical and Communication installation
- IS:14930Pt.-II: Particular requirements of Conduit system for Electrical and Communication installation
- IS: 2530: Method for test for Polyethylene moulding material and polyethylene compounds.
- IS:7328: HDPE materials for moulding and extrusion
- IS:12063 : Classification of degrees of protection provided by Enclosures of electrical equipment
- ASTMD 1693: Test method for environmental stress–Cracking of ethylene plastics



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- 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 D648: 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 tainted 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



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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

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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 woor 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, mudandra in water in to 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

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- 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. ROUTINETESTS

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 best 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 measures 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 data 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, itwill 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

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conditioned in a cold chamber at a temperature of $-5\pm 1^{\circ}\text{C}$ 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 (+1%/-0%)kg	Fall Height (+0%/-1%)(mm)	Energy Joules
Upto60 mm	5	300	15
61to90 mm	5	400	20
91to140 mm	5	570	28
Above140mm	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 $-5\pm 1^{\circ}\text{C}$. 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 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 hold.
- 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 and 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 16hrs. 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°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°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.
 - ☐ Aluminum Pan Preparation: Standard aluminum DSC pans as per ASTM D 4565 are

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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%extradrygrade) at 60±10 cc per minute.
- ☐ Oxidation Test: Rapidly increase the temperature of the sample (20°C/minor greater) from 100°C or lower initial temperature to 199±1°C. After thermal equilibrium is obtained (steady recorder signal) switch to 80±20cc per minute oxygen flow and simultaneously start time-base recording. The oxygen used for the test should be equivalent to or betterthan99.6% 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 lop eat the start of the exothermic reaction. The test in the pure dry oxygen atmosphere shall continue until the exothermic peak is produced. The inter section of the tangent of the exothermic sloped line with the extended base line will be drawn. The time from time zero to is inter section point is read from the base line and recorded as the oxidative induction time.

e) RESISTANCET OF LAME PROPAGATION TEST PROCEDURE

- i. Samples of DWC HDPE Ducts shall be checked by applying 1KW flame.
- ii. As ample 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 +10mm apart and approximately equal distance 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 on to the tissue paper. A suitable piece of white pine wood board, approximately 10 mm thick, covered with single layer of white is sue 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 clampbeing500+10mmabovetheintern allowed surface of the enclosure.
- iv. The burner is supported so that its axis is 45+20to 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



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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 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 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, Rattus rattus.

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



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FIGURE- 1
IMPACT APPRATUS

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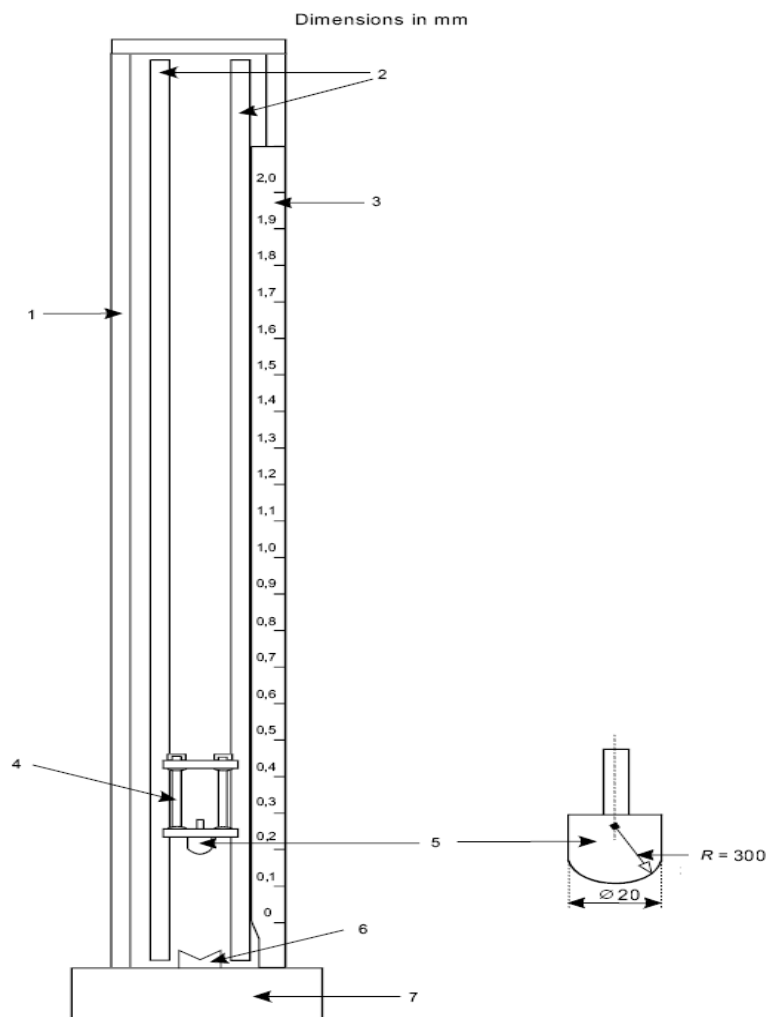
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Key	
1	Frame
2	Guide rails
3	Graduated scale
4	Guidance carriage
5	Head of hammer
6	120° vee block
7	Rigid base

NOTE This drawing is not intended to govern design except as regards the dimensions shown

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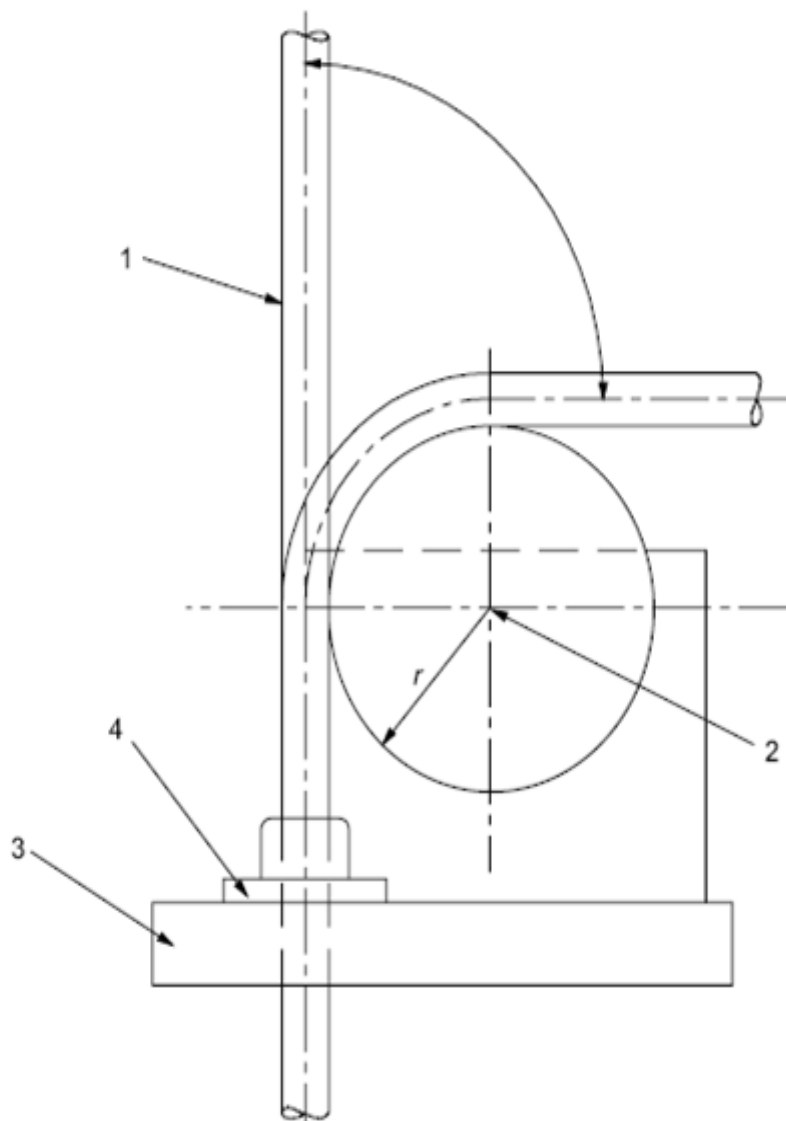
surat

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FIGURE- 2
BENDINGTESTAPPARATUS

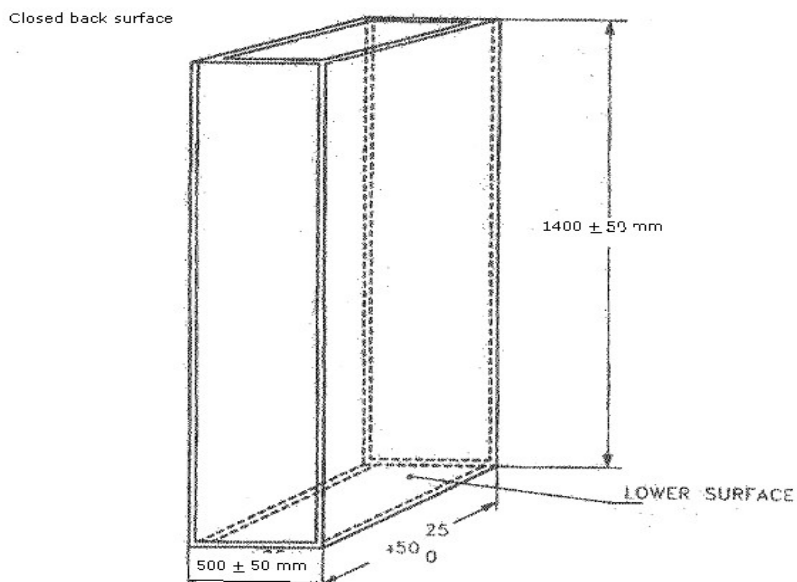


Key

- 1 Sample
- 2 Centre of bending cylinder
- 3 Support
- 4 Guide for conduit

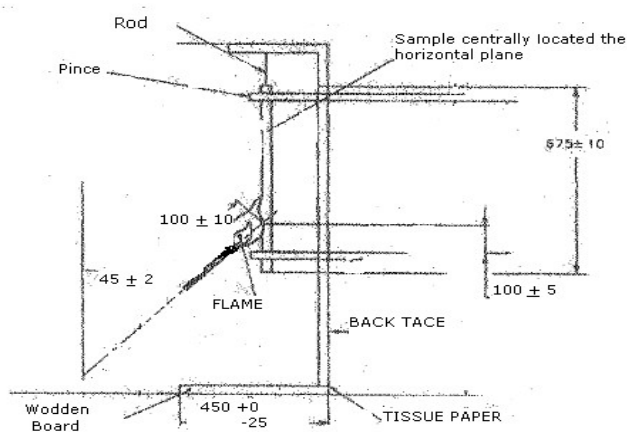
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RESISTANCETOFLAMEPROPAGATIONTESTAPPARATUS





Note:- This drawing is not intended to govern design

ENCLOSURE FOR BURNING TEST



Note:- This drawing is not intended to govern design except as regards the dimension shown
ARRANGEMENT FOR BURNING TEST

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GTP OF HDPE PIPES



SR	DESCRIPTION / PARAMETERS	OFFERED BY THE BIDDER
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)	

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Signature of Tenderer
Place:

Company's Round Seal
Signature of Tenderer

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TECHNICAL SPECIFICATION FOR RCC HALF ROUND HUME PIPE

1 Scope:

This Specification provides for the manufacture, inspection and testing, forwarding and delivery at site/stores of R.C.C. Half Round Hume Pipe for covering HT & LT. cables as specified hereunder:

2 Tests Procedure

The R.C.C. Half Round Hume Pipe shall have the following Parameters



Dimensions	
Inner Diameter	150.00 mm
Thickness	30.00 mm
Length	1 Meter (+/- 10 mm)
M.S. Welded Wire mesh Max.	40 mm X 40 mm
Spacing for mesh	
Wire Thickness	2.65 mm

3 General Requirement:

- 3.1 The inner & outer surface shall not have any sharp edge, which can damage the cable. No additional cost shall be provided to smooth the surface.
- 3.2 The welded wire mesh shall not be exposed to surface. Also, the wire mesh shall be properly welded type.
- 3.3 Grade of concrete shall be M25. The raw material shall be of standard quality. The cement shall be 53 Grade OPC of any reputed make available in market only.
- 3.4 The R.C.C. Half Round Hume Pipe shall be cured in water pond for minimum 14 days. Also, the R.C.C. Half Round Hume Pipe shall be completely dried before dispatch.
- 3.5 In concrete mixing, the ratio shall be maintained. The Grit shall be used instead of Gravel with size of 12mm.
- 3.6 Process of manufacturing shall be rolling machine made or Table vibrator type.

4 Marking:

- 6.1 The R.C.C. Half Round Hume Pipe shall be indelibly marked with the following information.
- 6.2 "Purchasers name or Logo" & "Manufacturer's name or Trade mark shall be embossed or printed on outer surface.
- 6.3 Voltage Rating "Up to 11000 V " OR as directed by Engineer In charge shall be embossed / printed on outer surface.
- 6.4 Printing shall be with RED color in readable size & format.

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5 Inspection

- 6.1 The Purchaser shall have access at all reasonable times to the works and all other places of manufacture, where the R.C.C. Half Round Hume Pipe are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works raw materials, manufacture of the equipment, all the accessories and for conducting necessary tests.
- 6.2 The supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.

6 Test

Fractural test at Government approved Laboratory on sample basis as per DGVCL requirement will be carried out by supplier in presence of DGVCL representative. The charges of test shall be borne by supplier. The maximum deviation in test result value shall be within +/- 5%.

7 Packing and Handling:

- 7.1 Vendor shall be responsible for any damage to the material during transit.
- 7.2 Vendor is liable for free replacements of damaged items due to defective or insufficient packing and / or protection.

8 Warranty:

The material found defective to be replaced by supplier free of cost within 7 days of notification.

Note: Bidder shall fill up the values clearly wherever applicable

Signature of the Bidder:

Name:

Designation:

Date:

Stamp / seal of the bidder: