## Report No. TC.20.03.000602

## Date of Issue 06/09/2020

**Applicant:** **Caledonian Cables Limited**

**Applicant address:** **1/F., CMA Building, 64-66 Connaught Road Central, Hong Kong**

**Description of the test subject:**

| Sample | Description | Photo |
|---|---|---|
| 001 | Sample Description: Rolling stock Cables<br><br>Style No.: FRL-MW-1SU 1C*400mm$^2$<br><br>Manufacturer: Caledonian Cables Limited |  <br>  |

**Receipt Date of Sample:** **03/10/2020**

**Date of Testing:** **From 03/10/2020 to 06/09/2020**

**Sample submitted:** **The sample(s) was (were) submitted by applicant and identified.**

**Conclusion:**

| Test Items | | | Result |
|---|---|---|---|
| No. | Items | Standard | |
| 1 | Single wire or cable burn testing | EN 50264-3-1:2008<br>EN 60332-1-2:2004+A1:2015 | Pass |
| 2 | Vertically-mounted bunched wires or cables burn testing | EN 50264-3-1:2008<br>EN 60332-3-24: 2009 | Pass |
| 3 | Smoke density testing | EN 50264-3-1:2008<br>EN 61034-2:2005 | Pass |
| 4 | Smoke toxicity testing | EN 50264-3-1:2008<br>EN 50305: 2002 | Pass |



Changzhou Jinbiao Railway Transportation Technical Service Co.,Ltd.

Phone: +86/ (0) 519-8123-9872
Fax: +86/ (0) 519-8123-9872 ext.123
E-mail: hui.shen@tuv-sud.cn
www.tuv-sud.cn

No. 164, Wuyi Road ,Lucheng Street, Wujin District, Changzhou city, Jiangsu Province, 213015 P.R. China

| | | | |
|---|---|---|---|
| 5 | Constructional and dimensional characteristics | EN 50264-3-1:2008 | Pass |
| 6 | Electrical properties of cables | EN 50264-3-1:2008 | Pass |
| 7 | Mechanical Properties | EN 50264-3-1:2008 | Pass |
| 8 | Cable marking and identification | EN 50264-3-1:2008 | Pass |
| 9 | Assessment of halogens | EN 50264-3-1:2008 | Pass |

**Test Results**

**EN 50264-3-1:2008 Railway applications - Railway rolling stock power and control cables having special fire performance - Part 3-1: Cables with crosslinked elastomeric insulation with reduced dimensions - Single core cables**

**1.EN 60332-1-2:2004+A1:2015 Tests on electric and optical fiber cables under fire conditions —Part 1-2: Test for vertical flame propagation for a single insulated wire or cable —Procedure for 1 kW pre-mixed flame**

**1.1 Sample details**

| | |
|---|---|
| Diameter | 31.4mm |
| Specimen size | 600mm |

| Precondition | Temperature（℃） | Humidity（%） | Duration(h) |
|---|---|---|---|
| | 23±5 | 50±20 | 16 |

**1.2 Test results**

| Measurements/ observation | 1st Test |
|---|---|
| The distance between the lower edge of the top support and the onset of charring (mm) | 395 |
| The distance between the lower edge of the top support and the charring downwards (mm) | 495 |

**Note:** If a failure is recorded, two more tests shall be carried out. If both tests result in passes, the single insulated conductor or cable shall be deemed to have passed the test.

**1.3 Requirement and conclusion**

1) The single insulated conductor or cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50 mm.
2) In addition, a failure shall be recorded if charring extends downwards to a point greater than 540 mm from the lower edge of the top support.

**Conclusion: Pass**



Changzhou Jinbiao Railway Transportation Technical Service Co.,Ltd.

Phone: +86/ (0) 519-8123-9872
Fax: +86/ (0) 519-8123-9872 ext.123
E-mail: hui.shen@tuv-sud.cn
www.tuv-sud.cn

No. 164, Wuyi Road ,Lucheng Street, Wujin District, Changzhou city, Jiangsu Province, 213015 P.R. China

**2. EN 60332-3-24: 2009 Tests on electric and optical fibre cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C**

**2.1 Sample details**

| | |
|---|---|
| Specimen size | 3.5m |
| Cable diameter | 31.4mm |
| Conductor diameter | 22.6mm |
| Non-metallic volume per meter of test sample(L) | 1.5 |
| Range of conductor cross-sections ($mm^2$) | >35 |
| Number of layers | 4 |
| Number of burners | 1 |
| Positioning of test pieces | Spaced |
| Flame application time (min) | 20 |

| Precondition | Temperature（℃） | Humidity（%） | Duration(h) |
|---|---|---|---|
| | 20±10 | 50±20 | 16 |

**2.2 Test results**

| Measurements/ observation | Result |
|---|---|
| The extent of damage | 0.62m |

**2.3 Requirement and conclusion**

| Test Item | Requirement | Result | Conclusion |
|---|---|---|---|
| Vertically-mounted bunched wires or cables burn testing (m) | ≤2.5 | 0.62 | Pass |

**3. EN 61034-2:2005 Measurement of smoke density of cables burning under defined conditions Part 2: Test procedure and requirements**

**3.1 Sample details**

| | |
|---|---|
| Diameter | 1.0mm |
| Cable diameter | 31.4mm |
| Number of bundles | 2 |

| | |
|---|---|
| Number of strands in the bundle | 1 |

| | | | |
|---|---|---|---|
| Pre-conditioning | Indoor | | Duration(h) |
| | Temp: 23±2℃ | Humidity: 50±5% | 16 |
| Ignition Source | Fire source 1 | | |

**3.2 Test Result**

| | |
|---|---|
| The minimum light transmittance within 40 minutes; (%) | 88.40 |

**3.3 Requirement and conclusion**

| Test Item | Requirement | Result | Conclusion |
|---|---|---|---|
| Smoke density（%） | ≥70 | 88.40 | Pass |

**4. EN 50305:2002 Railway applications — Railway rolling stock cables having special fire performance — Test methods**

**4.1 Sample details**

| | | | |
|---|---|---|---|
| Weight (g) | S1: 1.0023 g; S2: 1.0069 g; S3: 1.0070 g | | |
| Conditioning | Temperature（℃） | Humidity（%） | Duration (h) |
| | 23±2 | 50±5 | At least 48 |

**4.2 Test results**

| Gas | MDL | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| Carbon Monoxide (CO) | 5 | 36.6 | 41.2 | 32.1 | 36.6 |
| Carbon Dioxide ($CO_2$) | 40 | 136.8 | 172.8 | 187.2 | 165.6 |
| Sulphur Dioxide ($SO_2$) | 0.1 | ND | ND | ND | ND |
| Nitrogen Dioxide ($NO_2$) | 0.5 | ND | ND | ND | ND |
| Hydrogen Cyanide (HCN) | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |

**Remark:** MDL=Method Detection Limited
ND= Not Detected



Changzhou Jinbiao Railway Transportation Technical Service Co.,Ltd.

Phone: +86/ (0) 519-8123-9872
Fax: +86/ (0) 519-8123-9872 ext.123
E-mail: hui.shen@tuv-sud.cn
www.tuv-sud.cn

No. 164, Wuyi Road ,Lucheng Street, Wujin District, Changzhou city, Jiangsu Province, 213015 P.R. China

| Gas | CCz; mg/m$^3$ | Mz; mg | $\frac{Mz}{CCz}$ |
|---|---|---|---|
| Carbon Monoxide (CO) | 1750 | 36.6 | 0.021 |
| Carbon Dioxide ($CO_2$) | 90000 | 165.6 | 0.002 |
| Sulphur Dioxide ($SO_2$) | 260 | 0 | 0 |
| Nitrogen Dioxide ($NO_2$) | 90 | 0 | 0 |
| Hydrogen Cyanide (HCN) | 55 | 0.3 | 0.005 |
| ITC | | | 2.81 |

The toxicity index (ITC) shall be calculated using the following formula:

$$ITC = \frac{100}{\mathrm{m}} \text{å} \frac{Mz}{CCz}$$

Where,
M = weight of the sample, g;
Mz = weight of gas Z produced by the sample combustion, mg;
CCz = critical concentration for a 30 min exposure for gas z, mg/m$^3$.

**The ITC Value determined was** 2.81 .

**4.3 Requirement and conclusion**

| Test Item | Requirement | Result | Conclusion |
|---|---|---|---|
| Toxicity index (ITC) | ≤3 | 2.81 | Pass |

## 5. Constructional and dimensional characteristics

| No. | Test Item | Unit | Requirement | Result | Conclusion |
|---|---|---|---|---|---|
| | Insulation core color and mark | | | Black | |
| | Constructional and dimensional characteristics | | | | |
| 5.1 | Conductor material and construction | / | Tinned copper | Tinned copper | Pass |
| | Conductor number | | / | 2013 | -- |
| | Wires diameter | mm | Maximum 0.51 | 0.50 | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | Average elongation of wires | % | Minimum 15 | 25.2 | Pass |
| | Minimum elongation of individual wire | % | Minimum 10 | 23.7 | Pass |
| 5.2 | Insulation thickness | | | | |
| | Average thickness | mm | Minimum 2.0 | 2.41 | Pass |
| | Minimum thickness | mm | Minimum 1.7 | 2.11 | Pass |
| 5.3 | Cable overall diameter | mm | 28.1-32.9 | 31.4 | Pass |

**6. Electrical properties of cables**

| No. | Test Item | Unit | Requirement | Result | Conclusion |
|---|---|---|---|---|---|
| | Electrical properties of cables | | | | |
| 6.1 | Conductor resistance | Ω/km | Maximum 0.0495 | 0.0448 | Pass |
| 6.2 | Voltage test on cable | / | (3.5kV 5min) No breakdown | No breakdown | Pass |
| 6.3 | Dielectric strength | kV | Minimum 6 | 25 | Pass |
| 6.4 | Insulation resistance (20℃) | MΩ/km | Minimum 2.4 | 201 | Pass |
| 6.5 | Insulation resistance (90℃) | MΩ/km | Minimum 0.024 | 44 | Pass |
| 6.6 | D.C stability | | | (85℃ 240h 3%NaCl Water solution) | |
| | Voltage test (d.c.) | / | (±1.5kV) No breakdown | No breakdown (anode and cathode) | Pass |
| | Voltage test (a.c.) | / | (1.0kV 5min) No breakdown | No breakdown (anode and cathode) | Pass |

**7. Mechanical Properties**

| No. | Test Item | Unit | Requirement | Result | Conclusion |
|---|---|---|---|---|---|
| | Mechanical Properties | | | | |
| 7.1 | Properties in the state as delivered | | | | |
| | Tensile strength | MPa | Minimum 10 | 12.0 | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | Elongation at break | % | Minimum 150 | 153 | Pass |
| 7.2 | Properties after ageing in air oven | | (135℃ 168h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | +24.2 | Pass |
| | Elongation at break: Variation | % | Maximum ±30 | -11.8 | Pass |
| 7.3 | Hot set test | | (200℃ 15min 20N/cm$^2$) | | |
| | Elongation under load | % | Maximum 100 | 15 | Pass |
| | Elongation after unloading | % | Maximum 25 | 0 | Pass |
| 7.4 | Mineral oil resistance | | (100℃ 72h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | -11.7 | Pass |
| | Elongation at break Variation | % | Maximum ±40 | +12.4 | Pass |
| 7.5 | Fuel resistance | | (70℃ 168h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | -20.8 | Pass |
| | Elongation at break Variation | % | Maximum ±40 | +11.8 | Pass |
| 7.6 | Acid resistance test | | (23℃ 168h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | -6.7 | Pass |
| | Elongation at break | % | Minimum100 | 144 | Pass |
| 7.7 | Alkali resistance test | | (23℃ 168h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | -2.5 | Pass |
| | Elongation at break | % | Minimum100 | 137 | Pass |
| 7.8 | Compatibility | | (100℃ 168h) | | |
| | Tensile strength: Variation | % | Maximum ±30 | +25.0 | Pass |
| | Elongation at break Variation | % | Maximum ±40 | +1.3 | Pass |
| 7.9 | Ozone resistance | / | (25℃ 24h 250ppm) No cracks | No cracks | Pass |
| 7.10 | Cold elongation test | | (-40℃) | | |

| | | | | | |
|---|---|---|---|---|---|
| | Elongation at break | % | ≥30 | 33.3 | Pass |
| 7.11 | Impact test at low temperature | / | (-25℃) No cracks | No cracks | Pass |

**8. Cable marking and identification**

| No. | Test Item | Unit | Requirement | Result | Conclusion |
|---|---|---|---|---|---|
| | Cable marking and identification | | | | |
| 8.1 | Marking of Cable | / | There shall be marked with manufacturer's name; EN reference; rated voltage ($U_o$); conductor size and code designation | CALEDONIAN CABLE FRL-MW-1SU EN 50264-3-1 0.6/1kV 1×400 2019 M | Pass |
| 8.2 | Cable surface appearance | / | It shall be smooth, round, without spots, scratches, color difference, etc. | Meet the requirements | Pass |
| 8.3 | Continuity of marking | mm | The distance between the end of the mark and the starting point of the next similar mark shall not exceed 275mm | 28 | Pass |
| 8.4 | Durability of marking | / | Use cotton fabric or absorbent cloth to rub the mark or color for 10 times, and the mark or color will not be wiped off | Meet the requirements | Pass |

**9. Assessment of halogens**

| No. | Test Item | Unit | Requirement | Result | Conclusion |
|---|---|---|---|---|---|
| 9.1 | Amount of halogen acid gas | | | | |
| | HCl and HBr | % | Maximum 0.5 | 0.2 | Pass |
| | HF | % | Maximum 0.1 | <0.1 | Pass |

| | | | | | |
|---|---|---|---|---|---|
| 9.2 | PH | / | Minimum 4.3 | 4.5 | Pass |
| 9.3 | Conductivity | μs/mm | Maximum 10 | 0.36 | Pass |

**Statement:** The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use

Test results are just for client internal reference.

Changzhou Jinbiao Railway Transportation Technical Service Co., Ltd.

Drafted by: Approved by:

Lynn liu Shen hui

-End of Report-



Changzhou Jinbiao Railway Transportation Technical Service Co.,Ltd.

Phone: +86/ (0) 519-8123-9872
Fax: +86/ (0) 519-8123-9872 ext.123
E-mail: hui.shen@tuv-sud.cn
www.tuv-sud.cn

No. 164, Wuyi Road ,Lucheng Street, Wujin District, Changzhou city, Jiangsu Province, 213015 P.R. China