PURCHASE SPECIFICATIONS

OF

SINGLE CORE, 1525/0.5MM, 300SQMM, EVA INSULATED & EVA SHEATHED FLEXIBLE COPPER POWER CABLES

FOR

OIL RIG APPLICATIONS

SPECIFICATION NO :	**OR 12003**
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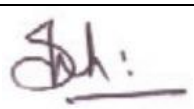	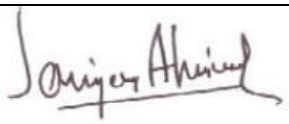	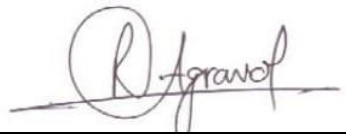
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SPECIFICATIONS FOR SINGLE CORE, 1525/0.5MM., 300 SQ.MM EVA RUBBER INSULATED & EVA RUBBER SHEATHED FLEXIBLE COPPER POWER CABLES FOR OIL RIG APPLICATIONS.

1.0 GENERAL :-

This specification governs the quality requirements of 1100 V grade, Single core, 300 Sq.mm, 1525/0.5 mm., heat resistant Ethylene Vinyl Acetate (EVA) rubber insulated cable (suitable for 125 deg C continuous operation), conductor made of annealed tinned stranded copper wire and sheathed with heavy duty, oil resistant, flame retardant, abrasion resisting modified EVA Rubber.

There is no Indian Standard covering complete details of above cable. Assistance has been drawn from the following standards/Circulars in formulating this specification :

IS 9968-1 (1988)	:	Specification for Elastomer Insulated Cables
IS 6380 (1984) & BS 6899 (1991)	:	Specification for Elastomeric Insulation & Sheath of Electric Cables.
IS 8130 (1984) & BS 6360 (1991)	:	Conductors for insulated electric cables & flexible cords
IS 10810-0 (1984)	:	Method of Test for Cables
BS 6007 (1993)	:	Rubber insulated cables for electric power & Lighting
BS 6007 (2000)	:	Single Core unsheathed heat resisting cables for voltages upto & including 450/750V for internal wiring.
BS 4066-1 (1994)	:	Test on Electric Cables under fire conditions
BS 6883 (1991)	:	Elastomer Insulated cables for fixed wiring in ships and on mobile & fixed offshore units.
VDE 0207 Part 20	:	Insulating & Sheathing Compounds for cables and Flexible cords, rubber insulating compounds
DGMS(Tech Cir) No 9	:	Use of Flexible Cables in drilling rigs and in other similar equipment in Oil Mines Reg.
DGMS(Tech Cir) No 12: 25/5/2015		Requirement of General approval for cables for Oil mines

2.0 CONDUCTOR :-

2.1 The conductor core shall consist of High conductivity, bright tinned and annealed stranded copper conductor conforming to ***IS 8130 class 5 Table 3.*** .

Nominal Diameter of each strand	-	0.5 mm.
Total Number of strands in core	-	1525 (61 bundles of 25 strands each)
Diameter of built-up conductor	-	26.0 mm (for reference)

The conductor shall be built-up with multirope stranding for maximum flexibility.

2.2 Resistance of conductor core at 20 deg C shall not exceed the maximum value of 0.0654 ohms per kilometer length.

2.3 Persulphate test for tinned copper wires shall meet the requirements of ***IS 8130.***

2.4 Conductor shall conform to the requirements of annealing test specified in ***IS 8130.***

3.0 INSULATION :-

3.1 **EVA Insulation -** All electrical & Physical properties along with other requirements as specified in this specification shall be strictly meet. The insulation shall be of Black colour, (Ref specification for Insulation Polymer shall be VDE-0207 Part 20)

3.2 The insulation shall be so applied with conductor in center and that insulation fits closely on the conductor but shall not adhere to it.

3.3 The insulation shall be applied by extrusion process.

3.4 Insulated core shall have reasonable round shape and outer surface shall be uniform.

3.5 Polyester film (Melinex) separator Tape of 0.0125 to 0.05mm thickness shall be applied between conductor and insulation so as to prevent penetration of insulation between conductor strands but this application of tape shall not cause the insulation to move or slip over the conductor. The tape shall be compatible with the thermal class of the EVA insulation i.e. 125 deg C. The tape shall have manufacturer name printed on it at an interval not greater then 500mm.

3.6 Thickness of Insulation :

Nominal Radial thickness of insulation shall be 2.8 mm.

The average thickness of the insulation shall not be less than nominal value as specified above when determined by the method described in ***IS 10810 Part 6***. However the smallest of the measured values of the insulation shall not fall below the nominal value by more than 0.38 mm (Ref clause 12.3 of ***IS 9968-1***).

4.0 OUTER SHEATH :-

4.1 EVA Sheath - The Outer sheath shall be of heavy duty, Oil Resistant & fire retardant, abrasion resisting modified EVA based rubber compound of Black colour shall be provided over the insulated conductor by extrusion process. All electrical & Physical properties along with other requirements as specified in this specification shall be strictly meet. (Ref specification for Sheath Polymer shall be VDE-0207 Part 20).

4.2 The sheath shall fit closely and surround the insulated core. The sheath shall not slip over the insulation.

4.3 The sheath shall be capable of offering high degree of resistance to mechanical damage and abrasions..

4.4 Thickness of Sheath :

Nominal Radial thickness of sheath shall be 1.8 mm.

The average thickness of the sheath shall not be less than nominal value as specified above when determined by the method described in ***IS 10810 Part 6***. The smallest of the measured values of the sheath shall not fall below the nominal value by more than 0.37 mm (Ref clause 10.3 of ***BS 6007-1993***).

5.0 CONSTRUCTION OF CABLE :-

5.1 The conductor shall be built up with multi rope stranding for maximum flexibility (61 bundles of 25 strands each).

5.2 Suitable separator melinex coloured tape as specified above shall be used between the conductor and extruded insulation to prevent penetration of the insulating material between the conductor strands. But this application of tape must not cause the insulation to slip and move over the conductor.

5.3 The conductor shall be centered accurately in the insulation and sheath.

5.4 Overall diameter :

The overall diameter of completed cable shall be - 35.0 mm +1.0 mm., - 0 mm.

5.5 Finish of Cable :

The vulcanizing process of the outer sheath shall not involve the use of curing tape. The finish of outer sheath is required to be uniformly smooth without any sharp ridges and shall not be sticky.

6.0 CURRENT CARRYING CAPACITY :-

Current carrying capacity of the cable shall be as follows:

- In Air - 925 Amps. (approx.)
- In Duct - 875 Amps. (approx.)
- In Ground - 825 Amps. (approx.)

7.0 IDENTIFICATION OF MANUFACTURER AND CABLE MARKING:-

7.1 Manufacturer name & cable identification marking consisting of following shall be printed in white indelible ink on finished cable outer sheath surface, at an interval of not more than 750mm :-" ***MFG BY …….. 300 SQMM X 1C EVA CABLE 125 DEG. C. CLASS 1100V BHEL CODE BP9048490901***".

7.2 Manufacturer's name and year of manufacture shall be also be printed on a melinex (separator) tape applied over the conductor as specified in Clause 3.5 & 5.2.

7.3 Sequential marking of cable length in meters at per meter length to be printed on the outer Sheath of the cable.

8.0 TESTS : -

Following tests shall be carried out by the manufacturer on the cable. Cable length required for Type testing / any other testing shall be in supplier scope. Supplier to supply full PO qty of cable length as per PO within acceptable tolerance (Ref Cl. No. 9.0 also) :

8.1 Type Tests (To be done for each Purchase order 1st lot) :

8.1.1 Composition of Conductor :

All wires must be of same nominal diameter. The diameter of the wires must not differ from the nominal diameter beyond the tolerance of +/- 0.01mm.

The diameter of the wires shall be measured by means of a ratchet micrometer or a dial micrometer, between smooth faces circular in shape. The average of the readings of the two measurements taken at right angles to each other shall be accepted as the value of the diameter.

8.1.2 Annealing Test :

To be conducted on copper wire for conductor as per IS 10810 Part 1. For requirements refer IS 8130 clause 6.1.2.1.

8.1.3 Persulphate test

To be conducted on copper wire for conductor as per IS 10810 Part 4. For requirements refer IS 8130 clause 6.1.1.

8.1.4 Conductor Resistance Test :

The per kilometer resistance values obtained of the built-up conductor shall not exceed as specified in Cl no 2. To be measured as per IS 10810 Part 5.

8.1.5 Test for thickness of Insulation, Sheath & Overall diameter of the cables:
Test for thickness of insulation, sheath & overall diameter of the cables to be conducted as per IS 10810 Part 6. The values shall be as per this specification Cl No 3.6 for insulation, Cl No 4.4 for Sheath and Cl No 5.4 for Overall diameter of the cable.

8.1.6 Physical Tests for Insulation and Sheath:

The results obtained shall comply with the specified values as given below :

8.1.6.1 Tensile strength (N/sqmm), unaged test piece (Test method as per IS10810 Part 7)
- i) Insulation : 5 Min
- ii) Sheath : 10.0 Min at break
- iii) Sheath : 3.0 Min at 200% elongation

8.1.6.2 Elongation (%), at break on unaged test piece (Test method as per IS10810 Part 11)
- i) Insulation : 150 Min
- ii) Sheath : 200 Min

8.1.6.3 Accelerated ageing of insulation in air oven at 140+/-3 deg C for 10 days (Test method as per IS10810 Part 11)
- i) Tensile strength : 4 N/sqmm Min
- ii) Elongation at break : 120 percent Min

8.1.6.4 Effect of ageing on Sheath in air bomb at 127+/-1 deg C for 40 hours & 0.55 +/-0.02MPa pressure (Test Method as per IS6380 Appendix A)
% Variation in Tensile strength & Elongation (of unaged samples)
- i) Sheath : +/- 50 %

8.1.6.5 Oil Resistant Test on Sheath : After aging at 100+/-2 deg C for 24 hrs (Test method as per IS10810 Part 31)
- i) Tensile strength (% value of unaged samples) : 65 Min
- ii) Elongation at break (% value of unaged samples) : 65 Min

8.1.7 Flammability Test :

A sample of 700mm length shall be suspended vertically in a rectangular chimney. A gas flame 125 mm long & at an angle of 45 degree shall be applied at a distance of 70 mm from the lower end of the cable, five times, for a duration of 15 seconds each, having intervals of 15 seconds after each application. The cable must not continue to burn for more than a minute after the fifth application.

8.1.8 Flame Retardance Test (Special test) :

As per BS 4066 (Part 1).

8.1.9 Test for Identification of Rubber Polymer (optional test) :

This test shall be carried out in line with ASTM-D-3677 and meet the requirements of ASTM-D-3677.

8.1.10 Bending, High Voltage / Insulation Resistance Test :

A specimen of cable in 'as received' condition shall be closed wound round on a mandrel having diameter as specified below:

Diameter of cable (D)	Diameter of mandrel
Upto and including 20 mm.	3 D
Above 20 mm.	5 D

The cable shall be wound for 10 continuous turns in right hand direction. This process shall be repeated thrice, the cable sample shall be straightened and rewound three times on the same mandrel for 10 turns in left hand direction. This is done so that the external surface of cable situated on the outside during the first operation is now on the inside.

There should not be any bulging or wrinkle formation on the outer sheath while the sample is on the mandrel. There should not be any slipping of the sheath over the insulation.

No cracks shall be visible when viewed by unaided eye. The cable shall meet the voltage test specified below :

High Voltage Test :

The voltage test shall be performed after the cable has been immersed in water for 16 hours and while still in water at room temperature, an alternating voltage with frequency of 40 to 60 Hz and RMS value of 3 KV shall be applied between the water and the cable conductor. The water shall be earthed.

The voltage shall be applied gradually and maintained at the full value of 3 KV for 15 minutes without showing any signs of failure of the insulation.

The voltage shall be increased further to 5 KV and maintained for 15 seconds. The cable insulation shall not show any sign of break-down.

Insulation Resistance Test :

Insulation resistance shall be conducted as per IS 10810 Part 43. Immediately after completion of the high voltage test, insulation resistance shall be measured between conductor and water at 1000V and the value shall not be less than 45 M.Ohm/Km at 20 Deg.C.

8.1.11 Surface Resistivity :

The surface resistivity when measured along a 25 mm length of the surface of the cable at room temperature shall be not less than 60,000 M. Ohm. The reduction in surface resistivity as specified above shall not be more than 75% after immersion in water for 16 hrs. the measurement shall be made after wiping off the water and allowing the cable to dry at room temperature for 10 minutes.

Test Method:

Two 25 mm wide strips of aluminum foil or any other metallic foil shall be wrapped around with inner edges 25 mm apart, on the middle of a 0.5 meter long cable sample. One strip shall be connected to high voltage, the other to low voltage and the conductor to guard terminal of a multimillion megaohm meter (a sensitive galvanometer).

The surface insulation resistance (R) shall be measured after stressing the surface for 1 minute at 500 +/- 50V DC.

Then The surface resistivity shall be calculated from the following formula :

Surface Resistivity = π RD/ L Mega Ohms

where R = Surface insulation resistance in M. Ohms.
D = Diameter of cable in mm.
L = Distance between foils in mm.

8.1.12 Slippage Test

A sample of length approximately 350 mm is taken and bend to a radius of 150mm. The relative displacement of the conductor with insulation shall not be more than 15mm for cables over 25mm diameter.

8.2 Acceptance Tests (To be done on each lot for a PO, sampling plan for acceptance test shall be as per IS9968 Appendix A) :

8.2.1 Annealing Test : Same as clause 8.1.2 above

8.2.2 Conductor Resistance Test: Same as clause 8.1.4. above

8.2.3 Tests for thickness of Insulation & Sheath and Overall diameter of the cables: Same as clause 8.1.5 above

8.2.4 Physical Test Insulation and sheath : Same as Cl No 8.1.6 above

8.2.6 Bending, High voltage & Insulation Resistance test : Same as clause 8.1.10 above.

8.2.7 Slippage test : Same as Clause No 8.1.12 above.

8.3 Routine Tests (To be done on each drum of every lot) :

8.3.1 Conductor Resistance Test: Same as clause 8.1.4 above

8.3.2 High Voltage Tests & Insulation Resistance Test : Same as clause 8.1.10 above.

8.4 Test Certificates :

First Lot Supply :

i) 3 copies of manufacturer's Test Certificates for Type Tests.
ii) 3 copies of Acceptance test Certificates for first lot. All drum Nos of this lot shall be mentioned on Acceptance test certificate alongwith the drum Nos specifically sampled for Acceptance test.
iii) 3 copies of Routine test certificate for each drum of first lot.

Subsequent Lots supply :

i) 3 copies of manufacturer's Test Certificates for Type Tests (done for first lot).
ii) 3 copies of Acceptance test Certificates for this lot. All drum Nos of this lot shall be mentioned on Acceptance test certificate alongwith the drum Nos specifically sampled for Acceptance test.
iii) 3 copies of Routine test certificate for each drum of first lot.

Note : Above Test Certificates shall be furnished giving details, such as, BHEL PO number/date, BHEL specification number, manufacturer's reference etc. Cable will not be accepted unless above certificates are received.

9.0 PACKING & DRUM MARKING:-

9.1 The cable shall be supplied wound on strong wooden drums in lengths of 500 metres +/- 2% of unbroken continuous cable; suitably packed to prevent damage during transit and storage.

9.2 Overall length tolerance on complete PO qty shall be +/- 2% if PO qty is more than 500 mtrs. Upto 500 mtrs tolerance shall be +/-5%. Supplier to inform BHEL MM the final total length of cable supplied after last consignment.

9.3 Identification of manufacturer name and marking on cable shall be as per ***IS 9968 Cl 23***, Printing, indentation or embossing on the Sheath including Cable cross section, no. of cores and BHEL Material code as per clause No. 7.1.

9.4 Sequential marking of cable length in meters at per meter length to be printed on the outer Sheath of the cable.

9.5 Each packing drums shall be marked/ labeled as given below:

1. BHEL Purchase Order no. & Specification No.
2. Manufacturer's name, brand name or trade mark.
3. Size, cores, length and voltage grade of the cable.
4. Direction of Rotation of drum by means of arrow.
5. Approximate gross weight.
6. Country of manufacture
7. Year of manufacture.

10.0 GURANTEE & WARRANTY :-

Cables shall be supplied with guarantee/warrantee of the manufacturer for 12 months from the date of commissioning or 18 months from the date of supply which ever is earlier

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Details of Rev 07 :

1. Spec generally revised in line with IS 9968 requirements as per DGMS circular No 9 dtd 2.6.09.
2. Resistance values at 20 deg C revised in line with IS8130 Class 5 Table 3.
4. All test requirements revised in line with relevant Istandard requirements.
5. Sequential marking of cable length at each meter called in specification.
6. Overall PO qty tolerance called in spec in addition to tolerance over drum length.

Details of Rev 08 :

1. Clause No. 1.0 modified, DGMS Tech Circular No 12 of May 2015 added.
2. Clause No. 7.1 modified.
3. Clause No. 8.0 modified, Cable lengths for type testing shall be in supplier scope.
4. Clause No 9.0, modified. Earlier Drum length was 100 mtrs +/-5% now changed to 500mtrs +/-2%
5. Clause No 9.0 modified, Marking on cables included for size, no. of cores and BHEL Material code.