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SHEET-1

TENDER SPECIFICATION

No: CLW/ES/3/0459

Enclosure -

- 1- Drg. No. - CLW/ES/3/SK-1/0459
CLW/ES/3/SK-2/0459
CLW/ES/3/SK-3/0459
CLW/ES/3/SK-4/0459
CLW/ES/3/SK-5/0459
CLW/ES/3/SK-6/0459

2- Annexure

TOTAL NO. OF SHEETS : 27 28 29

| ALT | A | B | C |
|-------|----|----|----|
| Sheet | 27 | 28 | 29 |

ENCLOSURES

SPECIFICATION
FOR
SET OF MULTIPLE CORE CABLES
FOR WAG-9/WAP-5 LOCOMOTIVES

(This specification supersedes earlier specification no. CLW/ES/3/0166)

ISSUED BY
DY. CHIEF ELECTRICAL ENGINEER/CONTU-I
CHITTRANJAN LOCOMOTIVE WORKS
P.O. - CHITTRANJAN, 713331
DIST. - BURDWAN, WEST BENGAL, INDIA.

| | | | | |
|---|--|---|--|---|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>[Signature]</i> gdm/elect | Checked by <i>[Signature]</i> J.E-I | Reviewed by <i>[Signature]</i> f SEE/D&D | D & D CENTRE CHITTRANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2021 NO: CLW/ES/3/0459 ALT <i>[Signature]</i> B C |
| | APPROVED BY <i>[Signature]</i> 28/9/21 DY. CEE/CONTU-I | | | |

ALTERATION RECORD SHEET

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| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>Shrey</i> BDM/Elect. | Checked by <i>[Signature]</i> J.E.-I | Reviewed by <i>[Signature]</i> 3EE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | |
| | APPROVED BY <i>[Signature]</i> 25/5/01 DY.CEE/CON-TU-I | | | DATE: 28/9/2001 NO: CLW/CS/3/6459 | ALT X R C |

SHEET-3

INDEX

1. SCOPE
2. CLIMATIC AND ENVIRONMENTAL CONDITION
3. STANDARD
4. MATERIAL AND CONSTRUCTION DETAILS
5. TEST METHOD AND REQUIREMENT
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7. CONFORMITY TO CONSTRUCTION
8. DRAWINGS
9. TECHNICAL DOCUMENTS TO BE SUPPLIED BY THE SUPPLIERS
10. GUARANTEE
11. IDENTIFICATION, PACKING AND MARKING
12. REFERENCE OF ORIGINAL EQUIPMENT MANUFACTURER
13. NOTE

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|---|--|------------------------------|------------------------------------|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/Elect</i> | Checked by <i>J.E. II</i> | Reviewed by <i>fsee/D&D</i> | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>h</i> 28/9/01 DY.CEE/CON/TU-I | | | |

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

- 1.1 The specification covers the design performance requirement of Copper Flexible Control Cables 415/110 V 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°C to $+120^{\circ}\text{C}$.

2.0 CLIMATIC AND ENVIRONMENTAL CONDITIONS:

- * Maximum Atmospheric temperature : Under Sun: 70°C
In Shade: 50°C
- * Humidity : 100% saturation during rainy season.
- * Reference site conditions :
 - i) Ambient Temperature Max. : 55°C , Min: 0°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.
- * Coastal area : Locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere.

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SHEET-5

* 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:

BS 3G 230, IEC 811-2-1, IEC 811-1-1, IEC 754-2, BS 6360, BS5467

BS 5099, IEC 96-1, IEC189-1, BS6469, UIC895, IEC 811-1-4, DIN53 387,

IEC332-3, NF F 16-101, IEC1034-1, IEC 754-2, NEC713, BIU814.00

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 wire, 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.

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

4.2.3

Sheathing:

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

4.2.4

EMC screen optimized: - Tin plated copper braid.
(for screened cable)

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SHEET-6**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 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 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 tests 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, a fresh 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 below.

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

| | | | | | |
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SHEET-7

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 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/CLW or his authorized representative.

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SHEET-8

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).

Cable - r x 1.0 mm²Test on Cores

| | Properties | Test Conditions | Requirements | Test Method | Type |
|-----|--|--------------------------------------|------------------------------------|--------------------|--------|
| 1. | Construction & dimensions | | See Tab. 1 | IEC 811-1-1 | T, A |
| 2. | Electrical Properties | | | | |
| 2.1 | Voltage Test | 5 kV, 50 Hz, 15 min., RT | No breakdown | BS 3G 230 = 7.17.1 | T |
| 2.2 | Spark Test | 5 kV | No breakdown | BS 3G 230 = 7.17.2 | S |
| 2.3 | Voltage breakdown | ≥ 20 kV | No breakdown | IEC 885-1 = 3 | T |
| 3. | Mechanical Properties | | | | |
| 3.1 | Bending Followed by voltage test | 5xD RT see cl. 2.1 | No cracks No breakdown | BS 3G 230 = 7.25 | T T |
| 3.2 | Identification durability | 150g, 100 strokes double | No continuous line and no abrasion | BS 3G 230 = 7.25 | T |
| 4. | Thermal Properties | | | | |
| 4.1 | Accelerated ageing Followed by voltage test | 6h 200°C ± 120h 150°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 = 7.20 | T T |
| 4.2 | Heat ageing resistance Followed by voltage test | 200 days 144°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 = 7.20 | T T |
| 4.3 | Blocking | 1 h, 200°C | No blocking | BS 3G 230 = 7.24 | T |
| 4.4 | Pressure test at high Temperature | 4h, 120°C, k = 4 | Idemutation < 50% | IEC 811-3-1 = 8 | T |
| 4.5 | Cold bend Followed by voltage test | 5xD, -40°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 = 7.26 | T T |
| 4.6 | Adherence of insulation on conductor | RT | Stripping force: 10N < x < 30N | BS 3G 230 = 7.21 | T |
| 4.7 | Shrinkage | 180°C, 6h | < 1.5 mm | BS 3G 230 = 7.23 | T |

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|---|--|----------------------------|--|--|----------|----------|----------|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/slect</i> | Checked by <i>J-E-I</i> | Reviewed by <i>Qnts</i> XSEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | | | |
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| | | | | ALT | <i>A</i> | <i>B</i> | <i>C</i> |

SHEET-9

| | Properties | Tests conditions | Requirements | Test Method | Type |
|-----|--|----------------------------------|---|-----------------|------|
| 5 | Environmental Properties | | | | |
| 5.1 | Ozone resistance Followed by voltage test | 2ppm, 10 days, RT see cl. 2.1 | No breakdown | IEC 811-2-1 # 8 | T |
| 5.2 | Corrosivity of combustion gases | | $\alpha H \geq 4.2$ conductivity ≤ 10 $\mu S/cm$ | IEC 754-2 | T |

Cable $n \times 1.0 \text{ mm}^2$

TEST ON CABLES:

| | Properties | Tests conditions | Requirements | Test Method | Type |
|-----|---|---|-----------------------------|-------------------------------------|-------------|
| 1 | Construction and Dimensions | | Acc. Tab.1 | IEC 811-1-1 # 8 | T, A |
| 2 | Electrical Properties | | | | |
| 2.1 | Conductor resistance R_{20} | 20°C | Acc. Tab.2 | BS 6360 | T, A |
| 2.2 | Voltage Test Core/core + core/screen | 4 kV, 50 Hz, 15 min. RT | No breakdown | BS 5467 # 17.1 | T |
| 2.3 | Spark test of sheath | 4 kV, 50 Hz, RT | No breakdown | BS 5099 | S |
| 2.4 | Transfer impedance of EMC-screen | 20°C only screen cables | Acc. Tab.2 | IEC 96-1 | T, A |
| 3 | Transmission Data | 20°C only screen cables | Acc. Data sheet II | IEC 189-1 | T, A |
| 4 | Mechanical Properties | | | | |
| 3.1 | Tensile strength of sheath | RT | $\geq 8.0 \text{ N/mm}^2$ | BS 6469 # 2.2 | T |
| 3.2 | Elongation at break of sheath | RT | $\geq 125\%$ | BS 6469 # 2.2 | T |
| 3.3 | Tear resistance | RT | $\geq 6.0 \text{ N/mm}$ | BS 6469 # 3.4 | T |
| 4 | Thermal Properties | | | | |
| 4.1 | Hot set Elongation under load Permanent set | 15 min, 200°C, 0.2 N/mm ² | $\leq 100\%$ $\leq 10\%$ | BS 5469 # 3.3 | T |
| 4.2 | Heat ageing resistance Test sample acc. Test on completed cable Followed by voltage test | 200 days, 144°C see cl. 2.2 | No cracks No breakdown | UTC 893 OR # 5.2.2 BS 6469 # 2.3 | T T T |
| 4.3 | Cold bend Followed by voltage test | 5xD, -75°C see cl. 2.2 | No cracks No breakdown | IEC 811-1-4 # 8.2 | T |
| 4.4 | Cold impact Followed by voltage test | -25°C see cl. 2.2 | No cracks No breakdown | IEC 811-1-4 # 8.3 | T |

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SHEET-10

| Properties | Tests conditions | Requirements | Test Method | Type |
|--|--|--|---|------------------|
| 5. Environmental Properties | | | | |
| 5.1 Ozone resistance Test on completed cable Followed by voltage test | 2 ppm, 20°C, 10 days see cl. 2.2 | No cracks No breakdown | IEC 811-2-1 # 8 | T T T |
| 5.2 Weathering resistance Test sample acc. Test on completed cable Followed by voltage test | 200 days see cl. 2.2 | No cracks No breakdown 10 days | IEC 895 OR # 5.3.2 DIN 53 387 | T T T T |
| 5.3 Water resistance Test sample acc. Test on completed cable Followed by voltage test | 10 days, 60°C, 500V DC see cl. 2.2 | no breakdown no breakdown | IEC 895 OR # 5.3.2 IEC 895 OR # 5.3.3 | T T T T |
| 5.4 Chemical resistance Test sample acc. - ASTM-oil No. 2 - Acid detergent e.g. SU 73 Ausimont per followed by voltage test | 34 h, 100°C 24 h, RT see cl. 2.2 | no cracks no cracks no breakdown | IEC 895 OR # 5.3.2 IEC 811-2-1 # 10.3 - 10.4 IEC 811-2-1 # 10.4 | T T T |
| 5.5 Flame propagation | | self extinguishing | IEC 332-3 Cat.C | T |
| 5.6 Behaviour with fire * | | B / F0 | NF F 16 - 101 | T |
| 5.7 Smoke intensity | | Passed | IEC 1034-1 | T |
| 5.8 Halogen content | | Zero halogen | IEC 754-1 | T |
| 5.9 Corrosivity of combustion gases | | pH \geq 4.3 conductivity \leq 10 μ S/cm | IEC 754-2 | T |
| 5.10 Toxicity of combustion gases | | Toxicity index \leq 3 | NES 713 | T |
| 5.11 Waste disposal | | Waste disposal with little pollution effects | BrU 814.00 50aV 814.013 | T |

* - RAPT report 190 959/ABGS 7 x 0.2

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|---|--|------------------------------|------------------------------------|--|-----|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/Elect</i> | Checked by <i>J.C. II</i> | Reviewed by <i>fsee/D&D</i> | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | |
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SHEET :1

Cable - n x 0.5 mm

Test on Cores

| | Properties | Tests Conditions | Requirements | Test Method | Type |
|-----|---|---------------------------------------|--------------------------------------|--------------------|------|
| 1. | Construction dimensions | | See Tab. 1 | IEC 811-1-1 | I. A |
| 2. | Electrical Properties | | | | |
| 2.1 | Voltage Test | 1.5 kV, 50 Hz, 15 min., RT | No breakdown | BS 3G 230 + 7.17.1 | T |
| 2.2 | Spark Test | 4kV | No breakdown | BS 3G 230 + 7.17.2 | S |
| 2.3 | Voltage breakdown | ≥ 9 kV | No breakdown | IEC 885-1 + 2 | T |
| 3. | Mechanical Properties | | | | |
| 3.1 | Bending Followed by voltage test | 5x D RT see cl. 2.1 | No cracks No breakdown | BS 3G 230 + 7.25 | T |
| 3.2 | Identification durability | 150g/100 strokes | No construction film and no abrasion | BS 3G 230 + 7.37 | T |
| 4. | Thermal Properties | | | | |
| 4.1 | Accelerated ageing Followed by voltage test | 4h, 120°C - 120h/170°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 + 7.20 | T |
| 4.2 | Heat crimp resistance Followed by voltage test | 300 days/144°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 + 7.20 | T |
| 4.3 | Blocking | 1 h, 100°C | No blocking | BS 3G 230 + 7.24 | T |
| 4.4 | Pressure test at high temperature | 4h, 120°C, k = 4 | Identification < 50% | IEC 811-3-1 + 8 | T |
| 4.5 | Cold bend Followed by voltage test | 5x D, -40°C see cl. 2.1 | No cracks No breakdown | BS 3G 230 + 7.26 | T |
| 4.6 | Adherence of insulation on conductor | RT | Stripping force: 10N - 20N | BS 3G 230 + 7.21 | T |
| 4.7 | Shrinkage | 180°C, 6h | < 1.5 mm | BS 3G 230 + 7.23 | T |

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| | <i>gdm/et</i> | <i>FEU</i> | <i>SEE/D&D</i> | |
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



SHEET-12

| | Properties | Tests conditions | Requirements | Test Method | Type |
|-----|--|----------------------------------|--|-----------------|------|
| 3. | Environmental Properties | | | | |
| 3.1 | Ozone resistance Followed by voltage test | 2ppm, 10 days, RT see cl. 2.1 | No breakdown | IEC 811-2-1 = 8 | T |
| 3.2 | Corrosivity of combustion gases | | pH \geq 4.3 conductivity \leq 10 μ S/cm | IEC 754-2 | T |

Cable - n x 0.5 mm²

TEST ON CABLES:

| | Properties | Tests conditions | Requirements | Test Method | Type |
|-----|---|---|------------------------------|--------------------------------------|-------------|
| 1. | Construction and dimensions | | Acc. Tab.1 | IEC 811-1-1 = 8 | T, A |
| 2. | Electrical Properties | | | | |
| 2.1 | Conductor resistance R ₂₀ | 20°C | Acc. Tab.2 | BS 6369 | T, A |
| 2.2 | Voltage Test Core/core + core/screen | 1.5 kV, 50Hz, 15 min RT | No breakdown | BS 5467 + 17.2 | T |
| 2.3 | Spark test of sheath | 4 kV, 50 Hz, RT | No breakdown | BS 5099 | S |
| 2.4 | Transfer impedance of EMC-screen | 20°C only screen cables | Acc. Tab.2 | IEC 98-1 | T, A |
| 2.5 | Transmission Data | 20°C only screen cables | Acc. Data sheet II | IEC 189-1 | T, A |
| 3. | Mechanical Properties | | | | |
| 3.1 | Tensile strength of sheath | RT | \geq 8.0 N/mm ² | BS 6469 + 2.2 | T |
| 3.2 | Elongation at break of sheath | RT | \geq 125% | BS 6469 + 2.2 | T |
| 3.3 | Tear resistance | RT | \geq 6.0 N/mm | BS 6469 + 2.4 | T |
| 4. | Thermal Properties | | | | |
| 4.1 | Hot set Elongation under load Permanent set | 15 min, 200°C, 0.2 N/mm ² | \leq 100% \leq 10% | BS 6469 + 2.3 | T |
| 4.2 | Heat ageing resistance Test sample acc. Test on completed cable Followed by voltage test | 200 days, 144°C see cl. 2.2 | No cracks No breakdown | IEC 811-2-1 + 5.3.2 BS 6469 + 2.3 | T T T |
| 4.3 | Cold bend Followed by voltage test | 5xD, - 25°C see cl. 2.2 | No cracks No breakdown | IEC 811-1-4 + 8.2 | T T |
| 4.4 | Cold impact Followed by voltage test | - 25°C see cl. 2.2 | No cracks No breakdown | IEC 811-1-4 + 8.5 | T T |

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| | APPROVED BY  25/2/01 DY.CEE/CON/TU-1 | | | DATE: 28/9/2001 NO: GLW/ES/0/0459 | |
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SHEET-13

| | Properties | Tests conditions | Requirements | Test Method | Type |
|------|---|--|--|---|------------------|
| 5. | Environmental Properties | | | | |
| 5.1 | Ozone resistance Test on completed cable Followed by voltage test | 2 ppm, 20°C, 10 days see cl. 2.2 | No cracks No breakdown | IEC 811-2-1 # 8 | T T T |
| 5.2 | Weathering resistance Test sample acc. Test on completed cable Followed by voltage test | 200 days see cl. 2.2 | No cracks No breakdown 10 days | IEC 895 OR # 5.3.2 DIN 53 387 | T T T T |
| 5.3 | Water resistance Test sample acc. Test on completed cable Followed by voltage test | 10 days, 60°C, 500V DC see cl. 2.2 | no breakdown no breakdown | IEC 895 OR # 5.3.2 IEC 895 OR # 5.3.5 | T T T T |
| 5.4 | Chemical resistance Test sample acc. - ASTM-d No. 2 - Acid detergent e.g. 5L 72 Aussetreniger followed by voltage test | 24 h, 100°C 24 h, RT see cl. 2.2 | no cracks no cracks no breakdown | IEC 895 OR # 5.3.2 IEC 811-2-1 # 10.3 - 10.4 IEC 811-2-1 # 10.4 | T T T |
| 5.5 | Flame propagation | | self extinguishing | IEC 332-3 Cat C | T |
| 5.6 | Behaviour with fire * | | B / F0 | NEC 16 - 101 | T |
| 5.7 | Smoke intensity | | Passed | IEC 1074-1 | T |
| 5.8 | Halogen content | | Zero halogen | IEC 754-1 | T |
| 5.9 | Corrosivity of combustion gases | | pH ≥ 4.3 conductivity ≤ 10 µS/cm | IEC 754-2 | T |
| 5.10 | Toxicity of combustion gases | | Toxicity index ≤ 5 | NES 713 | T |
| 5.11 | Waste disposal | | Waste disposal with little pollution effects | BSU 814.00 StoV 814.013 | T |

* - RAPT report 190 959 ABGS 7 x 0.5

| | | | | |
|---|---|--|---|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>[Signature]</i> BDM/Elct | Checked by <i>[Signature]</i> J.E.-S | Reviewed by <i>[Signature]</i> +SEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>[Signature]</i> DY.CEE/CONTU-I | | | |
| | ALT: <i>[Signature]</i> A B C | | | |

SHEET-14

6.0 Recommended sampling plan:

As per appendix B of IS: 9960 (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% |

8.0

DRAWINGS:- Drawings are attached on sheet no.22 to 27

| | | | | |
|---|-----------------------------------|-----------------------------|------------------------------|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm</i> | Checked by <i>J.E-II</i> | Reviewed by <i>TS/EDD</i> | D.S.D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 25/5/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>[Signature]</i> | | | |
| | DY.GEN/CDN/TU-1 | | | |
| ALT | | | | <i>[Initials]</i> |

SHEET-15

9.0

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.
- xxviii) Details of screen.

| | | | | |
|---|---|--|---|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by  J. S. Datta | Checked by  J. S. Datta | Reviewed by  J. S. Datta | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 29/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY  J. S. Datta DY. CHIEF ENGINEER | | | |

SHEET-16

10.

GUARANTEE

The supplier shall give a guarantee of clear eighteen months from the date of Commissioning or twenty four 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.

11.0

IDENTIFICATION, PACKING AND MARKING :-

11.1

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) Rated Voltage
- iv) Cable size.
- v) Indication of insulating material and its operating temperature.

11.2

Packing and Marking:-

11.2.1

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

11.2.2

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

ALT. (A)

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

| | | | | |
|---|--|---|--|---|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>[Signature]</i> GDM/5/10/2 | Checked by <i>[Signature]</i> J. E. I | Reviewed by <i>[Signature]</i> KSEED&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/05/2004 NO: CLWES/35423 |
| | APPROVED BY <i>[Signature]</i> DY. CEE/CON/10/1 | | | |
| | ALT <i>[Signature]</i> <i>[Signature]</i> <i>[Signature]</i> | | | |

SHEET-17

11.2.3

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

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

12.0

REFERENCE OF OEMU (Original Equipment Manufacturer)

M/s. HUBER + SUTNER 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 sheet No. 515784C (e) dated 11.02.1997, 529591C (e) dated 11.02.1997 and 529592 C (e) dated 11.02.1997.

13.0

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 are not screened cables.

| | | | | |
|---|---|-------------------------------|--|---|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gsm/ghet</i> | Checked by <i>J. E. D.</i> | Reviewed by <i>Shub</i> +SEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA /DATE: 26/5/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>22/5/01</i> DY. CEE/CON/10-1 | | | |

SHEET-18

DETAILS DESCRIPTION & TECHNICAL DATA OF MULTIPLE CORE CABLE

DATA SHEET - I

Voltage U_0/U : 300 V / 300 V
 Test Voltage : 3 kV ac, 50 Hz for 1 min.
 Temperature Range : - 40°C to + 120°C
 Min. bending radius : $D = 10 \text{ mm} - 5 \times D$
 $D = 10 \text{ mm} - 7 \times D$

Table 1:

| S N | Nominal Cross Section (Sq. mm) | IDEN. NOS. | Conductor Construction (no x m x mm) | Conductor Nominal Dia (mm) | Minimum Wall Thickness | | | Core dia. (mm) | Cable dia. (mm) | R20 max. (Ohms / Km) | Weight Nominal (Kg/100 m) |
|--------|--------------------------------------|-----------------|---|-------------------------------|---------------------------|-------------|------------|----------------|-----------------|----------------------|---------------------------|
| | | | | | Insulation (mm) | Sheath (mm) | Total (mm) | | | | |
| 1. | 2 x 0.2 SCR (Screened cable) | 3EHP470000P0502 | 19 x 0.176 | 0.86 | 0.25 | 0.75 | 1.00 | 1.45 | 5.3 ± 0.3 | 41.1 | 4.3 |
| 2. | 3 x 0.5 SCR (Screened cable) | 3EHP470000P0503 | 19 x 0.176 | 0.86 | 0.25 | 0.75 | 1.00 | 1.45 | 5.5 ± 0.3 | 41.1 | 4.7 |
| 3. | 2 x 0.5 SCR (Screened cable) | 3EHP470000P0504 | 19 x 0.176 | 0.86 | 0.25 | 0.90 | 1.15 | 1.45 | 7.8 ± 0.3 | 45.1 | 9.2 |
| 4. | 5 x 0.5 SCR (Screened cable) | 3EHP470000P0505 | 19 x 0.176 | 0.86 | 0.25 | 0.80 | 1.05 | 1.45 | 6.8 ± 0.3 | 41.1 | 7.9 |
| 5. | 9 x 0.5 SCR (Screened cable) | 3EHP470000P0509 | 19 x 0.176 | 0.86 | 0.25 | 0.55 | 0.89 | 1.45 | 8.2 ± 0.3 | 41.1 | 11.8 |
| 6. | 9 x 0.5 Twst (Screened cable) | 3EHP470002P0509 | 19 x 0.179 | 0.89 | 0.25 | 0.80 | 1.05 | 1.45 | 7.0 ± 0.3 | 41.1 | 8.6 |
| 7. | 25 x 0.5 Twst (Screened cable) | 3EHP470002P0525 | 19 x 0.179 | 0.89 | 0.25 | 0.95 | 1.20 | 1.45 | 11.2 ± 0.4 | 41.1 | 21.0 |

| | | | | |
|---|-----------------------------------|----------------------------|----------------------------|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/ghet</i> | Checked by <i>J.E-3</i> | Reviewed by <i>Shub</i> | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>[Signature]</i> | | | |
| | DY.CEE/CON/TU-I | | | |
| ALT | | | | <i>A B C</i> |

SHEET-19

Transmission Data:

| | | $\leq 6 \times 2 \times 0.5$ | $\geq 8 \times 2 \times 0.5$ | |
|-------------------------------------|---------------|------------------------------|------------------------------|--------------|
| Mutual capacitance at 1 kHz | core / core | 115 | 110 | nF / km |
| | core / screen | 190 | 180 | nF / km |
| Characteristic impedance | at 100 kHz | 70 | 75 | Ohm |
| Attenuation | at 100 kHz | 8 | 7 | dB / km |
| Cross talk attenuation | at 100 kHz | 70 | 70 | dB |
| Insulation resistance at 20 °C | | ≥ 2000 | ≥ 2000 | M ohm - km |
| Pair inductance | at 1 kHz | 500 | 550 | Micro H / km |
| Capacitance unbalance between pairs | | ≤ 300 | ≤ 300 | pF / 500 m |

Table 2:

| Cable Type (n x mm ²) | R 20 max (Ohm/km) | Current Rating * | | Transfer Impedance of EMC-screen*** | | |
|--|----------------------|------------------|----------------|-------------------------------------|------------------------|-------------------------|
| | | In Air (A) | On Tray (A) | 0...1 MHz (MOhm/m) | At 10 MHz (M Ohm/m) | Upto 20 MHz (MOhm/m) |
| 2 x 0.5 SCR (Screened cable) | 41.1 | 17.4 | 15.3 | 25 | 18 | 40 |
| 3 x 0.5 SCR (Screened cable) | 41.1 | 14.6 | 13.2 | 25 | 18 | 40 |
| 2 x 7 x 0.5 SCR ** (Screened cable) | 43.1 | 15.0 | 13.6 | 20 | 12 | 30 |
| 5 x 0.5 SCR (Screened cable) | 41.1 | 12.8 | 11.3 | 22 | 15 | 34 |
| 9 x 0.5 SCR (Screened cable) | 41.1 | 10.2 | 9.2 | 16 | 10 | 24 |

* - Continuous operation.

***. Typical value

** - Conductor pair twist: 1 + 2/3 + etc.

Min. twisting per pair = 20 turns/m.

Twisting pair / pair = 10 turns / m

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 | 0.63 | 0.58 | 0.49 |

Table 2.2: Reduction factors for cable bunching

| Number of cables | 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 MULTIPLE CORE CABLE | Prepared by <i>J. E. II</i> 80m/Sheet | Checked by <i>J. E. II</i> | Reviewed by <i>[Signature]</i> +SEE/D&D | O & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>[Signature]</i> DY.CEE/CON/TU-I | | | |
| | ALT <i>[Signature]</i> <i>[Signature]</i> <i>[Signature]</i> | | | |

SHEET-20

DETAILS DESCRIPTION & TECHNICAL DATA OF MULTIPLE CORE CABLE

DATA SHEET - II

Voltage U_0/U : 600 V/1000 V
 Test Voltage : 6 kV ac, 50 Hz for 15 min.
 Temperature Range : -40°C to +120°C
 Min. bending radius : $D = 10 \text{ mm} - 5 \times D$
 $D = 10 \text{ mm} - 7 \times D$

Table I*

| S N | Nominal Cross Section (Sq.mm) | IDEN. NOS. (As per ABB No.) | Conductor Construction (m x n x mm) | Conductor Nominal Dia (mm) | Minimum Wall Thickness | | | Core dia. (mm) | Cable dia. (mm) | B20 max. (Ohm/Km) | Weight Nominal (Kg/100 m) |
|--------|-------------------------------------|--------------------------------|--|-------------------------------|---------------------------|-------------|------------|----------------|-----------------|-------------------|---------------------------|
| | | | | | Insulation (mm) | Sheath (mm) | Total (mm) | | | | |
| 1. | 2 x 1.0 SCR (Screened cable) | 3EHP470001P1002 | 19 x 0.25 | 1.25 | 0.5 | 0.80 | 1.20 | 2.30 | 7.1 ± 0.3 | 20.0 | 8.4 |
| 2. | 2x1x1.0 SCR * | 3EHP470001P1004 | 19 x 0.25 | 1.25 | 0.5 | 1.00 | 1.20 | 2.30 | 11.0 ± 0.4 | 20.4 | 18.1 |
| 3. | 3x1.0 SCR ** (Screened cable) | 3EHP470001P1012 | 19 x 0.25 | 1.25 | 0.5 | 1.30 | 1.80 | 2.30 | 15.5 ± 0.5 | 20.4 | 33.8 |
| 4. | 1 x 1.0 Twist | 3EHP470003P1012 | 19 x 0.25 | 1.25 | 0.5 | 0.80 | 1.10 | 2.30 | 6.5 ± 0.3 | 20.0 | 6.4 |

* - 2 conductor pair twisted 1-2/3 - etc.
 Min. twisting per pair = 20 turns/m.
 Twisting pair / pair = 10 turns / m

** - 3 x spiral quad cable twisting notch
 UIC / CBB ART 112 29 53

| | | | | |
|---|-----------------------------------|----------------------------------|-----------------------------------|---|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/elect.</i> | Checked by <i>[Signature]</i> | Reviewed by <i>[Signature]</i> | D & D CENTRE CHITARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 26/9/2001 NO: CLW/ES/3/0459 |
| | APPROVED BY <i>[Signature]</i> | | | |
| | DY. CEE CON/TU-I | | | |
| ALT | | | | <i>4</i> <i>B</i> <i>C</i> |

Digitally signed by
AMITAVA RAY
Date: 2021.08.18
12:08:01 +05'30'
Reason: IREPS
Document
Location: IREPS-CRIS

SHEET-21

Transmission Data:

| | | | | |
|-------------------------------------|---------------|--------|--------|--------------|
| Mutual capacitance at 1 kHz | core / core | paires | quads | nF / km |
| | core / screen | 145 | 130 | nF / km |
| Characteristics impedance | at 100 kHz | 80 | 90 | Ohm |
| Attenuation | at 100 kHz | 7 | 5 | dB / km |
| Cross talk attenuation | at 100 kHz | 85 | 75 | dB |
| Insulation resistance at 20 °C | | ≥ 2000 | ≥ 2000 | M ohm - km |
| Pair inductance | at 1 kHz | 600 | 650 | Micro H / km |
| Capacitance unbalance between pairs | | ≤ 300 | ≤ 300 | pF / 500 m |

Table 2:

| Cable Type (n x mm ²) | R 20 max (Ohm/km) | Current Rating * | | Transfer Impedance of EMC-screen ** | | |
|--------------------------------------|----------------------|------------------|----------------|-------------------------------------|-----------------------|----------------------------|
| | | In Air (A) | On Tray (A) | 0...1 MHz (MOhm/m) | At 10 MHz (MOhm/m) | Unto 30 MHz (MOhm/m) |
| 2 x 1.0 SCR (Screened cable) | 20.0 | 25.5 | 23.5 | 20 | 12 | 40 |
| 2 x 2 x 1.0 SCR (Screened cable) | 20.1 | 20.5 | 19.0 | 10 | 6 | 25 |
| 1 x 4 x 1.0 SCR (Screened cable) | 20.1 | 14.5 | 13.5 | 7 | 5 | 20 |

* - Continuous operation

** - Typical value

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 2.2: Reduction factors for cable bunching

| Number of cables | 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 MULTIPLE CORE CABLE | Prepared by | Checked by | Reviewed by | D & D CENTRE CHITARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/3/2001 NO: CLW/ES/3/01/50 |
| | <i>gdm/elect</i> | <i>J.E.-II</i> | <i>[Signature]</i> | |
| | APPROVED BY <i>[Signature]</i> DY.CEE/CON/TU-I | | | |
| ALT | | | | <i>A</i> <i>B</i> <i>C</i> |

UIC CABLE 5x4x1+2 CORE SCR CONFIGURATIONS

1. Configuration of quad Conductors

| | | |
|-----------------|----|--|
| 5 quads | :- | 4 x 1.0 mm ² |
| Conductor | :- | Stranded tin plated copper, 19 x 0.25mm ϕ |
| Insulation | :- | Electron Beam Cross linked polyolefin based polymer EPDM ϕ : 2.3 mm |
| Colour | :- | white, numbered |
| 4 cores twisted | :- | ϕ 5.6 mm |

2. Configuration of databus Conductors

| | | |
|------------------------|----|---|
| 1 pair Databus 120 ohm | :- | 2 x 0.75 mm ² |
| Conductor | :- | Stranded tin plated copper, 19 x 0.22mm ϕ |
| Insulation | :- | Cross linked foamed polyolefin ϕ : 2.65 mm |
| Colour | :- | white, black |
| 2 cores twisted ϕ | :- | 5.30 mm |
| EMC | :- | Screen : tin plated copper braid |
| Jacket | :- | TPE, colour : white ϕ : 6.70 mm |

| | | |
|------------|----|---|
| 3. EMC | :- | Screen optimized tin plated copper braid ϕ : 15.0 mm |
| 4. Sheath | :- | TPE, colour : black ϕ : 18.5 \pm 0.5 mm |
| 5. Marking | :- | Firm's Name, Production Lot No., Part No. |

TECHNICAL DATAA. Quad 4x1.0 mm² :

| | | |
|---------------------------------|----|---|
| 1. Conductor resistance at 20°C | :- | $\leq 20.4 \Omega / \text{km}$ |
| 2. Voltage rating U_0 / U | :- | 300 / 300 V |
| 3. Test voltage | :- | 2 kv ac, 50 Hz for 1 min |
| 4. Mutual capacitance at 1KHz | :- | Core/ Core 80 nF/Km Core/ Screen 130 nF/Km |

B. Pair 2x0.75 mm² Data bus 120 ohm :

| | | |
|---------------------------------|----|---|
| 1. Conductor resistance at 20°C | :- | $\leq 28.7 \Omega / \text{km}$ |
| 2. Voltage rating U_0 / U | :- | 300 / 300 V |
| 3. Test voltage | :- | 2 kv ac, 50 Hz for 1 min |
| 4. Mutual capacitance at 1KHz | :- | Core/ Core 40 nF/Km |
| 5. Impedance | :- | f=0.5 to 2 MHz, 120 \pm 12 Ω |
| 6. Attenuation | :- | f=1MHz, $\leq 10.0 \text{ dB/km}$ f=2MHz $\leq 14.0 \text{ dB/km}$ |
| 7. Transfer impedance | :- | At f $\geq 30\text{MHz}$, $\leq 30 \text{ m}\Omega/\text{m}$ |

C. Cable :

| | | |
|---------------------------------------|----|---|
| 1. Crosstalk attenuation | :- | f=60 to 200MHz, pair / pair $\leq 80\text{dB}$, quad/quad $\leq 60\text{dB}$ |
| 2. Transfer impedance of total screen | :- | f $\leq 500\text{kHz}$ $\leq 10 \text{ m}\Omega/\text{m}$ |
| 3. Temperature range | :- | -40°C to +90°C |
| 4. Min. bending radius | :- | Fixed 4 x cable dia, Flexing 5 x cable dia |
| 5. Cable weight per 100m | :- | approx 50kg |

DELETED
ALT - 'C'

| | | | | | | |
|---|-------------------------------|-------------------------|--|------------------|---|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by | Reviewed by | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL | | | |
| | Jayveer Kumar SSE/D/Elect. | Rohit Kumar AEE/D-II | | | | |
| | APPROVED BY | | DATE:- 04/11/2019 | No.CLV/ES/3/0459 | | |
| Dy.CEE/ D&D | | ALT | A | B | C | |

UIC CABLE 5x4x1+2 CORE SCR CONFIGURATIONS

SHEET No.22B

1. Configuration of quad Conductors

| | | |
|-----------------|----|---|
| 5 quads | :- | 4 x 1.0 mm ² |
| Conductor | :- | Stranded tin plated copper, 19 x 0.25mm ϕ |
| Insulation | :- | Electron Beam Cross Linked Polyolefin based Polymer EPDM, ϕ : 1.8 \pm 0.05 mm |
| Colour | :- | white, numbered |
| 4 cores twisted | :- | ϕ 4.40 \pm 0.15 mm |

2. Configuration of databus Conductors

| | | |
|------------------------|----|--|
| 1 pair Databus 120 ohm | :- | 2 x 0.75 mm ² |
| Conductor | :- | Stranded tin plated copper, 19 x 0.22mm ϕ |
| Insulation | :- | Cross Linked foamed Polyolefin, ϕ : 2.65 mm |
| Colour | :- | white, black |
| 2 cores twisted ϕ | :- | 5.30 mm |
| EMC | :- | Screen : tin plated copper braid |
| Jacket | :- | TPE; colour : white ϕ : 6.70 mm |

3. EMC :- Screen optimized Tin plated copper braid ϕ : 15.0 mm (nominal)
4. Sheath :- TPE; colour : black ϕ : 18.5 \pm 0.5 mm
5. Marking :- Firm's Name, Production Lot No., Part No.

TECHNICAL DATAA. Quad 4x1.0 mm² :

| | | |
|---------------------------------|----|---------------------------|
| 1. Conductor resistance at 20°C | :- | \leq 22.6 Ω / km |
| 2. Voltage rating U_0 / U | :- | 300 / 300 V |
| 3. Test voltage | :- | 2 kv ac, 50 Hz for 1 min |
| 4. Mutual capacitance at 1KHz | :- | Core/ Core \leq 50nF/Km |

B. Pair 2x0.75 mm² Data bus 120 ohm :

| | | |
|---------------------------------|----|--|
| 1. Conductor resistance at 20°C | :- | \leq 28.7 Ω / km |
| 2. Voltage rating U_0 / U | :- | 300 / 300 V |
| 3. Test voltage | :- | 2 kv ac, 50 Hz for 1 min |
| 4. Mutual capacitance at 1KHz | :- | Core/ Core 40 nF/Km |
| 5. Impedance | :- | f=0.5 to 2MHz, 120 \pm 12 Ω |
| 6. Attenuation | :- | f=1MHz, \leq 10.0dB/ km f=2MHz, \leq 14.0dB/ km |
| 7. Transfer impedance | :- | At f \geq 30MHz, \leq 30m Ω /m |

C. Cable :

| | | |
|---------------------------------------|----|--|
| 1. Crosstalk attenuation | :- | f=60 to 200KHz, pair /pair \leq 80dB, quad/quad \leq 60 dB |
| 2. Transfer Impedance of total screen | :- | f \leq 30MHz $<$ 10 m Ω / m |
| 3. Temperature range | :- | -40°C to +90°C |
| 4. Min. bending radius | :- | Fixed 4 x cable dia, Flexing 5x cable dia |
| 5. Cable weight per 100m | :- | approx 50kg |

| | | | | | | | |
|---|---|-----------------------------------|--|---|---|---|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by | Reviewed by | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL DATE: 14/09/2020 | | | | |
| | Jayveer Kumar 14-09-2020 SSE/D/Elect. | Rajendra 14/09/2020 SEE/D-1 | | | | | |
| | APPROVED BY | | | | | | |
| | Dy. CEE/D-1 | | ALT | A | B | C | |

SHEET-22TRACTION CABLE (SCREENED) $n \times 1.0 \text{ mm}^2$ General properties:

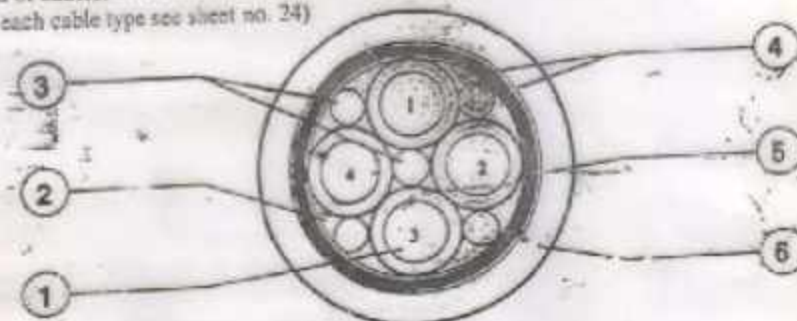
Excellent high temperature, low temperature, ozone and weathering resistance, zero halogen, flame retardant, solder ion resistant, easily strippable, flexible screening properties.

Application:

For permanent installation inside and outside of railway rolling stock to connect fixed and moving parts.

General composition of cables:

(Detailed drawing to each cable type see sheet no. 24)

Construction

1. Cores 1.0 mm^2

Conductor : Stranded tin plated copper.

Insulation Colour: White, Code numbered.

Cabling: Core and elements, lay ratio $\leq 15 \times D$ (D = lay dia)

2. Identification thread

3. Filler (optional)

4. Separator (optional)

5. EMC - Screen optimized

6. Sheath

7. Cable marking = Firm's name, Production Lot Number, Part Number

Plastic tape

Tin plated copper braid

Colour: Black

Technical Data

Dimension and Weight

Current rating, conductor resistance, transfer impedance

Table 1

Table -2

Operating conditions

Voltage U_0 / U

Test voltage for equipment acc. To IEC 77-1 Min. 50 Hz.

Max. conductor temperature

Continuous

Overload condition (max. 125 h / year)

At short circuit (max. 5s)

Operating temperature

Min. bending radius

Fixed installation

Fixed installation

600 / 1000 V

6000 V

+120°C

+170°C

+250°C

-40 +120°C

5 x cable dia.

| | | | | |
|---|---|------------------------------|------------------------------------|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>SDM/etnet</i> | Checked by <i>J.E.SII</i> | Reviewed by <i>/SEE/D&D</i> | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 22/9/2001 NO: CLW/ES/35X-1/0450 |
| | APPROVED BY <i>[Signature]</i> 22/9/01 | | | |
| | DY.CEE/CON/TU-I | | | |
| ALT | | | | A B C |

SHEET-23

TRACTION CABLE (Twist) $n \times 1.0 \text{ mm}^2$ **General properties:**

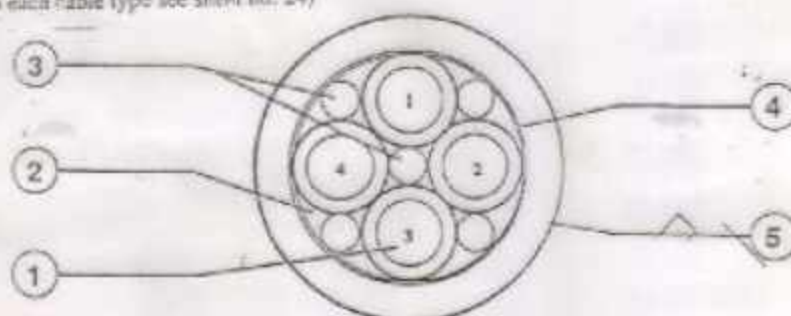
Excellent high temperature, low temperature, ozone and weathering resistance, zero halogen, flame retardant, solder ion resistant, easily strippable, flexible.

Application:

For fixed installation inside and outside of railway rolling stock to connect fixed and moving parts.

General composition of cables:

(Detailed drawing to each cable type see sheet no. 24)

**Construction**

1. Core 1.0 mm^2

Conductor: Stranded tin plated copper.

Insulation Colour: White, Code numbered.

Cabling: Core and elements, lay ratio $\leq 1.5 \times D$ (D = lay dia)

2. Identification thread

3. Filler (optional)

4. Separator(s) (optional)

5. Sheath

Plastic tape

Colour: Black

Cable marking = Firm's name, Production Lot Number, Part Number

Technical Data

Dimension and Weight

Table 1

Current rating, conductor resistance, transfer impedance

Table -2

Operating conditions

Voltage U_0 / U

600 / 1000 V

Test voltage for equipment acc. To IEC 77-1 Min, 50 Hz.

6000 V

Max. conductor temperature

Continuous

+120 °C

Overload condition (max. 125 h / year)

+170 °C

At short circuit (max. 5s)

+280 °C

Operating temperature




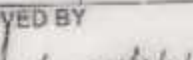
Fixed installation

-40 +120 °C

Min. bending radius

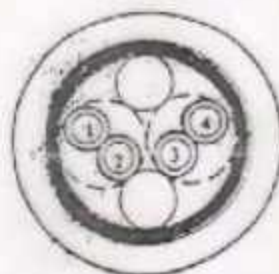
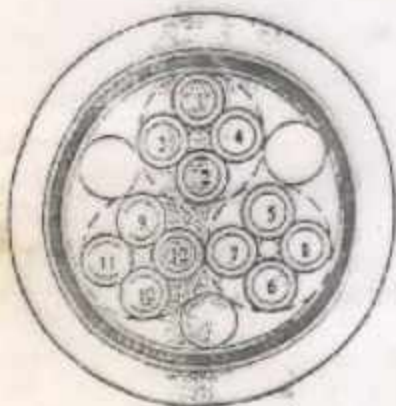
Fixed installation

5 x cable dia.

| | | | | |
|---|---|--|--|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by  gdm/eket | Checked by  T.E. II | Reviewed by  +SEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/IES/313K-2/0459 |
| | APPROVED BY  DY.CEE/CON/TU-I | | | |
| | ALT A B C | | | |

SHEET-24

Traction cable $n \times 1.0 \text{ mm}^2$ (SCREENED)

 $2 \times 1.0 \text{ mm}^2$  $2 \times 2 \times 1.0 \text{ mm}^2$  $3 \times 4 \times 1.0 \text{ mm}^2$ $3 \times 4 \times 1.0 \text{ mm}^2$ 80%2

$n \times 1.0 \text{ mm}^2$ (Twist)

 $2 \times 1.0 \text{ mm}^2$

| | | | | | |
|---|---|-----------------------------|-------------------------------------|--|--------------|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gaur. gdm/elec</i> | Checked by <i>J.E-II</i> | Reviewed by <i>5</i> /SEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | |
| | APPROVED BY <i>Indu 28/9/01</i> DY.CEE/CON/TU-I | | | DATE: 01/9/2001 NO: CLW/ES/35X-3/0453 | |
| | | | | ALT | <i>A B C</i> |

SHEET-2.5

TRACTION CABLE (SCREENED)**n x 0.5 mm²****General properties:**

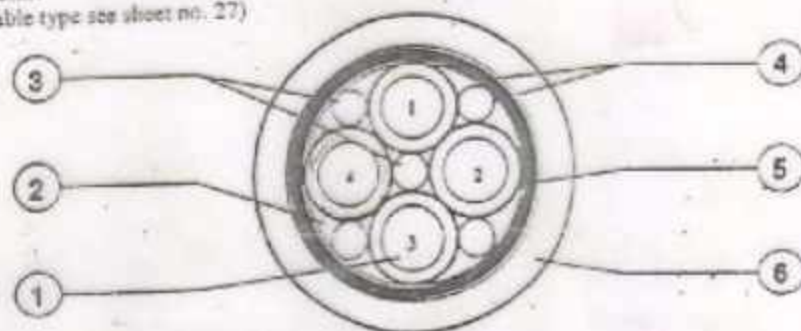
Excellent high temperature, low temperature, ozone and weathering resistance, zero halogen, flame retardant, solder ion resistant, easily shippable, flexible screening properties.

Application:

For permanent installation inside and outside of railway rolling stock to connect fixed and moving parts.

General composition of cables:

(Detailed drawing to each cable type see sheet no. 27)

**Construction**

1. Cores 1.0 mm²

Conductor : Stranded tin plated copper.
Insulation Colour: White. Code numbered.
Cabling: Core and elements, lay ratio $\leq 15 \times D$ (D = lay dia)

2. Identification thread

3. Filler (optional)

4. Separator(s) (optional)

5. EMC - Screen optimized

6. Sheath

Plastic tape

Tin plated copper braid

Colour: Black

Cable marking = Firm's name, Production Lot Number, Part Number

Technical Data

Dimension and Weight

Current rating, conductor resistance, transfer impedance

Table 1

Table -2

Operating conditions

Voltage U_0 / U

Test voltage for equipment acc. To IEC 77 1 Min, 50 Hz.

Max. conductor temperature

Continuous

Overload condition (max. 125 h / year)

At short circuit (max. 5s)

300 / 300 V

3000 V

+ 120 °C

+ 170 °C

+ 250 °C

- 40 + 120 °C

Operating temperature

Min. bending radius

Fixed installation

Fixed installation

5 x cable dia.

| | | | | |
|---|-----------------------------------|------------------------------|-------------------------------------|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>gdm/elect</i> | Checked by <i>J.E. II</i> | Reviewed by <i>+ SEE D&D</i> | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 22/9/2001 NO: CLW/ES/315 K-4/0453 |
| | APPROVED BY <i>[Signature]</i> | | | |
| | DY. CEE/CON/TU-1 | | | |
| ALT | | | | A B C |

SHEET-26

TRACTION CABLE (Twist) $n \times 0.5 \text{ mm}^2$ **General properties:**

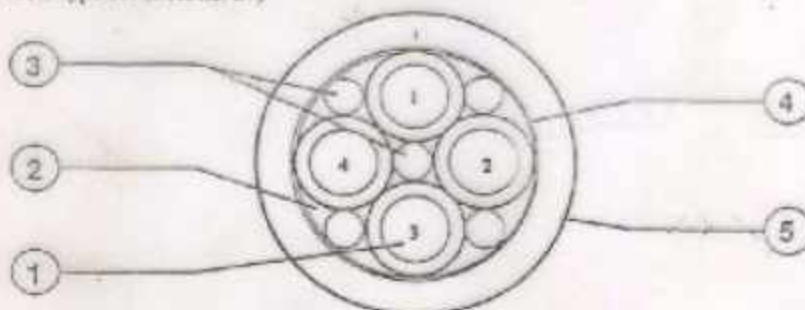
Excellent high temperature, low temperature, ozone and weathering resistance, zero halogen, flame retardant, solder ion resistant, easily strippable, flexible.

Applications:

For fixed installation inside and outside of railway rolling stock to connect fixed and moving parts.

General composition of cables:

(Detailed drawing to each cable type see sheet no. 27)

**Construction**

1. Cores 1.0 mm^2

Conductor: Stranded tin plated copper.

Insulation Colour: White, Code numbered.

Cabling: Core and elements, lay ratio $\leq 15\%$ (D = lay dia)

2. Identification thread

3. Filler (optional)

4. Separator(s) (optional)

5. Sheath

Plastic tape

Colour: Black

Cable marking: = Firm's name, Production Lot Number, Part Number

Technical Data

Dimension and Weight:

Table - 1

Current rating, conductor resistance, transfer impedance

Table - 2

Operating conditions

Voltage U_0 / U

300 / 300 V

Test voltage for equipment acc. To IEC 77-1 Min. 50 Hz.

3000 V

Max. conductor temperature

Continuous

+120 °C

Overload condition (max. 125 h / year)

+170 °C

At short circuit (max. 5s)

+280 °C

Operating temperature

Fixed installation

-40 +120 °C

Min. bending radius

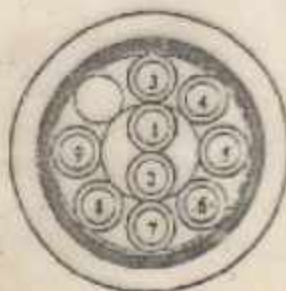
Fixed installation

5 x cable dia.

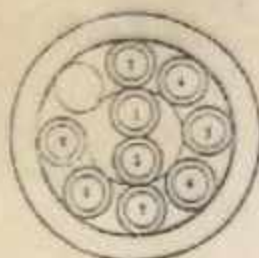
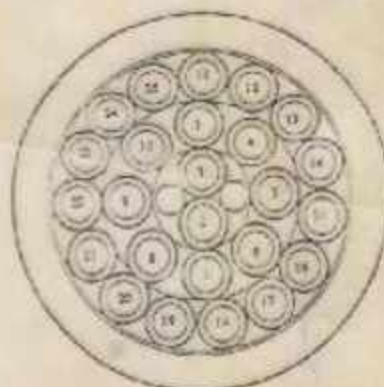
| | | | | |
|---|--|--|---|--|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>Shruti</i> g3m / elect | Checked by <i>[Signature]</i> J.E-II | Reviewed by <i>[Signature]</i> +SEE/D&D | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 28/9/2001 NO: CLW/IES/3157-5/0453 |
| | APPROVED BY <i>[Signature]</i> DY.CEE/CON/TU-I | | | |
| | ALT <i>N</i> <i>K</i> <i>C</i> | | | |

SHEET-27

Traction cable
 $n \times 0.5 \text{ mm}^2$ (SCREENED)

 $2 \times 0.5 \text{ mm}^2$  $3 \times 0.5 \text{ mm}^2$  $2 \times 2 \times 0.5 \text{ mm}^2$  $5 \times 0.5 \text{ mm}^2$  $9 \times 0.5 \text{ mm}^2$

TRACTION CABLE
 $n \times 0.5 \text{ mm}^2$ (Twist)

 $9 \times 0.5 \text{ mm}^2$  $25 \times 0.5 \text{ mm}^2$

| | | | | |
|---|--|---|--|---|
| SPECIFICATION FOR SET OF MULTIPLE CORE CABLE | Prepared by <i>[Signature]</i> JDM/Elect | Checked by <i>[Signature]</i> J.E.-II | Reviewed by <i>[Signature]</i> +SEED&O | D & D CENTRE CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA DATE: 22/9/2001 NO: CLW/ES/315/K-5/452 |
| | APPROVED BY <i>[Signature]</i> | | | |