

TENDER SPECIFICATION

No: CLW/ES/3/0458

Enclosure -

1- Drg. No.

2- Annexure

TOTAL NO. OF SHEETS: 29-32-33

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ENCLOSURES

SPECIFICATION  
FOR  
SET OF SINGLE CORE CABLES

FOR WAG-9 / WAP-5 LOCOMOTIVES

(This specification supersedes earlier specification No. CLW / ES / 3 / 0122)

## ISSUED BY

DY. CHIEF ELECTRICAL ENGINEER/CON/TU-I  
CHITTARANJAN LOCOMOTIVE WORKS  
P.C. CHITTARANJAN, 713331  
DIST. - BURDWAN, WEST BENGAL, INDIA.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>gdm/elect</i>	Checked by <i>[Signature]</i> J.E.-II	Reviewed by <i>[Signature]</i> SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 29 / 9 / 2001 NO: CLW/ES/3/0458
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### ALTERATION RECORD SHEET

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

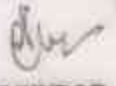
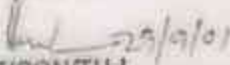


SHEET-4**TECHNICAL SPECIFICATION FOR SINGLE CORE CABLES FOR  
WAG-9 & WAP-5 CLASS LOCOMOTIVES****1.0 SCOPE:**

- 1.1 The specification covers the single core for operation voltage 1.8 kV and 4 kV ac for power, Auxiliary and control circuits. The cable covered are limited fire hazard type i.e. low flame spread, low smoke emission and less toxic fume emission. The cables are manufactured by Electron beam irradiated cross linked process. These cables are suitable for temperature range  $-40^{\circ}\text{C}$  to  $+120^{\circ}\text{C}$ .

**2.0****CLIMATIC AND ENVIRONMENTAL CONDITIONS:**

- \* Maximum Atmospheric temperature : Under Sun:  $70^{\circ}\text{C}$   
In Shade:  $50^{\circ}\text{C}$
- \* Humidity : 100% saturation during rainy season.
- \* Reference site conditions :
  - i) Ambient Temperature Max. :  $55^{\circ}\text{C}$ , Min:  $0^{\circ}\text{C}$
  - ii) Humidity : 60%
  - iii) Altitude : 100 m above mean sea level
  - iv) Rainfall : Very heavy in certain areas. The locomotive will be designed to permit its running at 10 km/hr in flood water level of 102 mm above rail level.
- \* Atmosphere during hot weather : Extremely dusty and desert terrain in certain areas.

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- \* Coastal area : Locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere.
- \* Vibration : The equipment, sub-system and their mounting arrangement will be designed to withstand vibrations and shocks encountered in service as specified in corresponding IEC publications unless otherwise prescribed.

3.0

**STANDARDS:**

1. UIC 895 OR
2. IEC 811-1-1 Cl. 5, Cl. 9, Cl. 9.1.3
3. IEC 811-1-2 Cl. 8
4. IEC 811-3-1 Cl. 8, Cl. 9
5. IEC 811-2-1 Cl. 9, Cl. 10
6. IEC 811-1-3 Cl. 10
7. IEC 811-1-4 Cl. 8.1, Cl. 8.5
8. IEC 228 Cl. 5
9. IEC 245-2 Cl. 2.1
10. IEC 885-1 Cl. 3, Cl. 4
11. IEC 332-1
12. IEC 332 Cat - C
13. IEC 754 - 2
14. IEC 1034 - 2
15. TDE/76/P/16 Cl. 36, Cl. 27, Cl. 28, Cl. 29, Cl. 134
16. UL 1581, 1983 Cl. 1320.4
17. DIN 53307
18. DIN 53387
19. UTTP Part 2E8, Part 2E7, Part 2E4

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4.0 **MATERIAL AND CONSTRUCTION DETAILS:**4.1 **Materials:-**4.1.1 **Conductor:**

The conductor shall be made up with circular tinned, annealed copper wires complying to IEC-228 class-5. Nominal cross sectional area, nominal diameter of wires in conductor, number of wires and maximum resistance of conductor at 20°C shall be as per Data Sheet I & II enclosed.

4.2.2 **Insulation:**

Electron, beam cross linked insulation heat and cold resistant as well as chemical and mechanical resistant

- Base polymer EPDM
- Polymer as modified as the base polymer
- Alumina Trihydrate (ATH)
- Anti oxidants
- Cross-linking agent.

4.2.3 **Sheathing:**

Electron, beam cross linked oil and fuel resistant as well as resistant to liquid media and mechanical stress.

- Base polymer ethylene - Acrylate, Co-polymer
- Polymer as modified as the base polymer
- Alumina Trihydrate (ATH)
- Anti oxidants
- Cross-linking agent.

4.3 **Construction:**

The conductor formation, minimum thickness of insulation/sheath and tolerance in overall diameter of the cable shall be according to Data Sheet I & II enclosed.

5.0 **TEST METHOD AND REQUIREMENTS:-**5.1 **Type tests:**

These tests shall be carried out to prove confirmation with the requirement of specification and general quality / design features of the cable. The results of the type tests shall be valid for a maximum period of three years for all sizes

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falling in that voltage grade. In case of any change in the material or design of the cable complete type tests shall be repeated.

Type test shall be carried out against each purchase order on all lots of cables manufactured by the manufacturer. The samples of different test shall be taken from different drums/ rolls of the lot as decided by the representative of Dy. CEE/CON/TU - I at the time of commencing of the test. If any sample fails in any of the type test, a fresh sample shall be taken and tested. If the sample again fails in that tests, the whole lot shall be rejected. At least three drums shall be offered for type test for taking samples.

#### ACCEPTANCE TESTS:

- 5.2 These tests are carried out on sample taken from a lot for the purpose of acceptance of a lot. Acceptance tests shall not be carried out a particular size from the lot on which type have already been conducted.

These tests are carried out as and when required on cables manufactured by a manufacturer. The samples (preferably 2/3 samples of each test) for different test shall be taken from different drums/rolls of the lot as decided by the inspecting authority. If any sample fails in any of the acceptance tests, afresh sample from a lot shall be taken & tested. If the sample again fails on that test the whole lot shall be rejected.

Cable manufactured in batch using the insulating sheathing materials from the same mix shall constitute a lot.

A recommended sampling plan is given bellow.

- 5.3 ROUTINE TEST :

These tests shall be carried out by the manufacturer on all finished cable lengths to ensure consistency of the product. However, the purchaser may carry out these tests on samples sealed at random as per the relevant specification to verify the results observed by the manufacturer.

These are tests carried out on each cable to check requirements, which are likely to vary during production.

- 5.3.1 The supplier shall provide all facilities to the inspecting officer of CLW to inspect and test the cables at various stages of manufacture and also the finished cables at his works. Necessary testing and measuring apparatus for

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carrying out the tests at the manufacturing place shall be provided by the supplier.

- 5.3.2 If it is considered by the representative of Dy.CEE/CON/TU/CLW to carry out any further tests or trials of the prototype/prototypes at Chittaranjan/ firms premises or to carry out tests if considered necessary at any stage during series supply, the supplier shall arrange for the same and/or send samples by the quickest means to clw. Improvement suggested after the tests shall be incorporated in the bulk supply without affecting the guaranteed deliveries.
- 5.3.3 Notwithstanding the fact that the product of the supplier has been accepted after testing and approval of the prototypes has been done by the purchaser's nominee, the supplier in no way shall be relived of his responsibility under the terms of the contract for faulty design, defective material, workmanship etc.
- 5.3.4 No consignment of series production shall be offered to the inspector authorized under the contract for routine inspection until the prototype has been finally approved by Dy.CEE/CON/TU-I/CLW or his authorized representative.

(5 A) **General: -**

**TEST:**

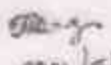
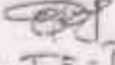
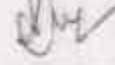

The tests are classified as type test (T) and / or Sample Test (S) and / or Routine Test (R) and / or Acceptance test (A).

	Type Tests	Requirements	Test Methods
1.	Construction and Dimensions (T, S)	Technical Data Sheet - I & II	UIC 895OR Cl. 5.1.1 or IEC 811-1-1 Cl. 8
1.1	Conductor (T, S)	Technical Data Sheet - I & II	IEC 228, Cl 5
1.2	Tin Plating (T)	No blistering No colour change	UIC 895OR Cl. 5.1.3
2	<b>Electrical properties</b>		
2.1	Conductor resistance (T, S) 1.8 kV 4 kV	Technical Data Sheet - I & II	UIC 895OR Cl. 5.1.2 or IEC 245-2, Cl. 2.1

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	Type Tests	Requirements	Test Methods
2.2	Voltage test		
2.2.1	After water immersion (T, S) 1.8 kV 4 kV	6 kV, 50 Hz, 10 min. 12 kV, 50 Hz, 15 min. after 24 hours H <sub>2</sub> O at $23 \pm 2^\circ\text{C}$ no breakdown.	UIC 8950R Cl. 5.3.3.2 or IEC 885-1 Cl. 3
2.2.2	Spark Test (T, R) 1.8 kV 4 kV	15 kV - No breakdown 22 kV - No breakdown	TDE/76/P/16 Cl. 36 or CENELEC FD 21.2 S2 Cl. 2.6.1
2.2.3	Voltage breakdown (T) 1.8 kV 4 kV	$\geq 15$ kV - No breakdown $\geq 22$ kV - No breakdown	UIC 8950R Cl. 5.3.3.3. or IEC 885-1 Cl. 3
2.2.4	Volume resistivity of insulation (T) at $23 \pm 2^\circ\text{C}$	$\geq 10^{10}$ Ohm.cm	TDE/76/P/16 Cl. 36 or IEC 885-1 Cl. 4
2.2.5	Leakage current factor (T)	$\leq 1.10^{-6}$ A/Vm	UT 1381.1993 Cl. 1320.4 test voltage $1.5 \times U_0$ 100 & $23 \pm 2^\circ\text{C}$
2.2.6	Water resistance (T) 1.8 kV 4 kV	1800 V DC - No breakdown 3600 V DC - No breakdown	UIC 8950R Cl. 5.3.3.5
2.2.7	Tracking Resistance (T, S) - Current consumption after 10 sec at 2 kV Cross Section: $\leq 2.5 \text{ mm}^2$ 4 - 10 mm <sup>2</sup> 25 - 95 mm <sup>2</sup> 100 - 300 mm <sup>2</sup> Tracking voltage Breakdown voltage	$\leq 1.0$ mA $\leq 1.5$ mA $\leq 2.0$ mA $\leq 2.5$ mA $\geq 20$ kV $\geq 25$ kV	UIC 8950R Cl. 5.3.3.4 or TDE/76/P/16 Cl. 34

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	Type Tests	Requirements	Test Methods
3	<b>Mechanical and Thermal Properties</b>		
3.1	Mechanical properties of the insulation (T) Tensile Strength as received Elongation as received Alteration after ageing 10 d, 150 °C	$\geq 8 \text{ N/mm}^2$ $\geq 125 \%$ $\leq 30 \%$	IEC 811-1-1, Cl. 9* IEC 811-1-2, Cl. 8 * Where dumb-bell test cannot be prepared tubes of the combined sheath and insulation shall be used.
3.2	Mechanical properties of the sheath (T) Tensile Strength as received Elongation as received Alteration after ageing 10 d, 150 °C	$\geq 8 \text{ N/mm}^2$ $\geq 125 \%$ $\leq 30 \%$	IEC 811-1-1, Cl. 9* IEC 811-1-2, Cl. 8 * Where dumb-bell test cannot be prepared tubes of the combined sheath and insulation shall be used.
3.3	Test resistance of insulation and sheath (T)	Tearing force $\geq 2.5 \text{ N/mm}$	DIN 53507 Test specimen : strip of material $2 \times 15 \times 100 \text{ mm}$
3.4	Strippability (T, S) For section 1.5 - 6.0 mm <sup>2</sup>	The admissible stripping force shall be between the minimum and maximum values. The conductor shall not be damaged and shall be free of residues.	Appendix B
3.5	Pressure test at High Temperature (T)	Rest wall thickness $\geq 60 \%$ Test temperature $150 \pm 2^\circ\text{C}$	ULC 8950R Cl. 5.3.4.1 or IEC 811-3-1 Cl. 8.1
3.6	Hot Set test (T) Insulation sheath	Maximum elongation - Under load $\leq 100 \%$ - after cooling $\leq 25 \%$	IEC 811-2-1 Cl. 9 Test temp. $200 \pm 3^\circ\text{C}$ Test load $20 \text{ N/cm}^2$

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	Type Tests	Requirements	Test Methods
3.7	Shrinking (T)	Shrinkage $\leq 2$ mm	IEC 811-1-3, Cl. 10 Length of specimen: 300 mm, test temp. $180 \pm 3^{\circ}\text{C}$ , test duration 6 hrs.
3.8	Heat shock (T)	No cracking in sheath or insulation layer.	IEC 811-3-1, Cl. 9 Test temp. $180 \pm 3^{\circ}\text{C}$ , Mandrel $\phi$ acc. Cl. 3.12.1 of this spec.
3.9	Dynamic cut through resistance (T)	The mean value P for 4 tests, each with $90^{\circ}$ rotation of the specimen and ca. 100 mm longitudinal displacement shall not be lower than the values given in the following table.	TDE/76/P/16, Cl. 27

Cut through force P (N)

Cross section mm <sup>2</sup>	1.8 kV		4 kV	
	$23 \pm 2^{\circ}\text{C}$	$90 \pm 2^{\circ}\text{C}$	$23 \pm 2^{\circ}\text{C}$	$90 \pm 2^{\circ}\text{C}$
2.5	$\geq 100$ N	$\geq 30$ N	$\geq 200$ N	$\geq 40$ N
35	$\geq 300$ N	$\geq 80$ N	$\geq 500$ N	$\geq 100$ N

	Type Tests	Requirements	Test Methods
3.10	Notch propagation (T)	No breakdown	TDE/76/P/16 Cl. 29. The depth of the notch shall be of one third of the minimum combined wall thickness value as mentioned in technical data sheet I and II. - Test temp. $+23 \pm 2^{\circ}\text{C}$ - Test voltages 1.8 kV, 3000 V, 50 Hz 4 kV, 6000 V, 50 Hz

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	Type Tests	Requirements	Test Methods
3.11	<b>Abrasion resistance (T)</b>		
3.11.1	Of sheath and insulation	The scrape abrasion resistance shall not be less than 1000 double-strokes.	IS 1676/16/2/16 Cl. 28 resp. Appendix A
3.11.2	Of marking (indelibility)	No continuous strip shall be visible on the marking under 150 double-strokes.	Appendix A
3.12	<b>Windability (deformation) of the finished cable</b>		
3.12.1	As received (T, C)	No cracking in sheath or insulation layer, no breakdown when tested according Cl. 2.2.1	UIC 8950B Cl. 5.3.2 Mandrel - Ø Cable Ø 3 x D for ≤ 10 mm 5 x D ≥ 10 & 20 mm 6 x D > 20 mm
3.12.2	After ageing (T)	No cracking in sheath or insulation layer, no breakdown when tested according Cl. 2.2.1	The test specimen acc. 3.12.1 shall be aged during 10 d at 150 ± 5°C before winding.
3.12.3	At -40 ± 2°C (T)	No cracking in sheath or insulation layer, no breakdown when tested according Cl. 2.2.1	IEC 811-1-4, Cl. 8.1 Mandrel - Ø according Cl. 3.12.1 of this specification. The test specimen shall be aged during 10 d at 150 ± 5°C before winding.
3.13	Impact at -40 ± 2°C (T)	No crack in sheath or insulation layer no breakdown when tested according Cl. 2.2.1	IEC 811-1-4, Cl. 8.4 Test specimen as received and after ageing in air oven during 10 d at 150°C ± 5°C.

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	Type Tests	Requirements	Test Methods
3.14	Slippage test (T. S)	The relevant displacement of the conductor with insulation shall not be more than 10 mm for cables with 25 mm dia resp. 15 mm for cables over 25 mm dia.	A sample length approximately 350 mm is taken and bent to a radius of 150 mm.
4	Thermal and climatic tests		
4.1	Ozone resistance (T)	275 $\pm$ 25 ppm, 96 h, 23 $\pm$ 2°C no cracks in sheath or insulation layer no breakdown when tested according to Cl. 2.2.1	UIC 895OR Cl. 5.2.4 or IEC 811-2-1 Cl. 9
4.2	Weatherability of sheath material (T)	Elongation at break $\geq$ 80 %	DIN 53387 and IEC 811-1-1 Cl. 9.1.3 Dumb-bell test piece figure 12 Test duration 2000 hrs.

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	Type Tests	Requirements	Test Methods
4.3	Wicking (T)	Depth of penetration $\geq 5$ mm	A sample of 150 mm length shall be 50 mm deep immersed into a Rhodamin - B - Solution (0.02 g Rhodamin - B in a mixture of 21 distilled water, 30 ml ethyl-alcohol and 3 ml of anionic wetting agent) and conditioned without air motion in pipe for 24 hrs. at rt. Then sample shall be removed from the solvent and cleaned with a dry, fluff free cloth. Sheath or insulation shall carefully be removed from the sample. Using ultra-violet light it shall be measured for which distance beyond the immersed part of 50 mm, the luminous solvent has penetrated into the insulation.

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	Type Tests	Requirements	Test Methods
4.4	<b>Resistance to fluid</b>		
4.4.1	Mineral oil - ASTM Nr. 2 100 ± 2°C, 21 hrs (T) - ASTM Nr. 3 100 ± 2°C, 72 hrs (T)	No cracks or other deterioration in sheath and insulation layer no break down when tested according to Cl. 2.2.1	Test equipment according IEC 811-2-1 Cl. 10 Test specimen according Cl. 3.12.1 of this specification. The specimen shall be immersed in the specified medium for the described test duration. The ends of the specimen shall rise above the test medium at least 50 mm
4.4.2	Diesel oil 70 ± 2°C, 168 hrs (T) 70 ± 2°C, 24 hrs (S)		
4.4.3	Cleaner 23 ± 2°C, 24 hrs (T) (Aussenreiniger SU 75-Lever – Industrie Olten)		
4.5	<b>Behavior with fire</b>		
4.5.1	Flame reterdance (T) (Single cable)	Charred length ≤ 200 mm Cease of burning ≤ 30 s	Appendix C (IEC 332-1)
4.5.2	Flame propagation (T) (Bunched cable)	The charred or affected portion should not have reached a height exceeding 2.5 m above the bottom edge or the burner.	Appendix D (IEC 332-3, Cut – C)
4.5.3	Corrosivity of combustion gases (T)	pH-Index ≥ 3.5 Electrolytic conductivity ≤ 100 μ S / cm	UITP Part 2 E 8 Or IEC 754-2
4.5.4	Toxicity of combustion gases (T)	Noxiousness – Index INC 800°C ≤ 100 Toxicity – Index ITC 800°C ≤ 5	UITP Part 2 E 7
4.5.5	Smoke Intensity (T)	Cable Ø                      Intensity < 3 mm                      Ao ≤ 0.4 3 ≤ Ø < 9 mm              Ao ≤ 0.8 > 9 mm                      Ao ≤ 1.2	UITP Part 2 E 4 Or IEC 1034 – 2

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				ALT	A	B	C	D

	Type Tests	Requirements	Test Methods
4.5.6	Waste Disposal		The material of the insulation sheath and the separators when applicable shall have little pollution effect, when disposed with the garbage (acc. Swiss Federal Law for environmental protection 814.001 and order for low pollution substances StoVS14.013). the relevant data safety sheet is to be presented by the manufacturer or supplier.




SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  gdm/Elect.	Checked by  J.E-II	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA		
	APPROVED BY  DY.CEE/CON/TU-I					DATE: 29/9/2001 NO: CLW/ES/3/0458
	ALT			A	B	C

(5B) (a) Following visual inspection / preliminary checks shall be carried out on cables during Routine Inspection by inspecting authority.

- Composition of conductor as per technical Data Sheet of relevant Specification.
- Any apparent damage of sheath or insulation.
- Any kind of bulging in the cable.
- Circularity of cable is maintained.
- Thickness of insulation / sheath is maintained throughout the length of cable.
- Sufficient bonding is there between sheath and insulation so that sheath is not easily separable from the cable insulation.
- **If found OK, conduct all the acceptance and routine tests as laid down in the relevant Specification including the following additional acceptance tests.**

- **Wrinkle formation** When the cable is tested as per clause 11.2 of RDSO Spec. 0019, it should be free from wrinkle in side the bend portion of the cable.
- **Flexibility** This shall be conducted as under.

At room temperature, one end of a 1.5 meter long test specimen shall be secured on to the mandrel and the other end to the weight specified in Table below. The mandrel shall be mounted in a fixer so that the weighted end of the test specimen is freely suspended. The mandrel shall be rotated at 2 rpm until at least 3 full turns of the test specimen have been wrapped around the mandrel. The flexibility of cable

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  JE-1/D&D	Checked by	Reviewed by 	D&D CENTRE  CHITTARANJAN LOCOMOTIVE WORKS, WEST BENGAL, INDIA
	Approved by  27/4/05 Dy. CEE/D-1			DATE 25/4/2005  NO. CLW/ES/3/0458
				Alt. A <input type="checkbox"/> B <input checked="" type="checkbox"/> C <input checked="" type="checkbox"/> D <input checked="" type="checkbox"/> E <input checked="" type="checkbox"/>



shall be such as to permit these turns to fit tightly against the mandrel. Any specimen exhibiting a continuous separation of adjacent turns for more than 90 deg. shall not meet the test requirement.



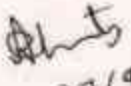
Cable sizes in mm sq.	Mandrel dia in mm.	Weight in kg.
95 mm sq	60 mm	6.0 kg
120 mm sq	77 mm	7.5 kg
185 mm sq	100 mm	10.5 kg
240 mm sq	115 mm	12.0
300 mm sq	130 mm	15.5 kg

- Mechanical properties of Insulation** Same as clause 7.1.2 of RDSO Spec. No. 0019 but the value will be 8 N / mm. sq.
- Mechanical properties of the sheath** Same as clause 7.1.3 of RDSO Spec. No. 0019 but the value will be 10 N / mm.sq.
- Tear resistance of the Insulation and sheath** Same as clause 7.2.6 of RDSO Spec. No.0019

**(b) Strippability Test:**

- The sheath and insulation together shall strip freely from the conductor in at least a 50 mm. length using Automatic / Manual Stripping Machine. The insulation shall be well bonded to the sheath so that it will strip off the conductor together with the sheath.




3.0 When all the tests are over / found satisfactory, allow the manufacturer for packing of cable drum / reel. Ensure that the packing is proper and safe for transportation. Put clearance or rejection endorsement on each Drum / Reel / Coil. Get the end

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  JE-1/D&D	Checked by	Reviewed by 	D&D CENTRE  CHITTARANJAN LOCOMOTIVE WORKS, WEST BENGAL, INDIA  DATE 25/4/2005  NO. CLW/ES/3/0458 Alt. A B C D E
	Approved by  27/4/05 Dy. CEE/D-1			

sealing done of the cleared material and issue dispatch certificate to the manufacturer. All the manufacturers are to ensure that no damage takes place during loading at their Works & transportation to the site and purchaser is to ensure that no damage takes place during unloading at the destination.

#### 4.0 Acceptance criteria for the Purchaser

On receipt of cables, the consignee will thoroughly check each LOT for any damage or abnormality, note down the rejection if any and advise the same to the manufacturer within a reasonable time. On receipt of rejection advise, the manufacturer will replace the rejected lot by a fresh lot within a reasonable time duly inspected inspecting agency and also arrange to lift the rejected lot from consignee. For accepted lot, the consignee will issue certificate to the manufacturer.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  JE-1/D&D	Checked by	Reviewed by 	D&D CENTRE  CHITTARANJAN LOCOMOTIVE WORKS, WEST BENGAL, INDIA
	Approved by  27/4/05 Dy. CEE/D-1			DATE 25/4/05  NO. CLW/ES/3/0458
				Alt. A B <input checked="" type="checkbox"/> D E

6.0 Recommended sampling plan:

As per appendix B of IS: 9968(PART-I) - 1981.

NO.OF DRUMS/COILS/REELS IN THE LOT	NO.OF DRUMS/COILS/REELS TO BE TAKEN AS SAMPLE	PERMISSIBLE NO. OF DEFECTIVES
(N)	(n)	(a)
(1)	(2)	(3)
UPTO 25	3	0
26-50	5	0
51-100	8	0
100-300	13	1
301-and above	20	1

7.0 CONFORMITY TO CONTRUCTION

SL. NO.	DESCRIPTION OF TEST/CHECK	TEST METHOD	% TO BE CHECKED
1.	Check number of core as per purchase order details( lay of cores) in case of multicore cables.	visual	100%
2.	Check packing in standard lengths as specified in p.o. check sealing both ends of the cable in the drums.	visual	100%
3.	Check provision of deep coloured melinex or polyester tape on core insulation sheath should not slip over each other easily and insulation should also slip over conductor.	visual	100%
4.	Provision of correct identification tape indicating type grade and manufacturer's identification & year of manufacture.	visual	100%
5.	Check over all diameter of the cable to be within max. permissible limits.	visual	100%
6.	Check liberal use of French chalk while coiling in drums / reels, in case of multicore cables check on above between cores also on opening the sheath.	visual	100%

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  J. E. S.	Checked by  J. E. S.	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA				
	APPROVED BY  DY.CEE/CON/TU-I			DATE: 29/9/2001 NO: CLW/ES/3/0458				
				ALT	A	B	C	D



8.0

**TECHNICAL DOCUMENTS TO BE SUPPLIED BY THE TENDERER:-**

The tenderer shall interlay furnish the following in 3 copies along with the quotation.

- i) Clause wise comments on the specification and test programme.
- ii) Detailed drawings.
- iii) Past experience with supporting papers (if any).
- iv) Past test reports (if any).
- v) Manufacturer's name / trade name.
- vi) Specification no.
- vii) Type of cable, voltage grade and composition class.
- viii) Number of cores.
- ix) Nominal cross sectional area of conductor.
- x) No. of strands.
- xi) Diameter of each strand.
- xii) No. of bunches & wires per bunch.
- xiii) Conductor diameter.
- xiv) Over all diameter of cable.
- xv) Insulating material & its operating temperature.
- xvi) Material for sheath.
- xvii) Thickness of insulating material.
- xviii) Thickness of sheath.
- xix) Details of printing over sheath.
- xx) Rate per 100 meters of cable.
- xxi) Packing length of cable.
- xxii) Date by which prototype will be ready for inspection and test.
- xxiii) Commencement of bulk supply.
- xxiv) Rate of supply per month.
- xxv) Completion of delivery.
- xxvi) Guarantee of cable.
- xxvii) End sealing.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  J. E. II	Checked by  SEE/D&D	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 29/9/2001 NO: CLW/ES/3/0458
	APPROVED BY  DY.CEE/CONTU			

SHEET-22A

10.2.2 Cable length per drum:-

Three Phase:-

Sl. NO	SIZE	CABLE / DRUM
1.	<b>4GKW</b> 150 sqmm	500 meter
2.	120 sqmm	100 meter
3.	95sqmm	100 meter
4.	70sqmm	500 meter
5.	50 sqmm	500 meter
6.	35 sqmm	100 meter
7.	25 sqmm	500 meter
8.	16 sqmm	100 meter
9.	10 sqmm	500 meter
10.	6 sqmm	500 meter
11.	2.5 sqmm	1000 meter
12.	1.5 sqmm	1000 meter
13.	<b>9GKW</b> 150 sqmm	100 meter
14.	120 sqmm	500 meter
15.	95sqmm	100 meter
16.	70sqmm	100 meter
17.	25 sqmm	100 meter
18.	10 sqmm	100 meter
19.	0.5 FLEX YE-RED (D)	1000 meter
20.	0.5 FLEX YE-G	100 meter

**NOTE:-** Drum length of Cable can be accepted with tolerance  $\pm 2$  meter, the balance ordered qty. which does not fit in the standard drum length can be short closed.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>[Signature]</i> J-E-II	Checked by <i>[Signature]</i> SE/P	Reviewed by <i>[Signature]</i>	D&D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 18/03/08 NO: CLW/ES/3/0458
	APPROVED BY  DY.CEE/CON/D-II <i>[Signature]</i> 18/3/2008			
				ALT <input checked="" type="checkbox"/> A <input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C <input checked="" type="checkbox"/> D <input checked="" type="checkbox"/> E

9.

**GUARANTEE**

The supplier shall give a guarantee of clear eighteen months from the date of Commissioning or twenty months from the date of dispatch, whichever is earlier. The date of commissioning the Locomotive shall be deemed as the date of the cable going into service. The date of dispatch shall be reckoned from marking of the month and year of manufacture embossed on the cable. In the event of the firm's not being able to emboss marking of month, the month of dispatch will be considered from the December of the year. Any design or defect noticed during this period due to defective design / material / workmanship shall be replaced by the supplier free of cost.

10.0

**IDENTIFICATION, PACKING AND MARKING :-**

10.1

**Identification:**

The following details shall be printed on the sheath of the cable within 500 mm:

- i) Manufacturer's Name/Trade Mark
- ii) Year of Manufacture
- iii) Cable size.
- iv) Rated Voltage
- v) Indication of insulating material and its operating temperature.

10.2

**Packing and Marking:-**

10.2.1

**End Sealing:-** All cables shall have their ends sealed with non-hygroscopic sealing materials.

10.2.2

The cables shall be either wound on reels or drums or supplied in coils packed and labeled as 100 mtr./spool (A)

<u>CABLE LENGTH</u>	<u>CABLE SIZE</u>
1000 M/SPPOOL	UP TO 25 SQ mm.
500 M/SPPOOL	FROM 26 SQ mm TO 100 SQ mm
100 M/SPPOOL	> 100 SQ mm.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  PDM/Exec	Checked by  PDM/Exec	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA				
	APPROVED BY  DY.CEE/CON/TH			DATE: 29/9/2001 NO: CLW/ES/3/0458				
				ALT	A	B	C	D



10.2.3

The label or the stenciling on the drum shall contain the following information:

- Reference specification number.
- Manufacturer's Name, Brand Name or Trade Mark.
- Type of cables and voltage grade.
- Number of cores.
- Nominal cross-sectional area of the conductor.
- Cable code.
- Length of the cable on the drum/reel/coil.
- No. of lengths of the reel, drum or coil (if more than one).
- Direction of rotation of drum (by means of arrow).
- Approximate gross weight.
- Year of Manufacture.

11.0

#### REFERENCE OF OEM (Original Equipment Manufacturer)

M/s. HUBER + SUHNER AG

Energy and Signal Transmission

CH-8330, Pfaffikon ZH/Switzerland

Phone: 019522211. FAX: 019522424/+41-1-9522670

This specification has been framed based on Huber + Suhner's Technical Data specification 4/9 GW-AX issued on 19-07-1994 through ADtranz TOT Document 3EHW470015 / 3EHW470016.

12.0

**NOTE:-** The cables offered shall be similar to the cables used in WAG-9/WAP-5 locomotives of Indian railways

- All cables whose description includes SCR are screened cables (copper tin plated) and cables having twist in the description is not screened cables.

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>[Signature]</i> JDM/Elect	Checked by <i>[Signature]</i> J.E.-II	Reviewed by <i>[Signature]</i> SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA					
	APPROVED BY <i>[Signature]</i> DY.CEE/CONTU-I			DATE: 29/9/2001 NO: CLW/ES/3/0458					
				ALT	A	B	C	D	E

## DETAILS DESCRIPTION &amp; TECHNICAL DATA OF SINGLE CORE CABLE 1.8 kV

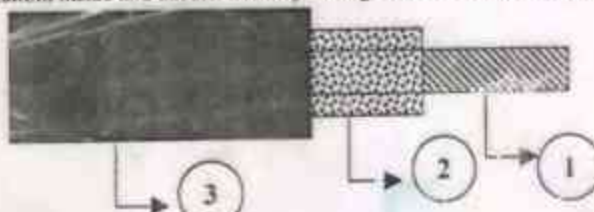
## DATA SHEET - I

## General Properties: -

Limited fire hazard electrical insulation cable, dual wall insulation, low smoke, halogen free, flame retardant, excellent resistance to high and low temperature, oil, ozone, weathering and abrasion, flexible, easy stripable.

## Application: -

For protected permanent installation, inside and out side railway rolling stock to connect fixed and moving parts.



- 1- Conductor - Stranded tin-plated copper acc. To IEC 228 CL 5
  - 2- Insulation - Electron - beam cross linked, copolymer, colour - Grey
  - 3- Sheath - Electron - beam cross linked, copolymer, colour - Black
- Cable marking- As per CL No. 10.0 of this specification.

## Technical Data

Voltage rating : 1.8 kV AC  
 Test Voltage : 6 kV ac, 50 Hz for 15 min.  
 Temperature Range : - 40°C to + 120°C  
 Min. bending radius

Free installation:  $D \leq 10 \text{ mm}$  :  $3 \times D$   
 $D > 10 \text{ mm}$  :  $5 \times D$   
 Fixed installation: all D :  $2 \times D$  at bending  $\leq 90^\circ$   
 $D \leq 10 \text{ mm}$  :  $3 \times D$  at bending  $> 90^\circ \leq 108^\circ$   
 $D > 10 \text{ mm}$  :  $4 \times D$  at bending  $> 90^\circ \leq 108^\circ$

Table 1: Dimensions, conductor resistance, Cable weight

Nominal Cross Section (sq. mm)	IDEN. NOS.	Conductor Typical Construction (m x m x mm)	Nominal Dia (mm)	Minimum Wall Thickness			Cable dia (mm)	R20 max. (Ohms / Km)	Weight Nominal (Kg/100 m)
				Insulation (mm)	Sheath (mm)	Total (mm) Combine			
1.5	3EHW47001SP0015	1 x 30 x 0.25	1.6	0.30	0.40	0.70	3.20 ± 0.10	13.7	2.0
2.5	3EHW47001SP0025	1 x 50 x 0.25	2.1	0.30	0.40	0.70	3.70 ± 0.15	8.21	3.0
6.0	3EHW47001SP0060	1 x 84 x 0.30	3.3	0.35	0.45	0.80	5.10 ± 0.15	3.39	7.0
10.0	3EHW47001SP0100	1 x 80 x 0.40	4.2	0.40	0.50	0.90	6.30 ± 0.20	1.95	11.0
16.0	3EHW47001SP0160	7 x 18 x 0.40	5.5	0.50	0.70	1.20	8.30 ± 0.20	1.24	18.0
25.0	3EHW47001SP0250	7 x 27 x 0.40	6.8	0.60	0.80	1.40	10.20 ± 0.30	0.795	26.0
35.0	3EHW47001SP0350	7 x 37 x 0.40	7.8	0.65	0.85	1.50	11.70 ± 0.30	0.565	36.0
50.0	3EHW47001SP0500	7 x 54 x 0.40	9.5	0.70	0.90	1.60	13.60 ± 0.30	0.393	52.0
70.0	3EHW47001SP0700	12 x 29 x 0.50	11.5	0.75	0.95	1.70	16.80 ± 0.30	0.277	72.0
95.0	3EHW47001SP0950	12 x 38 x 0.50	12.9	0.85	1.05	1.90	17.80 ± 0.30	0.210	95.0
120.0	3EHW47001SP1200	19 x 30 x 0.50	14.8	0.95	1.15	2.10	19.60 ± 0.30	0.164	124.0
150.0	3EHW47001SP1500	19 x 39 x 0.50	16.3	1.0	1.20	2.20	21.90 ± 0.30	0.132	152.0

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>gim/Elect.</i>	Checked by <i>J.E.-II</i>	Reviewed by <i>SEED&amp;D</i>	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA	
	APPROVED BY <i>BY/SEED/CONVLM</i>			DATE: 29 / 9 / 2001 NO: CLW/ES/3/0458	
				ALT	A B C D E

**DETAILS DESCRIPTION & TECHNICAL DATA OF SINGLE CORE CABLE 4 kV**

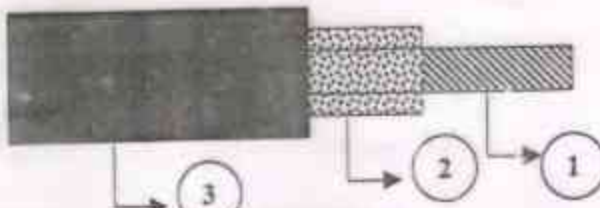
**DATA SHEET - II**

**General Properties: -**

Limited fire hazard electrical insulation cable, dual wall insulation, low smoke, halogen free, flame retardant, excellent resistance to high and low temperature, oil, ozone, weathering and abrasion, flexible, easy strippable.

**Application:-**

For protected permanent installation, inside and out side railway rolling stock to connect fixed and moving parts.



- 1- Conductor - Stranded tin-plated copper acc. To IEC 228 Cl. 5
  - 2- Insulation - Electron - beam cross linked, copolymer, colour - Red
  - 3- Sheath - Electron - beam cross linked, copolymer, colour - Black
- Cable marking - As per Cl. No. 10.0 of this specification.

**Technical Data**

Voltage rating : 4.0 kV AC  
 Test Voltage : 12 kV ac, 50 Hz for 15 min.  
 Temperature Range : -40°C to +125°C  
 Min. bending radius

Free installation :  $D \leq 10 \text{ mm}$  :  $3 \times D$   
 $D > 10 \text{ mm}$  :  $5 \times D$   
 Fixed installation : all  $D$  :  $2 \times D$  at bending  $\leq 90^\circ$   
 $D \leq 10 \text{ mm}$  :  $3 \times D$  at bending  $> 90^\circ \leq 108^\circ$   
 $D > 10 \text{ mm}$  :  $4 \times D$  at bending  $> 90^\circ \leq 108^\circ$

**Table 1: Dimensions, conductor resistance, Cable weight**

Nominal Cross Section (Sq. mm)	IDEN. NOS.	Conductor typical Construction (m x m x mm)	Nominal Dia (mm)	Minimum Wall Thickness			Cable dia (mm)	R20 max. (Ohms / Km)	Weight Nominal (Kg/100 m)
				Insulation (mm)	Sheath (mm)	Total (mm) Combined			
10.0	3EHW470016P0100	1 x 80 x 0.40	4.2	0.70	0.80	1.50	7.50 ± 0.20	1.93	14.0
16.0	3EHW470016P0160	7 x 18 x 0.40	5.5	0.85	0.95	1.80	9.40 ± 0.30	1.24	21.0
25.0	3EHW470016P0250	7 x 27 x 0.40	6.8	0.85	0.95	1.80	10.90 ± 0.40	0.795	25.0
70.0	3EHW470016P0700	12 x 29 x 0.50	11.5	1.05	1.15	2.20	16.50 ± 0.40	0.237	77.0
95.0	3EHW470016P0950	12 x 38 x 0.50	12.9	1.20	1.30	2.50	18.30 ± 0.50	0.210	102.0
120.0	3EHW470016P1200	19 x 30 x 0.50	14.8	1.30	1.40	2.70	20.60 ± 0.50	0.164	130.0
150.0	3EHW470016P1500	19 x 39 x 0.50	16.3	1.35	1.45	2.80	22.90 ± 0.50	0.132	161.0

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  GDM/Elect.	Checked by  J.E-II	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 29 / 9 / 2001 NO: CLW/ES/2/0458
	APPROVED BY  DY.CEE/CON/TU-I			
	ALT			



## Appendix - A

Abrasion resistance of insulation and sheath (3.11.1)Test method (Reference TDE/76/P/16, Cl. 2<sup>nd</sup>)

Test equipment according to the figure, a hardened tungsten carbide blade (detail X) will be mounted perpendicularly to the axis of the sample and rubbed over the sample with an amplitude of oscillation of 10 to 20 mm.

40 to 60 double strokes per minute shall be made. Test weight according to table, number of cycles shall be counted with a counter.

In the moment the steel blade reamer has contact to the conductor, the equipment shall be switched off automatically by a circuit with max. D.C. 50 V and 0.05 A.

Sample shall be positioned straight on its support during test by a suitable fixture.

Each test shall be performed. After each test the sample (length about 750 mm) shall be moved forward by 50 mm and turned by 90°.

Requirements

The arithmetic mean value of the eight results must to according to Cl.3.11.1.

Test weight

Cross section mm <sup>2</sup>	1.8 kV	4 kV
2.5	0.5	1
35	1	2

Abrasion resistance and indelibility of marking (3.11.2)Test method

Sample of suitable length is fixed into apparatus according to the figure, in such a manner, that the marking positioned under the steel wire, which is loaded with a test weight of 200 gm.

Diameter 'd' of steel wire 0.5 mm according to detail Y.

Three tests shall be made.

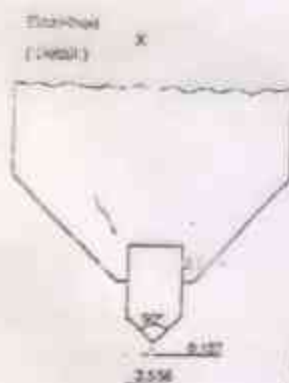
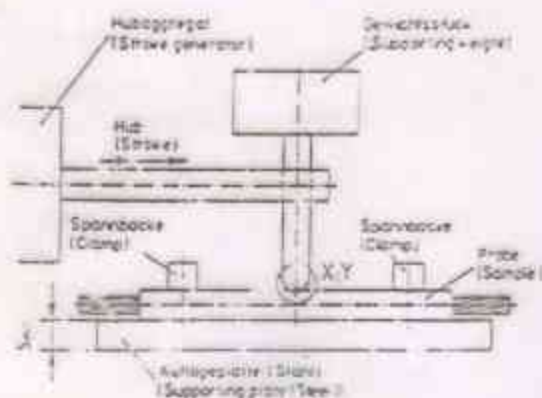
Amplitude of oscillation shall be 10 – 20 mm, 40 – 60 double strokes per minute shall be made.

Requirements

According to Cl. 3.11.2

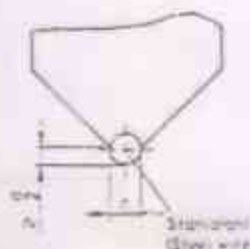
SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by  JDM/Spec	Checked by  J.E-II	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 29 / 9 / 2021 NO: CLW/ES/3/0458	
	APPROVED BY  DY.CEE/CON/TU-I				
	ALT	A	B		C

## Appendix A (continued)



Made in mm  
(Dimensions in millimeters)

Ensemble (Detail) Y



Test arrangement for abrasion of insulation/sheath and marking

SPECIFICATION  FOR  SET OF SINGLE CORE CABLE	Prepared by  Dm/lect	Checked by  J.E-II	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA				
	APPROVED BY  29/9/01 DY.CEE/CON/TU			DATE: 28/09/2001 NO: CLW/ES/3/0458				
				ALT	A	B	C	D

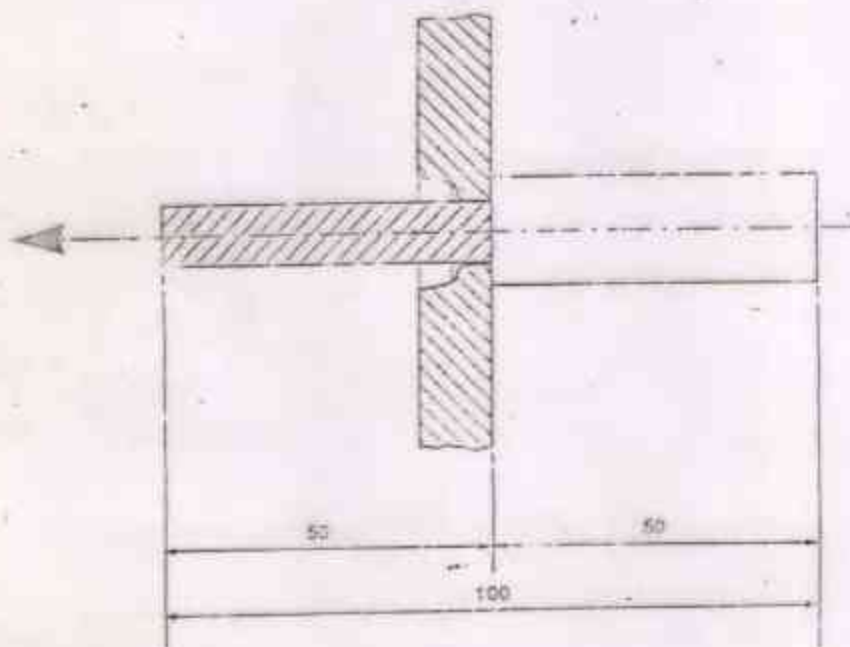
## Appendix B

## Strippability

## Test method

A sample of 100 mm length shall be stripped 50 mm carefully, so that the remaining portion of 50 mm is not moved or deformed.

The stripped end shall be slipped into the bush according the figure. The diameter of the bore hole shall slightly exceed the diameter of the conductor. The conductor shall be pulled out from the insulation with constant speed by means of an elongation test equipment.



## Retention force

Nominal Cross-section mm <sup>2</sup>	Pull force N	
	minimum in N	maximum in N
1.5	20	60
2.5	25	80
4	30	80
6	30	80

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>[Signature]</i> SDM/Elect.	Checked by <i>[Signature]</i> J.E-II	Reviewed by <i>[Signature]</i> SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA	
	APPROVED BY <i>[Signature]</i> 29/9/01 DY.CEE/CON/TU-I			DATE: 29/9/2001 NO: CLW/ES/3/0458	
				ALT	A B C D E



## Appendix C

## Flame retardance (single cable)

## Metallic screen

Three side metallic screen, 1200 mm high, 300 mm wide  
450 mm deep, open front, top and bottom closed

## Gas burner

1 kW acc. IEC 695-2-4/1

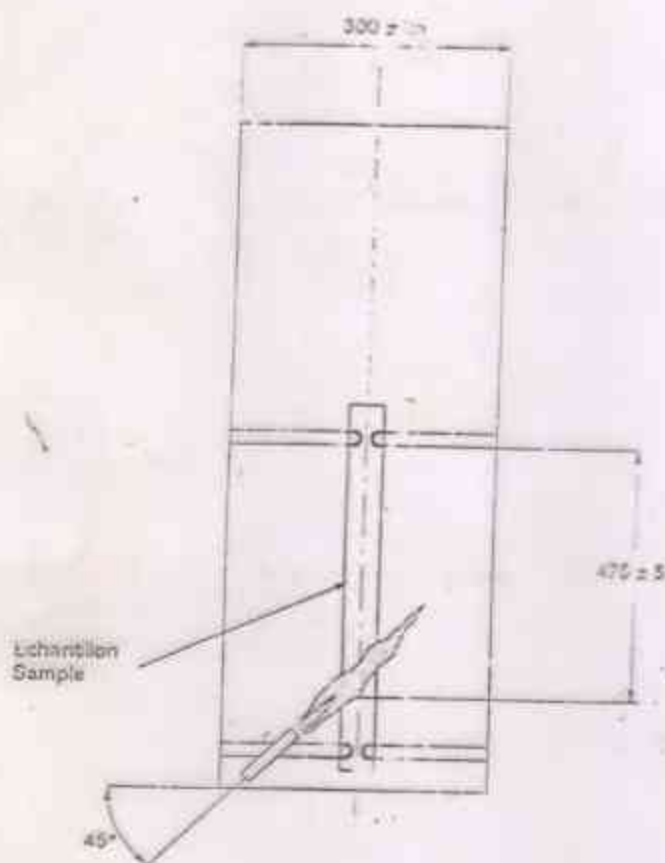
## Sample

Finished cable:  $(600 \pm 25)$  mm long

## Flame application time

60s IEC 332-1, table 1

Performance requirement according cl. 5.2.4.5.1



Test apparatus and arrangement of fire resistance test

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by <i>[Signature]</i> gsm/elect.	Checked by <i>[Signature]</i> J.E.-II	Reviewed by <i>[Signature]</i> SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA	
	APPROVED BY <i>[Signature]</i> DY.CEE/CON/TU-I			DATE: 29/9/2001 NO: CLW/ES/200458	
				ALT	A B C D E

## Appendix D

Flame Propagation (bunched cables)

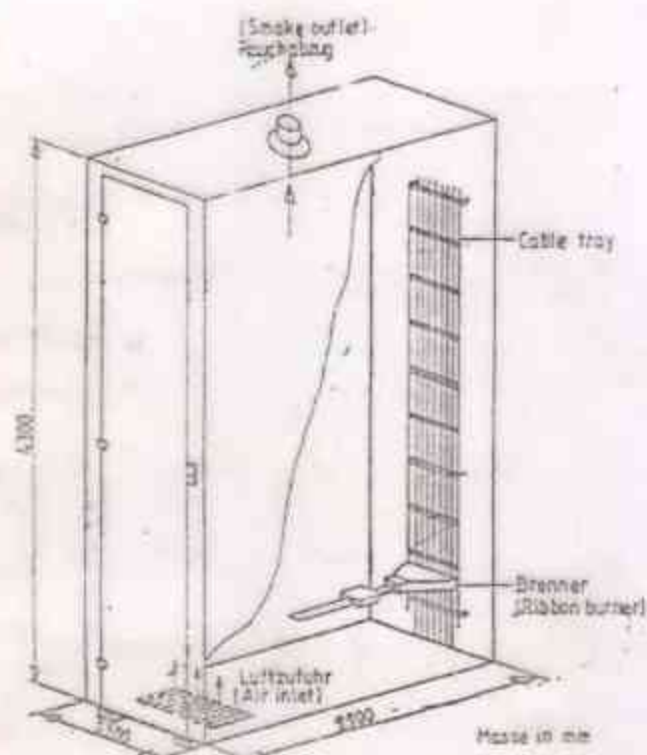
Vertical test chamber with ladder

Gas burner (70'000  $\pm$  1500, Buth Ribbon, type propane gas burner)

Test pieces category C, non metallic material volume 1.5 l/m

Flame application time 20 min.

Performance requirements: according cl. 6.2.4.5.2



Fire test rig

SPECIFICATION  FOR  SET OF SINGLE CORE CABLE	Prepared by  gdm/Elect	Checked by  J.E.-II	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA				
	APPROVED BY  DY.CEE/CON/TU-I			DATE: 02/09/2001 NO: CLW/ES/3/0450				
				• ALT    A    B    C    D    E				

SHEET- 31

**DETAILS DESCRIPTION & TECHNICAL DATA OF SINGLE CORE CABLE 300 V AC**  
**DATA SHEET - III**

**General Properties: -**

Excellent high temperature, low temperature, ozone and weathering resistance, zero halogen, flame retardant, solder iron resistant, easily strippable, flexible.

**Application: -**

For protected, fixed installation, inside equipments.

**General composition**

- 1- Conductor - Stranded tin-plated copper braid.
  - 2- Insulation - Electron - beam cross linked, base copolymer, colour - Diverse.
- Cable marking - As per Cl. No. 10.0 of this spec.

**Technical Data**

Voltage rating		300 / 500 V AC
Test Voltage		4 kV ac, 50 Hz for 1 min.
Max. conductor temperature	continuous	+110 °C
	at short circuit (max. 5 sec)	+280 °C
Operating temperature	fixed installation	-40°C to +120°C
	flexing installation	-25°C to +120°C
Min. bending radius	fixed installation	3 x cable dia.
	flexing installation	4 x cable dia.

**Table 1: Dimensions, conductor resistance, Cable weight**

Core type n x mm <sup>2</sup>	IDEN. NOS.	Conductor Construction (n x mm dia.)	Conductor nominal Dia. mm (mm)	Insulation Min. wall (mm)	Core nom. Dia. (mm)	Marking	Weight Nominal (Kg/100 m)
0.5	HZN452926P0201	19 x 0.179	0.89	0.35	1.71	Red.	0.67
0.5	HZN452926P0301	19 x 0.179	0.89	0.35	1.71	Yellow - green.	0.67

**Table - 2 Conductor resistance, current rating**

Core type mm <sup>2</sup>	Voltage U <sub>0</sub> / U V	Test voltage V	R <sub>20</sub> max. Ω / km	Current rating *	
				In air A	on tray A
0.5	300 / 500	3000	40.1	21.0	17.3

\* - Continuous operation.

**Table - 2.1 Reduction factors for increased ambient temperature**

Ambient temperature °C	30	40	50	60	70	80	90	100	110
Reduction factor	1.00	0.95	0.90	0.85	0.79	0.72	0.65	0.58	0.49

**Table - 2.1 Reduction factors for core bunching**

Number of cores	1	2	3	4	5	6	7	8	10
Reduction factor	1.00	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50

SPECIFICATION FOR SET OF SINGLE CORE CABLE	Prepared by	Checked by	Reviewed by	<b>D &amp; D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA</b>  DATE: 29 / 9 / 2001 NO: CLW/CS/2/0450
	<i>[Signature]</i> BDM/Elect	<i>[Signature]</i> J.S.	<i>[Signature]</i> SEE/DES.	
	APPROVED BY <i>[Signature]</i> DY.CEE/CON/TU-1			
ALT <input checked="" type="checkbox"/> A <input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C <input checked="" type="checkbox"/> D <input checked="" type="checkbox"/> E				



Cable - 0.5 x mm <sup>2</sup>					
Test on Cores					
	Properties	Tests Conditions	Requirements	Test Method	Type
1.	Construction dimensions	&	Acc. Tab. 1	IEC 811-1-1	L.A
2.	Electrical Properties				
2.1	Voltage Test	3 kV, 50 Hz, 15 min., RT	No breakdown	BS 3G 230 # 7.17.1	T
2.2	Spark Test	4 kV	No breakdown	BS 3G 230 # 7.17.2	S
2.3	Voltage breakdown	≥ 12 kV	No breakdown	IEC 885-1 # 3	T
2.4	Leakage current factor	450 V, 20°C	≤ 0.25 μA / V m	SEVTP208/3A-313	T
3.	Mechanical Properties				
3.1	Bending	5xD RT	No cracks	BS 3G 230 # 7.25	T
	Followed by voltage test	see cl. 2.1	No breakdown		T
4.	Thermal Properties				
4.1	Heat ageing	6h 200°C - 120h 170°C	T. 28, Type A	BS 3G 230 # 7.20	T
	Followed by bending	5 x D, RT	No cracks	BS 3G 230 # 7.25	T
	Followed by voltage test	see cl. 2.1	No breakdown		
4.2	Heat ageing resistance	200 days 144°C	No cracks	BS 3G 230 # 7.20	T
	Followed by bending	5 x D, RT	No breakdown	BS 3G 230 # 7.25	T
	Followed by voltage test	see cl. 2.1			
4.3	Cold bend	5xD, -40°C	No cracks	BS 3G 230 # 7.26	T
	Followed by voltage test	see cl. 2.1	No breakdown		T
5.	Environmental Properties				
5.1	Ozone resistance	2ppm, 10 days, RT		IEC 811-2-1 # 8	
	Followed by bending	5 x D, RT	No cracks	BS 3G 230 # 7.25	T
	Followed by voltage test	see cl. 2.1	No breakdown		T
5.2	Weathering resistance	200 days		ULC 895 OR CL 5.3.2 DIN 53387	T
	Followed by bending	5 x D, RT	No cracks	BS 3G 230 # 7.25	T
	Followed by voltage test	see cl. 2.1	No breakdown		T
5.3	Flame propagation		Self extinguishing	IEC 332-1, Cat. C	T
5.4	Behaviour with fire		B / Fo	NF F 16-101	T
5.5	Smoke intensity		Light absorption ≤ 20%	SEVTP208/3A-313	T
5.6	Halogen content		Zero halogen	IEC 754-1	T
5.7	Corrosivity of combustion gases		pH > 4.3 conductivity ≤ 100 μS/cm	IEC 754-2	T
5.8	Toxicity of combustion gases		Toxicity index < 5	NES 713	T
5.9	Waste disposal		Waste disposal with little pollution effects	EN 814-00 Sav 814.012	T

SPECIFICATION  FOR  SET OF SINGLE CORE CABLE	Prepared by  gdm/ekc	Checked by  T. F. D.	Reviewed by  SEE/D&D	D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA  DATE: 29 / 9 / 2001 NO: CLWES/3/0458
	APPROVED BY  DY. CHIEF ENGINEER			
	ALT: A B C D E			