
Caledonian
Rolling Stock Cables
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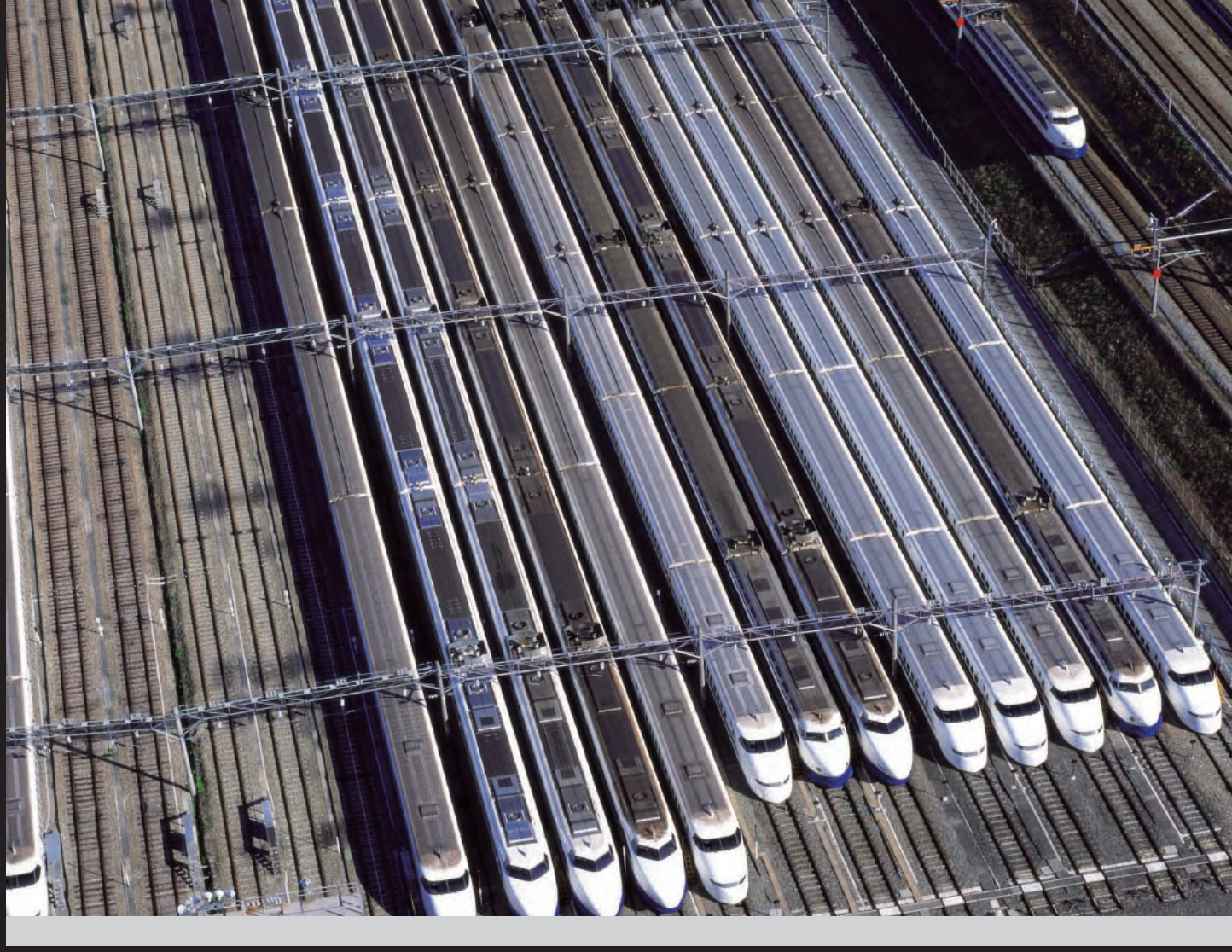
ADDISON



Caledonian & Addison, established in 1978, produced a wide range ofcopper and fiber optic cables for communication, power and electronics in its 2 plants in UK and 5 plants in China, with turnover exceeding USD exceeding USD 40 million in Yr 2004. Caledonian products are sold in more than 35 countries around the globe.

Our extensive global network of manufacturing facilities gives us significant scale and the flexibility to fulfill our customer requirements. This global presence provides design and consultancy solutions that are combined with core cable manufacturing and logistics services, and vertically integrated with our E commerce technologies, to optimize customer operations by lowering costs and reducing time to market.

Caledonian & Addison has been respected for its high standards of quality, excellent service level, competitive pricing and a unique and innovative spirit. With our latest technologies, we are both inspired and well-positioned to meet the changing needs of our customers. We have the resources to diversify and to enhance our product lines and services. We understand the need for change and with our accurate planning we are ready for the future and the promise of new marketing opportunities. Our tradition of growth through excellence is assured.

ISO 9001
REGISTERED FIRM

Registration Certificate

This document certifies that the administration systems of

Caledonian Cables Limited/Addison Technology Limited
Pheonix Works, North Street, Lewes, E. Sussex, BN7 2QJ

have been assessed and approved by QAS International to the following management systems, standards and guidelines:

ISO 9001 : 2000
With the permitted exclusion of clauses 7.3 Design and Development, 7.5.2 Validation of Processes for Production and Service Provision and 7.5.4 Customer Property

The approved administration systems apply to the following:

The manufacture and supply of electrical cables and ancillary power equipment to customers internationally.

Original Approval 6th September 1997
Current Certificate 7th February 2008
Certificate Expiry 7th February 2009
Certificate Number A8211

On behalf of QAS International

Our Design Centers work closely with customers to constantly improve its standard range of products and technologies and to develop customized, country and industry-specific solutions. Caledonian has established an extensive network of design, manufacturing, and logistics facilities in the world's major markets to serve the growing outsourcing needs of both multinational and regional customers.

Standard Wall power and control cables
> according to EN 50264

Medium Wall power and control cables
> according to EN 50264

Thin Wall instrumentation and control cables
> according to EN 50306

High Temperature cables
> according to EN 50382

Databus Cables

RSE/STD/024 PART 6 Rolling Stock Cables

NF F 63-808 Rolling Stock Cables

NF F 63-826 Rolling Stock Cables

NF F 63-827 Rolling Stock Cables

Rolling Stock Cable

This catalog covers rolling stock for underground, mass transit lines and tramlines as well as diesel and regional trains. The increasing need to reduce both volume and weight has lead to the development of miniaturized cables, as well as high temperature cables with enhanced performance. This leads to highly stressed materials being used in the harsh environment of rolling stock. Caledonian & Addison provides a full range of products from Medium Voltage to Instrumentation cables, and from Standard Wall, Medium Wall to Thin Wall designs. The materials used have been specially developed to improve mechanical and thermal properties, fire performance and extended life using advanced technologies, such as electron beam irradiation and silan.

New challenges in the rolling stock industry must be met due to long-awaited equipment upgrades, booming freight traffic and high-speed train projects, and the growing need for conventional subways, fully-automated metros,and light-rail suburban vehicles worldwide.
Caledonian & Addison manufactures a complete range of rolling stock cables and components, meeting national and international standards, We supply wide range of rolling stock cables from 300V to 6kV in diameter of 0.5mm sq to 400mm sq covering diverse railway standards. All cables meet strict technical requirements in terms of electrical safety, fire-performance (low-smoke and toxicity, continuous operation in the event of fire).

As an OEM, Caledonian rolling stock cables provides our railway customers with future headroom by meeting the following European Norms (EN) and international standards :

- EN 50264 European railway standard
- EN 50306 European railway standard
- BS 6853 British railway standard
- DIN 5510-2 German railway standard
- NF F 16 101 French railway standard
- UIC (International Union of Railways) 895

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CENELEC Standard

According to CENELEC Standards, railway rolling stock are designed to meet the following criticall requirements:
1) 2 levels of low temperature: -25°C and -40° C resistant
2) 2 levels of fluids resistance: oil resistant, or extra oil and fuel resistant
3) 3 levels of hazard: HL1. HL2-HL3. HL4

Low temperature, oil resistant	(-25° C, IRM 902)	A	B	C
Extra low temperature, oil resistant	(-40° C, IRM 902)	D	E	F
Low temperature, extra oil and fuel resistant	(-25° C, IRM 902. IRM 903)	G	H	J
Extra low temperature, extra oil and fuel resistant	(-40° C, IRM 902. IRM 903)	K	L	M
Extra low temperature, no oil and fuel resistant	(-40° C)	O	O	O

Caledonian Rolling Stock cables, branded as FIREROL, are mainly classified as follows:

EN 50264

Caledonian standard wall and medium wall rolling stock cables conform to EN 50264 for use in power cars, diesel-electric locomotives, electric and diesel multiple units EMU / DMU, high-capacity rails, mono rail and light rail vehicles, sleeping cars and passenger coaches. FIREROL are very flexible cables.

Application:

Strictly halogen free, these wires combine the advantages of small size, lightweight, high chemical resistance, high mechanical properties. They are recommended for installation in railway vehicles (locomotives, trains, trolleybusses...).
A 120°C conductor temperature is allowed for a 20000 hours cumulative working time.
The external sheath is oil and diesel oil resistant, ozone and UV resistant

Conductors:

Flexible stranded tinned copper class 5 according to IEC 60228 with optional separator tape. Conductors temperature +90°/105° C

Standard:

EN 50264-1: General requirements applicable to cables, including detailed requirement for the insulating and sheathing materials

Standard Wall rolling stock cables having special fire performance

EN50264-2 = pr EN50264-2-1	Standard wall single core cables with crosslinked elastomeric insulation 0.6/1kV Unscreened, unsheathed 1mm^2-400mm^2 FRL-SW-1SU 1.8/3kV Unscreened, unsheathed 1mm^2-400mm^2 FRL-SW-3SU 1.8/3kV Unscreened, sheathed 1mmsq-400mm^2 FRL-SW-3S 3.6/6kV Unscreened, sheathed 1mmsq-400mm^2 FRL-SW-6S
EN50264-3 = pr EN50264-2-2	Standard wall multi-core cables with crosslinked elastomeric insulation 300/500V Unscreened or screened 1/1.5/2.5 mm^2 (2-40 Cores) FRL-SW-05M / FRL-SW-05M-OS 0.6/1kV Unscreened or screened 1 mmsq-50 mm^2 (2.3.4 cores) FRL-SW-1M / FRL-SW-1M-OS
Insulation compounds:	Crosslinked halogen free rubber EI 101 (for A, B, C), EI 102 (for D, E, F), EI 103 (for G, H, J), EI 104 (for K, L, M) and EI 105 (for O, EPDM compound)
Sheathing compounds:	Special crosslinked halogen free black rubber type: EM 101 (for A, B, C), EM 102 (for D, E, F), EM 103 (for G, H, J), EM 104 (for K, L, M)

Medium Wall rolling stock cables having special fire performance

pr EN50264-3-1:	Medium wall single core cable with crosslinked elastomeric insulation with reduced dimensions 0.6/1kV Unscreened, unsheathed 1mm^2-400mm^2 FRL-MW-1SU 1.8/3kV Unscreened, unsheathed 1mm^2-400mm^2 FRL-MW-3SU 1.8/3kV Unscreened, sheathed 1mm^2-400mm^2 FRL-MW-3S 3.6/6kV Unscreened, sheathed 1mm^2-400mm^2 FRL-MW-6S
pr EN50264-3-2:	Medium wall multi-core cables with crosslinked elastomeric insulation with reduced dimensions 300/500V Unscreened or screened 1/1.5/2.5 mm^2 (2-40 Cores) FRL-MW-05M / FRL-SW-05M-OS 0.6/1kV Unscreened or screened 1 mm^2-50 mm^2 (2.3.4 cores) FRL-MW-1M / FRL-SW-1M-OS
Insulation compounds:	Crosslinked halogen free black rubber EI 106 (for A, B, C), EI 107 (for D, E, F), EI 108 (for G, H, J), EI 109 (for K, L, M) and EI 110 (for O, EPDM compound)
Sheathing compounds:	Special crosslinked halogen free rubber type: EM 101 (for A, B, C), EM 102 (for D, E, F), EM 103 (for G, H, J), EM 104 (for K, L, M)

EN 50306

Caledonian thin wall rolling stock cables conform to EN 50306 are resistant to chemicals, acids, oils, fuels and UV light. Anti-termite cables and anti-rodent cables can also be offered upon customer request.

Application:

Strictly halogen free, these wires combine the advantages of small size, lightweight, high chemical resistance, high mechanical properties. They are recommended for installation in railway vehicles (locomotives, trains, trolleybusses...).

A 120°C conductor temperature is allowed for a 20000 hours cumulative working time.

The external sheath is oil and diesel oil resistant, ozone and UV resistant

Conductors:

Flexible stranded tinned copper class 5 according to IEC 60228 with optional separator tape. Conductors temperature +90°/105° C or +105°/125° C

Insulation: Crosslinked halogen free polyethylene or polymer

Sheathing: Cables sheathed with special S1 and S2 compounds (described in EN 50306-1) or EN 50264 sheathing compounds (EM 101. EM 102. EM 103 and EM 104)

Standard:

EN 50306-1: General requirements applicable to cables, including detailed requirement for the insulating and sheathing materials

Thin Wall rolling stock cables having special fire performanceEN 50306-2:	Thin wall single core cables 300/500V Unscreened 0.5mm^2-2.5 mm^2 FRL-TW-05SU
EN 50306-3:	Thin wall single core and multi core cables (pairs, triads, and quads) screened 300/500V Screened 0.5mm^2-2.5 mm^2 (1-4 Cores) FRL-TW-05S-OS or FRL-TW-05M-OS
EN 50306-4:	Thin wall multi-core and multi pair cables Unscreened, sheathed for either exposed or protected wiring 0.5mm^2-2.5mm^2 (2-48 Cores) FRL-TW-05M-SW, FRL-TW-05M-ESW Screened, sheathed for either exposed or protected wiring 0.5mm^2-2.5mm^2 (2-8 Cores) FRL-TW-05M-SW-OS, FRL-TW-05M-ESW-OS Screened, sheathed for either exposed or protected wiring 0.5mm^2-1.5mm^2 (2-7 Pairs/Cores) FRL-TW-05MP-SW-IOS, FRL-TW-05MP-ESW-IOS

EN 50382

Caledonian High Temperature cable is characterized by its lightweight and small size which provide high flexibility and easy handling required for high-speed train cable applications. High temperature cables implies higher current capacity for the same cross-section. The higher the continuous temperature load, the longer the life time of the cable at a given working temperature. Caledonian High Temperature cable allow greater safety margins and higher current capacity, with the following features:

- Low weight cable
- Low size cable
- Thin wall cable
- Wide operating temperature range (+125°C down to -60°C)
- Low smoke density (>90% light transmission)
- Short circuit cable and Earth fault-proof cables (>250°C)

Conductors:
For 120°C class : Flexible stranded tinned copper
For 150°C class : Flexible plain annealed copper
Class 5 (or class 6 on request) according to IEC 60228 with optional separator tape
Braiding:
Optional textile braid (for reinforced versions)
Insulation: Type EI 111 or EI 112 (if sheathed) cross-linked halogen free silicone rubber
Sheathing: Low temperature, oil resistant, ozone and UV resistant
For 120°C class : special cross-linked black rubber type EM106 according to EN 50382-1
For 150°C class : special cross-linked black silicone rubber type EM 107 according to EN 50382-1
Miniumum bending radius:
Dynamic use : 5 to 8 x outer diameter
Static use : 4 x outer diameter
Standard:
EN 50382-1: General requirements applicable to cables, including detailed requirement for the insulating and sheathing materials
High temperature rolling stock cables having special fire performance

EN 50382-2	Single core, silicon rubber insulated cables for +120° C and +150° C 1.8/3 kV unscreened, unsheathed with or without textile braid 1.5mm^2-400mm^2 FRL-HT-3SU 1.8/3 kV unscreened, sheathed with or without textile braid 1.5mm^2-400mm^2 FRL-TW-3S 3.6/6 kV unscreened, unsheathed with or without textile braid 2.5mm^2-400mm^2 FRL-TW-6SU 3.6/6 kV unscreened, sheathed with or without textile braid 2.5mm^2-400mm^2 FRL-TW-6S

Cable design in accordance with EN 50264 & EN 50306

Cable Make Up

Conductors
Tinned fine copper strands according to VDE 0295 / IEC 60228. class 5 are generally used for railway cables. For nominal cross section of over 50mm sq, 0.41mm strand wire will be used instead of 0.51mm as stipulated in IEC 60228. The IEC 60228 Class 5 enhances flexibility and the ease of handling, thus lengthening the product life of the cable. These class 5 class conductors are extremely flexible, and easy-to-install in the compact rolling stock environment.
Insulation and outer sheath
Crosslinked polyolefine copolymer or EPR will generally be used for insulation whereas electron-beam cross-linked elastomer is employed for sheathing. Cross-linked elastomer compounds offer very good durability that can resist heat, oil, vibration, chemical aggression, etc

Electrical Characteristics

Nominal voltage
Nominal voltage of a cable refers to the reference voltage for which the cable is intended to be used. In EN 50264. applicable to power cables, different voltage ranges ranging from 0.6/1 kV, 1.8/3 kV to 3.6/6 kV are defined. For each of these voltage ranges, specific insulation thickness requirements are also stipulated in this standard. The operating voltage should not exceed the corresponding maximum nominal voltage allowed.
Current Carrying Capacity
Current carrying capacity is defined as the amperage a conductor can carry before melting either the conductor or the insulation. There are many factors which will limit the amount of current that can be passed through a wire. These major determining factors are:
Conductor Size:
The larger the circular mil area, the greater the current carrying capacity. The amount of heat generated should never exceed the

maximum temperature rating of the insulation

Ambient temperature:

The higher the ambient temperature, the less heat required to reach the maximum temperature rating of the insulation.

Conductor Number:

Heat dissipation is lessened as the number of individually insulated conductors, bundled together, is increased

Installation Conductors:

Restricting the heat dissipation by installing the conductors in conduit, duct, trays or raceways lessens the current carrying capacity. This restriction can be alleviated somewhat by using proper ventilation methods, forced air cooling, etc.

According to EN 50343. “Railway applications - Rolling stock – Rules for installation of cabling” current carrying capacity are based on maximum conductor temperatures of 90°C and 150°C defined in 3 b. The ambient temperature is 45°C. The following table shows the current carrying capacities for a cable installed in mid air.

Current carrying capacity for cables in accordance with EN 50264

Nominal cross section of copper conductor mm^2	Current carrying capacity Conductor temp. 90 °C (max) Ambient temp. 45 °C I [A]	Current carrying capacity Conductor temp. 150 °C (max) Ambient temp. 45 °C I [A]
0.5	14	-
0.75	16	-
1	20	-
1.5	25	-
2.5	33	46
4	46	64
6	60	84
10	85	119
16	110	154
25	150	211
35	190	267
50	240	337
70	300	422
95	360	506
120	425	598
150	490	689
185	560	788
240	675	950
300	775	1091
400	950	1337

Ambient temperature

External conditions such as ambient temperature and bundling must be taken into account when determining actual current carrying capacity. The following tables show the corresponding k1 modification factors depending on an ambient temperature differing from 45 °C. Current carrying capacity decreases or increases depending on these factors

Maximum conductor temperature 90°C

Temperature °C	10	20	30	40	45	50	60	70
k1	1.33	1.25	1.15	1.05	1	0.94	0.82	0.66

Maximum conductor temperature 150°C

Temperature °C	– 50	– 30	– 10	10	30	45	60	80	100	120
k1	1.38	1.3	1.23	1.15	1.06	1	0.92	0.81	0.69	0.53

Physical Characteristics

Temperatures and overload temperatures

EN 50264 defines two overload categories for cables at 90°C and 150°C : 160°C/50 h for 90°C and 250°C /50 h for 150°C. This means that for a period of less than or equal to 50 hours, increased conductor temperatures can be withstood, while the operability of the cables remains unimpaired. This has the advantage that short-time temperature increases can be identified and more serious damage such as fires can be prevented.

Environmental conditions

Cables are suitable for fixed installation in rail vehicles up to – 40°C and are resistant to oil according to EN 50305. EN 60811-2-1. UIC 895 and resistant to fuel according to
EN 50305. EN 60811-2-1. UIC 895.

Fire Performance

EN 50264 and EN 50306 only describe cables and wires made from halogen free materials that minimise the risk of damage to persons and property. These materials refer to hazard levels 1 – 4 as defined in EN 45545-1(fire protection on railway vehicles). These levels

define the degree of possibility of personal injury as the result of a fire. Amongst other things, they also form the basis of the requirements for materials used in rail vehicles.

Halogen Free

The test is for determination of the amount of halogen acid gas, other than the hydrofluoric acid evolved during combustion of compound. When tested in accordance with IEC 60754-1. the hydrochloric acid yield should be less than 0.5% (5mg/g) for LSOH compound.

Corrosivity

Corrosive gases produced in case of fire cause damage to vehicles and facilities and therefore should be avoided. According to EN 50267-2-2. a material is not corrosive if its combustion gases meet the stipulated target values for conductivity (≤10 . s/mm) and pH value (≥4.3).

This is equivalent to IEC 61034

Toxicity

In accordance with EN 50305- 9.2. or NFC-20454 a toxicity index (ITC) is calculated following analysis and titration of combustion gases. The aforementioned hazard levels require that certain toxicity indices are not exceeded.

The toxicity indices for power cables listed in the following table are derived from EN 50264.

HL	ITC
HL 1	not specified
HL 2 / HL 3	5 (max)
HL 4	3 (max)

The required toxicity indices for cables and wires, depending on hazard level, in accordance with EN 50306 (thin wall) are displayed in the following table:

HL	ITC	
	Insulation and sheath S1	EM101-104 and sheath S2
HL 1	not stipulated	not stipulated
HL 2 / HL 3	10 (max)	5 (max)
HL 4	6 (max)	3 (max)

Toxic Fumes

Naval standard NES713 burns a set amount of material and analyses the gases given off. The volume of each gas is multiplied by the toxicity index for each gas. The toxicity index for each gas are added together to give an overall toxicity index for the material. LFH materials should have a toxicity index maximum of 10.

Flame Retardance

In accordance with EN 50265- 2-1 or IEC 60332-1. testing is carried out for a single insulated wire or cable. The specimen is deemed to have passed this test, if after burning has ceased, the charred or affected position does not reach within 50mm of the lower edge of the top clamp.

In accordance EN 50266-2-4. EN 50305 9.1 and IEC 60332-3. testing is carried out for bunched cables. A gas burner flame is applied to the bottom of a vertically arranged conductor bundle in a test furnace. Following completion of the flame test, the specimen consisting of 3.5m, is deemed to have met the requirements, if after burning has ceased, the extent of charred of affected portion does not reach a height exceeding 2.5m above the bottom edge of the burner

Smoke Density

For smoke density testing, the cube test is employed according to EN 50268-2-1 or IEC 61034. The 3 metre cube test measures the generation of smoke from electric cables during fire. A light beam emitted from a window is projected across the enclosure of to a photo cell connected to a recorder at the opposite window.

The recorder is adjusted to register from 0% for complete obscuration to 100% luminous transmission. A 1 metre cable sample is placed in the centre of the enclosure and then subjected to fire. The minimum light transmission of the smoke is then measured.

The following table shows the minimum percentages of light transmission depending on hazard level:

HL	Light transmission
HL 1	not specified
HL 2 / HL 3	60 %
HL 4	70 %

BS 6853.

In 1999. BS 6853 was introduced in UK and whose highest categories are probably the most demanding in the world. BS 6853 covers both smoke emission testing and flammability testing. BS 6853 also introduced the concept of an R-Index, which is a single number quantification of the toxic gas risk associated with candidate composite materials for use in railway rolling stock. The R-Indices are split into the following categories:

Category 1a Trains which predominantly use tunnels R < 1.0

Category 1b Trains which use tunnels, but infrequently R < 1.6

Category 2 Trains which run, predominantly, overground R < 3.6

The R-Index is generated by analysing eight gases of combustion, for which critical concentrations have been established by NIOSH/OSHA and reported as IDLH, (Immediately Dangerous to Life and Health), values.
Toxicity is the most important factor to address during the cable design. Toxicity limit for the UK and France are identical because both require the same test method for elastomers (NF X 70-100). The only difference is that the U.K.'s specification requires an addendum for nitrous oxides. Toxicity limits for French and the U.K. standards are developed from the IDLH values published in the National Institute for Occupational Safety and Health (NIOSH) Guide. IDLH, or Immediately Dangerous to Life or Health, values are calculated based on levels of gas in a particular atmosphere for 30 min that would pose an immediate riskthe U.K.'s BS 6853 specification is the most stringent, closely followed by the French, and finally the U.S. It's important to note that Germany does not have a toxicity requirement.

R Index **IDLH Values**

Gases	U.K.(mg/m^3) BS 6853	French (mg/m^3) NF X 70-100	U.S. (ppm) SMP 800C
CO	1.400	1.750	3.500
CO_2	73.000	90.000	90.000
HCl	76	150	500
HBr	101	170	100
HCN	56	55	100
HF	25	17	100
NO/NO_2	38		100
SO_2	270	260	100

NFF 16-101/2

In France the French Railway's standard NFF 16-101/2 combines reaction to fire, (M rating), with smoke and toxicity, (F rating), to provide a true FST evaluation of the fire safe properties of a composite material.
As with the UK BS 6853 standard, the M/F rating required in NFF 16-101 is dependent on
the type of rolling stock, the extent to which it uses tunnels and the position and orientation of the composite part in the vehicle.

Test methods

The standard comprises the following test methods:
Flammability
NF-EN 60695-2 Glowing Wire at 850+/-15C and 960+/-15C
NF-EN ISO 4589-2 Oxygen index determination
Smoke Density
NFX 10-702 Smoke density determination
Toxicity
NFX 70-100 Pyrolysis and combustion gas analysis

M rating

M rating refers for the fire resistance classification of the materials to be used in the transportation industry
This classification rates the material in five categories

M0: incombustible
M1: non flammable
M2: burns with difficulty
M4: easily inflammable
M5: very easily inflammable

I/F rating

I/F rating refers to ignition resistance and fume classification of non metallic electrical components used in the underground transporation industry.

Test description

1. Ignition

The ignition characteristics is determined by a combination of glow wire test (GWT) and oxygen index.
The material under test is categorized in the following tables:

Class	Oxygen Index	Glow Wire
I0	>70	No ignition at 960C
I1	>45	No ignition at 960C
I2	>32	No ignition at 850C
I3	>28	Ignition does not persist at 850C after glow wire is withdrawn
I4	>20	
NC	<70	

(Not classified)

2. Fume composition

The parameters tested are fume opacity and analysis of pyrolysis as well as combustion gases.

All 3 parameters are used to calculate the smoke index (SI) which in turns determines the fume class F as follows:

F Class	S.I Values
F0	≤ 5
F1	≤20
F2	≤40
F3	≤80
F4	≤120
F5	>120

Classification

Each material will receive I/F rating, the smaller the number the better. Unfortunately, good I and good F are difficult to achieve: low I values frequently means addition of fire retardant packages which in turns leads to high F values.

Consequently, 4 overall I/F performance classes are defined as follows:

	I0	I1	I2	I3	I4	I5
F0	IV	IV	IV	II	I	I
F1	IV	IV	IV	II	I	I
F2	IV	IV	III	II	I	I
F3	IV	III	III	I	I	I
F4	IV	III	I	I	I	I
F5	IV	I	I	I	I	I

I Performance class 1. least demanding
II Performance class 2
III Performance class 3
IV Performance class 4. most demanding

DIN 5510

In Germany, the fire standards requirements in railways are defined by the DIN 5510. which does not include any measurement of toxic gases but focuses only on reaction to fire and smoke produced in a fire scenario.
According to DIN5510. the test samples, vertically arranged in the test chimney, are stressed by a special bunsen burner for 3 minutes. The combustibility, smoke release and dripping behaviour are then assessed.
The extent of destroyed surface area is decisive of the fire performance rating. The following are the fire performance classification:

Class		
B1	Easily ignitable	Damaged area 90%-100%
B2	Combustible	Damaged area 76%-90%
B3	Difficult to ignite	Damaged area <75%
B4	Incombustible	No damage

The rating with respect to burning dripping are also observed in the chimney test. Differentiation between the classes is based on visual observation by T1 burning dripping to T4 no visible deformation/ no softening.
The smoke release during the chimney test will be done by the reduced transmission value. Two classes, SR1 10% min and SR2 < 50% min are used.

EN 45545

En 45545 is a common new EU standard is to replace the existing national regulations for fire safety in trains and track-guided vehicles. This new standard constitutes a harmonising of the existing national standards based on the highest common denominator – and will therefore represent a stiffening of the fire safety regulations applied in the individual countries.

The new standard divides railway vehicles into four operation categories. As seen below, it particularly targets safety in connection with tunnels and bridges:

Category	Services	Infrastructure
1	Mainline, regional, urban and suburban	Operation not determined by underground sections, tunnels and/or elevated structures
2	Urban and suburban	Operation determined by underground sections, tunnels and/or elevated structures with walkways or other means for safe side evacuation from the vehicles
3	Mainline and regional	Operation determined by underground sections, tunnels and/or elevated structures with walkways or other means for safe side evacuation from the vehicles
4	Mainline, regional, urban and suburban	Mainline, regional, urban and suburban operation determined by underground sections, tunnels and/or elevated structures without any means for safe side evacuation from the vehicles

The standard also establishes four hazard levels that determine the requirements for protection against fire and smoke formation. Most new railway vehicles will be designed to hazard level 3. but some vehicles, for example for light rail systems, will have to conform to hazard level 4.:

Category	Design category			
	Standard vehicles	Automatic vehicles	Double-decked vehicles	Sleeping cars
1	HL 2	HL 2	HL 2	HL 2
2	HL 2	HL 3	HL 3	N/A
3	HL 3	HL 4	HL 3	HL 4
4	HL 4	HL 4	HL 4	HL 4

HL 1 Long distance train

HL2 Regional train without tunnel

HL3 High speed trains
City and regional trains
Trams with party going through tunnels.

HL4 Metro
Night train with sleeping coaches

Ordering Code

FRL-A-BC-D-E-F-G

A- Wall Type

SW- Standard Wall

MW- Medium Wall

TW- Thin Wall

HT- High Temperature

B- Voltage Type

05-300/500V

06-0.6/1KV

3-1.8/3KV

6-3.6/6KV

C- Core Type

S- Single Core

M-Multi Core

MP-Multi Pair

D-Insulation or Sheath Type

U-Unsheathed

SW-Standard Wall Sheath

ESW-Exposed Standard Wall Sheath

RI-Reinforced Insulation

E- Screen Type

OS-Overall Screen

IOS-Individual & Overall Screen

F-Number of Cores and Pairs

10C- 10 Cores

G- Cross Section Areas

1.5- 1.5mm^2

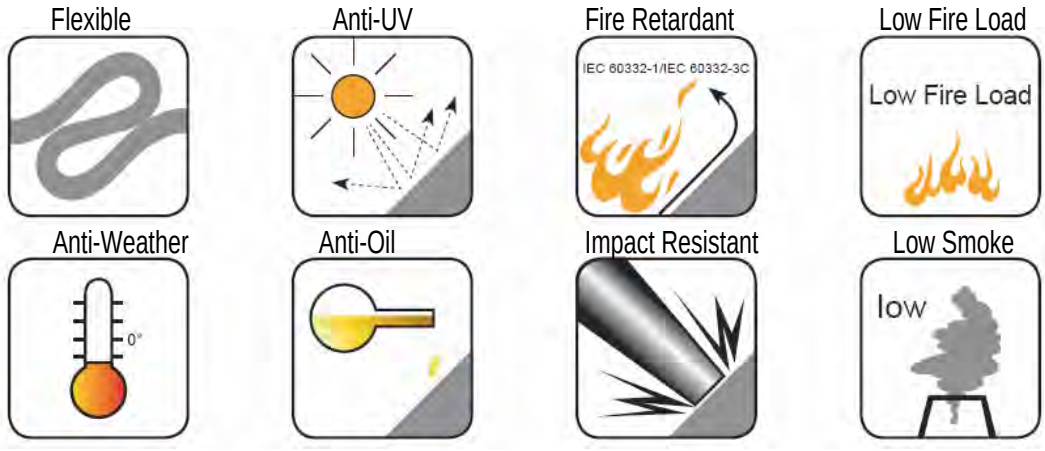
Test Method

EN 50305

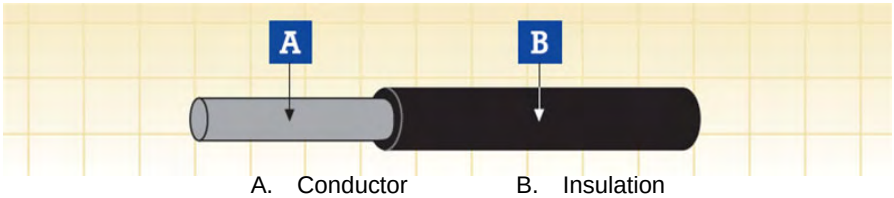
Test Methods

Special test are stipulated in EN 50305 for each European railway rolling stock. Below is the test method for the rolling stock cables to En 50264 and EN 50306 and EN 50382 :

For Standard Wall and Medium Wall cables according to EN 50264	
Ageing test at: +120° C	
Fluid Resistance:	IRM 902 for mineral oil resistance
	IRM 903 for fuel resistance
	N oxalic acid
	N sodium hydroxide
Test at low temperature:	-25° C or -40° C
Fire Propagation:	Single core test EN 50265-2-1 (IEC 60332-1)
	Bundle core test EN 50266-2-4 (IEC 60332-3C) + EN 50305
Toxicity Test:	Toxicity EN 50305
Smoke Density Test:	Low smoke EN 50268-2 (IEC 61034)
Halogen Test:	acid and toxic gases EN 50267-2-1/8-2-2 (IEC 60754-1&2)
Electrical Test:	Dielectric test and direct current stability test at +85° C
For Thin Wall cables according to EN 50306	
Standard Wall tests plus	
Long Term Ageing Test:	(20.000 h at +125° C) EN 50305
Notch Propagation Test:	EN 50305
Abrasion Test:	EN 50305
For High Temperature cables according to EN 50382	
Standard Wall tests plus	
Ageing Test	for silicon insulation at +200° C and long term sheath ageing test (20.000 h at +140° C)



FIREROL Standard Wall
Single Core Unsheathed
0.6/1 kV or 1.8/3 kV
to EN 50264-2-1 (FRL-SW-1SU, FRL-SW-3SU)



A. Conductor B. Insulation

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5

Insulation

LSZH elastomeric compound as defined in EN 50264-1 (EI 101 to EI 104)

Electrical & Mechanical Properties

Nominal Voltage	0.6/1 kV or 1.8/3 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

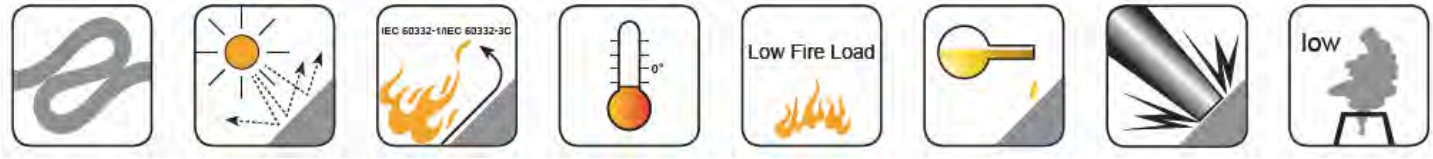
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-SW-1SU 0.6/1 kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	CONDUCTOR RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT 90°C
			min	max		max	min	min
mm^2	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.0	1.25	0.8	2.8	3.2	18	20	65	0.65
1.5	1.5	0.8	3.0	3.5	20	13.7	55	0.55
2.5	1.95	0.8	3.4	3.9	30	8.21	50	0.5
4.0	2.5	0.8	3.9	4.6	50	5.09	40	0.4
6.0	3.0	0.9	4.6	5.4	70	3.39	35	0.35
10	3.9	1.1	5.8	6.8	130	1.95	30	0.3
16	5.0	1.1	7.2	8.5	170	1.24	30	0.3
25	6.4	1.3	8.6	10	260	0.795	30	0.3
35	7.7	1.3	10.2	11.5	350	0.565	25	0.25
50	9.2	1.5	11.6	13.5	500	0.393	25	0.25
70	11.0	1.5	13.3	15.5	690	0.277	20	0.2
95	12.5	1.6	14.9	17.4	910	0.210	20	0.2
120	14.2	1.6	16.5	19.3	1120	0.164	20	0.2
150	15.8	1.9	18.5	21.7	1430	0.132	15	0.15
185	17.5	1.9	20.1	23.6	1720	0.108	15	0.15
240	20.1	2.1	22.9	26.8	2290	0.0817	15	0.15
300	22.5	2.2	25.4	29.7	2810	0.0654	10	0.1
400	25.8	2.3	28.7	33.6	2690	0.0495	10	0.1

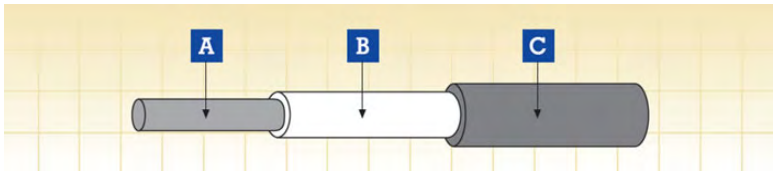
(a) = for information, indicative only

FRL-SW-3SU 1.8/3 kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT90°C
			min	max		max	min	min
mm^2	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	2.5	6.2	7.3	70	13.7	120	1.2
2.5	1.95	2.5	6.6	7.8	90	8.21	100	1.0
4.0	2.5	2.5	7.1	8.4	110	5.09	90	0.9
6.0	3.0	2.5	7.6	8.9	130	3.39	80	0.8
10	3.9	2.5	8.4	9.9	190	1.95	65	0.65
16	5.0	2.5	9.5	11.1	250	1.24	50	0.55
25	6.4	2.5	10.8	12.7	330	0.795	45	0.45
35	7.7	2.5	12.0	14.1	430	0.565	40	0.4
50	9.2	2.5	13.4	15.7	570	0.393	35	0.35
70	11.0	2.5	15.1	17.7	760	0.277	30	0.3
95	12.5	2.7	16.9	19.8	980	0.210	30	0.3
120	14.2	2.7	18.5	21.7	1210	0.164	25	0.25
150	15.8	2.7	20.0	23.4	1500	0.132	20	0.2
185	17.5	2.7	21.6	25.3	1800	0.108	20	0.2
240	20.1	2.7	24.1	28.2	2360	0.0817	20	0.2
300	22.5	2.7	26.3	30.8	2840	0.0654	15	0.15
400	25.8	2.9	29.8	34.9	3800	0.0495	15	0.15

(a) = for information, indicative only

FIREROL Standard Wall
Single Core Sheathed
1.8/3 kV or 3.6/6 kV
to EN 50264-2-1 (FRL-SW-3S / FRL-SW-6S)



A. Conductor B. Insulation C. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5
Insulation
LSZH elastomeric compound as defined in EN 50264-1 (EI 101 to EI 104)
Sheath
LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	1.8/3 kV or 3.6/6 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

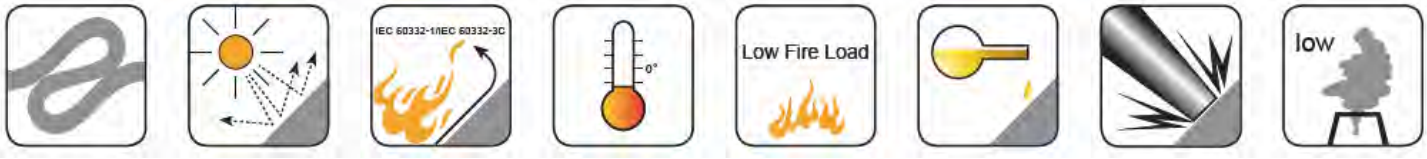
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-SW-3S 1.8/3 kV

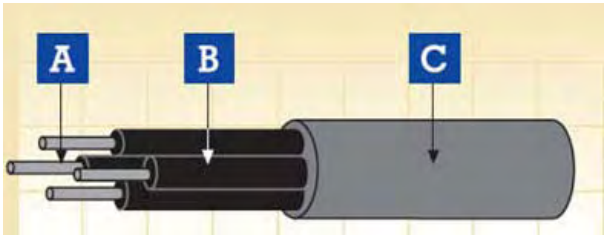
NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	MIN. MEAN THICKNESS OF SHEATH	OVERALL DIAMETER		WEIGHT	CONDUCTOR RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT 90°C
				min	max		max	min	min
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	1.3	1.4	6.7	7.8	80	13.7	960	9.6
2.5	1.95	1.3	1.4	7.1	8.3	100	8.21	850	8.5
4.0	2.5	1.3	1.4	7.6	8.9	120	5.09	750	7.5
6.0	3.0	1.3	1.4	8.1	9.5	140	3.39	670	6.7
10	3.9	2.2	1.4	10.6	12.4	250	1.95	550	5.5
16	5.0	2.2	1.4	11.7	13.6	310	1.24	450	4.5
25	6.4	2.2	1.4	13.0	15.2	410	0.795	390	3.9
35	7.7	2.2	1.4	14.2	16.6	520	0.565	350	3.5
50	9.2	2.2	1.4	15.6	18.3	660	0.393	300	3.0
70	11.0	2.2	1.5	17.5	20.5	880	0.277	260	2.6
95	12.5	2.4	1.6	19.6	22.3	1130	0.210	250	2.5
120	14.2	2.4	1.6	21.1	24.6	1370	0.164	220	2.2
150	15.8	2.4	1.7	22.7	26.6	1690	0.132	210	2.1
185	17.5	2.4	1.7	24.0	28.1	2000	0.108	200	2.0
240	20.1	2.4	1.8	27.0	31.6	2620	0.0817	180	1.8
300	22.5	2.4	1.9	29.4	34.4	3140	0.0654	170	1.7
400	25.8	2.6	2.0	32.7	38.3	4140	0.0495	150	1.5

FRL-SW-6S 3/6 kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	MIN. MEAN THICKNESS OF SHEATH	OVERALL DIAMETER		WEIGHT	CONDUCTOR RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT 90°C
				min	max		max	min	min
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2.5	1.95	3.0	1.4	10.5	12.3	170	8.21	1300	13
4.0	2.5	3.0	1.4	11.0	12.9	190	5.09	1150	11.5
6.0	3.0	3.0	1.4	11.5	13.4	230	3.39	1050	10.5
10	3.9	3.0	1.4	12.3	14.4	300	1.95	850	8.5
16	5.0	3.0	1.4	13.3	15.6	360	1.24	710	7.1
25	6.4	3.0	1.4	14.7	17.2	450	0.795	630	6.3
35	7.7	3.0	1.4	15.9	18.6	560	0.565	550	5.5
50	9.2	3.0	1.5	17.5	20.5	720	0.393	500	5.0
70	11.0	3.0	1.5	19.2	22.4	930	0.277	430	4.3
95	12.5	3.0	1.6	20.8	24.3	1160	0.210	400	4.0
120	14.2	3.1	1.7	22.7	26.6	1430	0.164	360	3.6
150	15.8	3.1	1.7	24.2	28.4	1740	0.132	340	3.4
185	17.5	3.2	1.8	26.2	30.7	2080	0.108	330	3.3
240	20.1	3.4	1.9	29.2	34.2	2730	0.0817	300	3.0
300	22.5	3.4	1.9	31.5	36.9	3230	0.0654	250	2.5
400	25.8	3.4	2.0	34.8	40.7	4210	0.0495	230	2.3

(a)= for information, indicative only

FIREROL Standard Wall Multi Core Unscreened 300/500 V or 0.6/1 kV to EN 50264-2-2 (FRL-SW–05M / FRL-SW-1M)



A. Conductor B. Insulation C. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5
Insulation
LSZH elastomeric compound as defined in EN 50264-1 (EI 101 to EI 105)
Outer sheath
LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V or 0.6/1 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

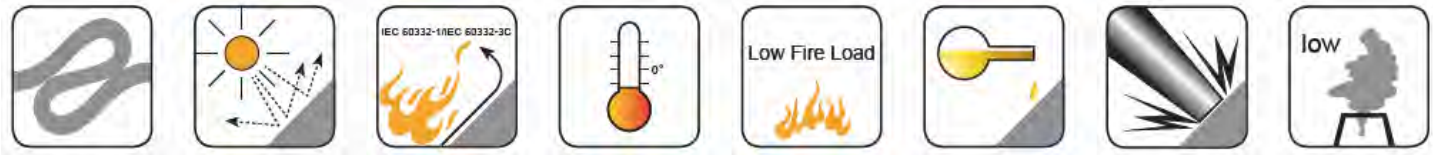
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-SW-05M 300/500 V

NUMBER AND NOMINAL CROSS SECTIONAL AREA (a)	CONDUCTOR DIAMETER (b)	MIN. MEAN THICKNESS OF INSULATION	DIAMETER OF CORE (b)	MAX WIRE DIAMETER OF SCREEN	MIN. MEAN THICKNESS OF SHEATH	OVERALL DIAMETER UNSREENED		WEIGHT	CONDUCTOR RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT 90°C
										EI 105	EI 101- EI 104
						min	max		max	min	min
n x mm²	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2x1	1.2	0.6	2.6	0.16	1.4	7.2	8.5	100	20.0	140	70
4x1	1.25	0.6	2.6	0.16	1.4	8.2	9.6	130	20.0	140	70
7x1		0.6	2.6	0.16	1.4	9.6	11.2	180	20.0	140	70
9x1		0.6	2.6	0.21	1.4	11.5	13.4	220	20.0	140	70
12x1		0.6	2.6	0.21	1.4	12.3	14.4	280	20.0	140	70
19x1		0.6	2.6	0.26	1.4	14.5	16.6	400	20.0	140	70
24x1		0.6	2.6	0.26	1.5	16.7	19.6	530	20.0	140	70
32x1		0.6	2.6	0.26	1.6	18.5	21.7	660	20.0	140	70
37x1		0.6	2.6	0.26	1.6	19.2	22.4	720	20.0	140	70
40x1		0.6	2.6	0.26	1.6	19.9	23.3	750	20.0	140	70
4x1.5	1.5	0.7	3.0	0.16	1.4	9.2	10.8	170	13.7	120	60
7x1.5		0.7	3.0	0.21	1.4	10.9	12.8	250	13.7	120	60
9x1.5		0.7	3.0	0.21	1.4	13.1	15.3	310	13.7	120	60
12x1.5		0.7	3.0	0.21	1.4	14.0	16.4	400	13.7	120	60
19x1.5		0.7	3.0	0.26	1.5	16.5	19.4	570	13.7	120	60
24x1.5		0.7	3.0	0.26	1.6	19.5	22.8	760	13.7	120	60
32x1.5		0.7	3.0	0.26	1.7	21.5	25.2	940	13.7	120	60
37x1.5		0.7	3.0	0.26	1.7	22.4	26.2	1040	13.7	120	60
4x2.5	1.95	0.8	3.7	0.21	1.4	10.7	12.5	240	8.21	90	45
7x2.5		0.8	3.7	0.21	1.4	12.7	14.9	360	8.21	90	45
9x2.5		0.8	3.7	0.26	1.5	15.6	18.3	450	8.21	90	45
12x2.5		0.8	3.7	0.26	1.5	16.7	19.6	590	8.21	90	45
19x2.5		0.8	3.7	0.26	1.6	19.7	23.1	860	8.21	90	45
24x2.5		0.8	3.7	0.26	1.8	23.5	27.5	1150	8.21	90	45

(a)= One earth conductor (green/yellow) can be included upon request

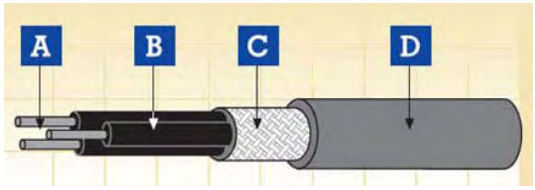
(b)= For information,indicative only

FRL-SW-1M 0.6/1 kV

NUMBER AND NOMINAL CROSS SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	CORE DIAMETER MIN.(mm)	CORE DIAMETER MAX.(mm)	MIN. MEAN THICKNESS OF SHEATH	OVERALL DIAMETER		WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C EI 105	INSULATION RESISTANCE AT +20°C EI 101-EI 104
						min	max		max	min	min
n x mm²	mm	mm	mm	mm	mm	mm	mm	kg/km	mm	Ω/km	MΩ·km
TWO CORES											
1.5	1.5	0.8	3.0	3.5	1.4	8.5	9.9	140	13.7	150	75
2.5	1.95	0.8	3.4	3.9	1.4	9.3	10.9	180	8.21	130	65
4	2.5	0.8	3.9	4.6	1.4	10.3	12.1	230	5.09	110	55
6	3.0	0.9	4.6	5.4	1.4	11.8	13.9	300	3.39	90	45
10	3.9	1.1	5.8	6.8	1.4	14.3	16.7	480	1.95	85	45
16	5.0	1.1	7.2	8.5	1.5	16.5	19.4	630	1.24	70	35
25	6.4	1.3	8.6	10.0	1.6	20.1	23.5	920	0.795	65	35
35	7.7	1.3	10.2	11.5	1.7	22.7	26.6	1200	0.565	60	30
50	9.2	1.5	11.6	13.5	1.9	26.7	31.2	1670	0.393	55	30
THREE CORES											
1.5	1.5	0.8	3.0	3.5	1.4	8.9	10.5	160	13.7	150	75
2.5	1.95	0.8	3.4	3.9	1.4	9.9	11.6	210	8.21	130	65
4	2.5	0.8	3.9	4.6	1.4	11.0	12.9	270	5.09	110	55
6	3.0	0.9	4.6	5.4	1.4	12.5	14.6	360	3.39	90	45
10	3.9	1.1	5.8	6.8	1.5	15.3	17.9	600	1.95	85	45
16	5.0	1.1	7.2	8.5	1.6	17.8	20.8	790	1.24	70	35
25	6.4	1.3	8.6	10.0	1.7	21.6	25.3	1170	0.795	65	35
35	7.7	1.3	10.2	11.5	1.8	24.4	28.6	1530	0.565	60	30
50	9.2	1.5	11.6	13.5	1.9	28.2	33.3	2120	0.393	55	30
FOUR CORES											
1.5	1.5	0.8	3.0	3.5	1.4	9.7	11.3	190	13.7	150	75
2.5	1.95	0.8	3.4	3.9	1.4	10.7	12.5	250	8.21	130	65
4	2.5	0.8	3.9	4.6	1.4	11.9	14.0	330	5.09	110	55
6	3.0	0.9	4.6	5.4	1.4	13.7	16.1	450	3.39	90	45
10	3.9	1.1	5.8	6.8	1.5	16.9	19.8	740	1.95	85	45
16	5.0	1.1	7.2	8.5	1.6	19.6	22.9	980	1.24	70	35
25	6.4	1.3	8.6	10.0	1.8	24.1	28.2	1460	0.795	65	35
3X35+25	7.7/6.4	1.3/1.3	10.2/8.6	11.5/10.0	1.9	28.5	34.2	1610	0.565/0.795	60	30
3X50+25	9.2/6.4	1.5/1.3	11.6/8.6	13.5/10.0	2.0	33.4	40.0	2230	0.393/0.795	55	30

(a)= For information,indicative only

FIREROL Standard Wall
Multi Core Overall Screened
300/500 V or 0.6/1 kV
to EN 50264-2-2 (FRL-SW-05M-OS / FRL-SW-1M-OS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5
Insulation
LSZH elastomeric compound as defined in EN 50264-1 (EI 101 to EI 105)
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V or 0.6/1 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

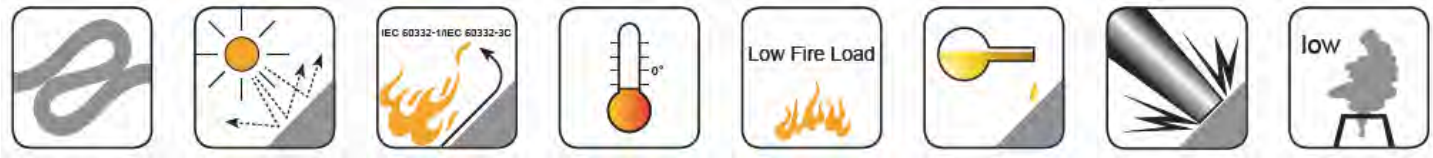
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-SW-05M-OS 300/500 V

NUMBER AND NOMINAL CROSS SECTIONAL AREA (a)	CONDUCTOR DIAMETER (b)	MIN. MEAN THICKNESS OF INSULATION	DIAMETER OF CORE (b)	MAX WIRE DIAMETER OF SCREEN	MIN. MEAN THICKNESS OF SHEATH (SCREENED)	OVERALL DIAMETER SCREENED		WEIGHT	CONDUCTOR RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C	INSULATION RESISTANCE AT 20°C
										EI 105	EI 101-EI 104
						min	max		max	min	min
n x mm²	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2x1	1.25	0.6	2.6	0.16	1.4	8.1	9.5	110	20.0	140	70
4x1		0.6	2.6	0.16	1.4	9.0	10.6	150	20.0	140	70
7x1		0.6	2.6	0.16	1.4	10.4	12.2	210	20.0	140	70
9x1		0.6	2.6	0.21	1.4	12.5	14.6	290	20.0	140	70
12x1		0.6	2.6	0.21	1.4	13.3	15.6	330	20.0	140	70
19x1		0.6	2.6	0.26	1.5	15.7	18.4	490	20.0	140	70
24x1		0.6	2.6	0.26	1.6	18.1	21.2	630	20.0	140	70
32x1		0.6	2.6	0.26	1.6	19.7	23.1	760	20.0	140	70
37x1		0.6	2.6	0.26	1.7	20.7	24.2	840	20.0	140	70
40x1		0.6	2.6	0.26	1.7	21.4	25.1	910	20.0	140	70
4x1.5	1.5	0.7	3.0	0.16	1.4	10.1	11.8	200	13.7	120	60
7x1.5		0.7	3.0	0.21	1.4	11.9	14.0	290	13.7	120	60
9x1.5		0.7	3.0	0.21	1.4	14.1	16.5	380	13.7	120	60
12x1.5		0.7	3.0	0.21	1.5	15.8	18.5	450	13.7	120	60
19x1.5		0.7	3.0	0.26	1.5	17.8	20.8	660	13.7	120	60
24x1.5		0.7	3.0	0.26	1.6	20.7	24.2	850	13.7	120	60
32x1.5		0.7	3.0	0.26	1.7	22.7	26.6	1050	13.7	120	60
37x1.5		0.7	3.0	0.26	1.7	23.6	27.6	1160	13.7	120	60
4x2.5	1.95	0.8	3.7	0.21	1.4	11.8	13.9	280	8.21	90	45
7x2.5		0.8	3.7	0.21	1.4	13.7	16.1	400	8.21	90	45
9x2.5		0.8	3.7	0.26	1.5	16.8	19.7	560	8.21	90	45
12x2.5		0.8	3.7	0.26	1.5	18.0	21.1	660	8.21	90	45
19x2.5		0.8	3.7	0.26	1.6	21.1	24.6	950	8.21	90	45
24x2.5		0.8	3.7	0.26	1.8	24.7	28.9	1260	8.21	90	45

(a)= One earth conductor (green/yellow) can be included upon request

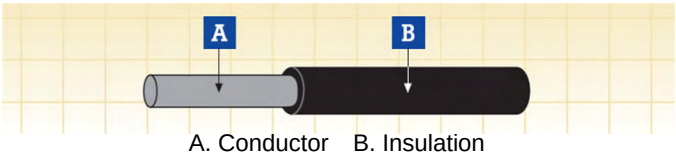
(b)= For information,indicative only

FRL-SW-1M-OS 0.6/1 kV

NUMBER AND NOMINAL CROSS SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	CORE DIAMETER MIN.(mm)	CORE DIAMETER MAX.(mm)	MIN. SCREEN WIRE DIAMETER	MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER		WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C EI 105	INSULATION RESISTANCE AT +20°C EI 101-EI 104
							min	max		max	min	min
N x mm^2	mm	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
TWO CORES												
1.5	1.5	0.8	3.0	3.5	0.16	1.4	9.3	10.9	150	13.7	150	75
2.5	1.95	0.8	3.4	3.9	0.16	1.4	10.2	11.9	180	8.21	130	65
4	2.5	0.8	3.9	4.6	0.21	1.4	11.5	13.4	240	5.09	110	55
6	3.0	0.9	4.6	5.4	0.21	1.4	12.9	15.1	300	3.39	90	45
10	3.9	1.1	5.8	6.8	0.21	1.5	15.5	18.2	460	1.95	85	45
16	5.0	1.1	7.2	8.5	0.26	1.5	17.9	20.9	610	1.24	70	35
25	6.4	1.3	8.6	10.0	0.26	1.7	21.6	25.3	830	0.795	65	35
35	7.7	1.3	10.2	11.5	0.31	1.8	24.4	28.6	1130	0.565	60	30
50	9.2	1.5	11.6	13.5	0.31	1.9	28.2	33.0	1500	0.393	55	30
THREE CORES												
1.5	1.5	0.8	3.0	3.5	0.16	1.4	9.8	11.4	180	13.7	150	75
2.5	1.95	0.8	3.4	3.9	0.16	1.4	10.7	12.5	220	8.21	130	65
4	2.5	0.8	3.9	4.6	0.21	1.4	12.0	14.1	300	5.09	110	55
6	3.0	0.9	4.6	5.4	0.21	1.4	13.6	16.0	380	3.39	90	45
10	3.9	1.1	5.8	6.8	0.26	1.5	16.7	19.6	620	1.95	85	45
16	5.0	1.1	7.2	8.5	0.26	1.6	19.1	22.3	800	1.24	70	35
25	6.4	1.3	8.6	10.0	0.26	1.7	22.9	26.8	1140	0.795	65	35
35	7.7	1.3	10.2	11.5	0.31	1.8	26.0	30.5	1500	0.565	60	30
50	9.2	1.5	11.6	13.5	0.31	2.0	30.3	35.4	2050	0.393	55	30
FOUR CORES												
1.5	1.5	0.8	3.0	3.5	0.16	1.4	10.5	12.3	210	13.7	150	75
2.5	1.95	0.8	3.4	3.9	0.21	1.4	11.8	13.9	280	8.21	130	65
4	2.5	0.8	3.9	4.6	0.21	1.4	13.1	15.3	360	5.09	110	55
6	3.0	0.9	4.6	5.4	0.21	1.4	14.9	17.4	470	3.39	90	45
10	3.9	1.1	5.8	6.8	0.26	1.6	18.4	21.6	780	1.95	85	45
16	5.0	1.1	7.2	8.5	0.26	1.7	21.1	24.6	1020	1.24	70	35
25	6.4	1.3	8.6	10.0	0.31	1.8	25.6	29.9	1490	0.795	65	35
3X35+25	7.7/6.4	1.3/1.3	10.2/8.6	11.5/10.0	0.31	1.9	30.0	35.1	1820	0.565/0.795	60	30
3X50+25	9.2/6.4	1.5/1.3	11.6/8.6	13.5/10.0	0.31	2.1	34.9	40.8	2480	0.393/0.795	55	30

(a)= For information,indicative only

FIREROL Medium Wall
Single Core Unsheathed
0.6/1 kV or 1.8/3 kV
to EN 50264-3-1 (FRL-MW-1SU / FRL-MW-3SU)



A. Conductor B. Insulation

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control,l auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5

Insulation

LSZH elastomeric compound as defined in EN 50264-1 (EI 106 to EI 109)

Electrical & Mechanical Properties

Nominal Voltage	0.6/1 kV or 1.8/3 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

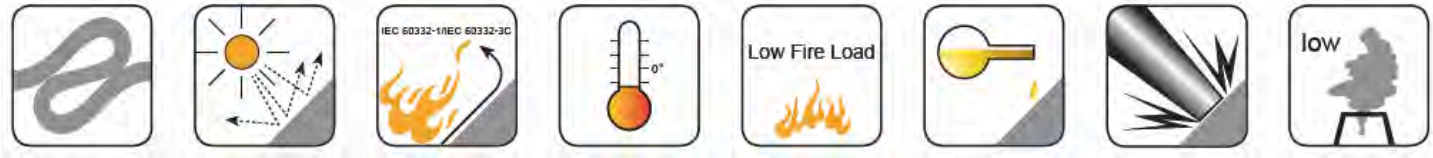
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-MW-1SU 0.6/1 kV

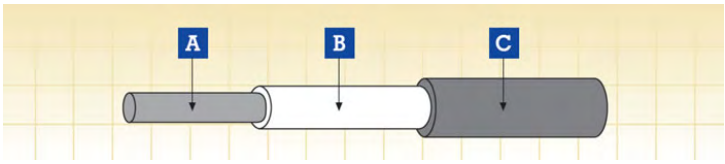
NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER MIN.(mm)	OVERALL DIAMETER MAX.(mm)	WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C	INSULATION RESISTANCE AT +90°C
						max	min	min
mm^2	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.0	1.25	0.6	2.4	2.8	10	20	11.4	0.114
1.5	1.5	0.7	2.8	3.3	20	13.7	11.0	0.110
2.5	1.95	0.7	3.2	3.8	30	8.21	9.1	0.091
4	2.5	0.7	3.8	4.4	50	5.09	7.5	0.075
6	3.0	0.7	4.2	5.0	60	3.39	6.5	0.065
10	3.9	0.7	5.1	5.9	110	1.95	5.2	0.052
16	5.0	0.7	6.1	7.2	160	1.24	4.2	0.042
25	6.4	0.9	7.8	9.1	240	0.795	4.1	0.041
35	7.7	0.9	9.0	10.6	330	0.565	3.5	0.035
50	9.2	1.0	10.6	12.4	460	0.393	3.3	0.033
70	11.0	1.1	12.5	14.6	660	0.277	3.0	0.030
95	12.5	1.1	13.9	16.3	860	0.210	2.7	0.027
120	14.2	1.2	15.7	18.4	1080	0.164	2.7	0.027
150	15.8	1.4	17.6	20.6	1370	0.132	2.7	0.027
185	17.5	1.6	19.6	22.9	1690	0.108	2.6	0.026
240	20.1	1.7	22.2	26.0	2230	0.0817	2.6	0.026
300	22.5	1.8	24.6	28.8	2780	0.0654	2.4	0.024
400	25.8	2.0	28.1	32.9	3740	0.0495	2.4	0.024

FRL-MW-3SU 1.8/3 kV

NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER MIN.(mm)	OVERALL DIAMETER MAX.(mm)	WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C	INSULATION RESISTANCE AT +90°C
						max	min	min
mm^2	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	2.0	5.3	6.2	50	13.7	21.0	0.210
2.5	1.95	2.0	5.7	6.7	60	8.21	18.0	0.180
4	2.5	2.0	6.2	7.3	80	5.09	15.5	0.155
6	3.0	2.0	6.7	7.8	100	3.39	13.7	0.137
10	3.9	2.0	7.5	8.8	150	1.95	11.5	0.115
16	5.0	2.0	8.6	10.0	220	1.24	9.5	0.095
25	6.4	2.0	9.9	11.6	290	0.795	7.9	0.079
35	7.7	2.0	11.1	13.0	390	0.565	6.8	0.068
50	9.2	2.0	12.5	14.6	530	0.393	5.9	0.059
70	11.0	2.0	14.2	16.6	720	0.277	5.0	0.050
95	12.5	2.2	16.0	18.7	940	0.210	4.5	0.045
120	14.2	2.2	17.6	20.6	1160	0.164	4.0	0.040
150	15.8	2.2	19.1	22.3	1440	0.132	3.7	0.037
185	17.5	2.4	20.9	24.4	1760	0.108	3.4	0.034
240	20.1	2.4	23.7	27.5	2350	0.0817	3.0	0.030
300	22.5	2.4	25.6	30.1	2820	0.0654	2.7	0.027
400	25.8	2.6	29.2	34.2	3730	0.0495	2.4	0.024

(a)= For information,indicative only

FIREROL
Medium Wall
Single Core Sheathed
1.8/3 kV or 3.6/6 kV
to EN 50264-3-1 (FRL-MW-3S / FRL-MW-6S)



A. Conductor B. Insulation C. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5
Insulation
LSZH elastomeric compound as defined in EN 50264-1 (EI 106 to EI 109)
Sheath
LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	1.8/3 kV or 3.6/6 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

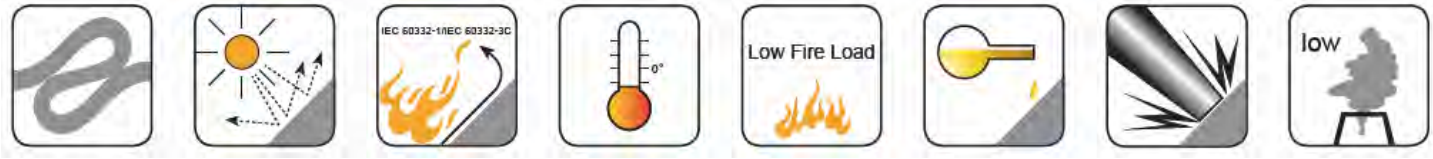
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-MW-3S 1.8/3 kV

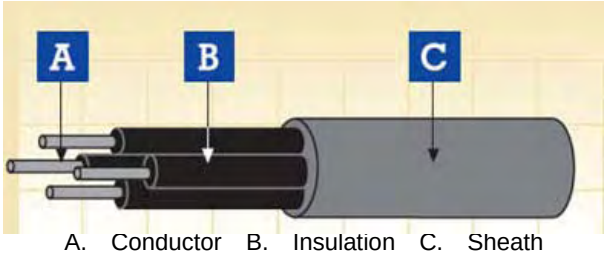
NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	SHEATH NOMINAL THICKNESS MIN.	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C	INSULATION RESISTANCE AT +90°C
							max	min	min
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	1.3	0.8	5.7	6.7	60	13.7	21.8	0.218
2.5	1.95	1.3	0.8	6.0	7.0	70	8.21	18.8	0.188
4	2.5	1.3	0.8	6.5	7.6	90	5.09	16.2	0.162
6	3.0	1.3	0.8	7.0	8.1	110	3.39	14.4	0.144
10	3.9	1.5	0.8	8.2	9.6	170	1.95	12.8	0.128
16	5.0	1.5	0.8	9.2	10.8	240	1.24	10.7	0.107
25	6.4	1.8	1.0	11.5	13.4	350	0.795	10.3	0.103
35	7.7	1.8	1.0	12.7	14.9	450	0.565	8.9	0.089
50	9.2	1.8	1.0	14.1	16.5	590	0.393	7.8	0.078
70	11.0	1.8	1.0	15.8	18.5	790	0.277	6.7	0.067
95	12.5	2.2	1.0	18.0	21.0	1050	0.210	6.5	0.065
120	14.2	2.2	1.0	19.6	22.9	1270	0.164	6.1	0.061
150	15.8	2.2	1.2	21.4	25.1	1590	0.132	5.8	0.058
185	17.5	2.4	1.2	23.4	27.4	1900	0.108	5.6	0.056
240	20.1	2.4	1.2	25.9	30.3	2490	0.0817	5.0	0.050
300	22.5	2.4	1.2	28.1	32.9	3010	0.0654	4.5	0.045
400	25.8	2.6	1.4	32.0	37.4	3980	0.0495	4.4	0.044

FRL-MW-6S 3.6/6KV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	SHEATH NOMINAL THICKNESS MIN.	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	CONDUCTOR RESISTANCE AT +20°C	INSULATION RESISTANCE AT +20°C	INSULATION RESISTANCE AT +90°C
							max	min	min
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2.5	1.95	2.6	0.8	8.6	10.1	120	8.21	24.6	0.246
4	2.5	2.6	0.8	9.1	10.7	140	5.09	21.6	0.216
6	3.0	2.6	0.8	9.6	11.2	165	3.39	19.5	0.195
10	3.9	2.6	0.8	10.4	12.2	220	1.95	16.7	0.167
16	5.0	2.6	0.8	11.5	13.4	290	1.24	14.2	0.142
25	6.4	2.9	1.0	13.7	16.1	430	0.795	13.1	0.131
35	7.7	2.9	1.0	14.9	17.5	540	0.565	11.6	0.116
50	9.2	2.9	1.0	16.4	19.1	670	0.393	10.2	0.102
70	11.0	2.9	1.0	18.0	21.1	880	0.277	8.9	0.089
95	12.5	2.9	1.0	19.5	22.8	1100	0.210	8.0	0.080
120	14.2	2.9	1.2	21.4	25.1	1380	0.164	7.5	0.075
150	15.8	2.9	1.2	22.9	26.8	1660	0.132	6.9	0.069
185	17.5	3.2	1.2	25.1	29.4	2010	0.108	6.7	0.067
240	20.1	3.4	1.4	28.3	33.1	2670	0.0817	6.4	0.064
300	22.5	3.4	1.4	30.6	35.8	3170	0.0654	5.9	0.059
400	25.8	3.4	1.4	33.7	39.4	4150	0.0495	5.2	0.052

(a)= For information,indicative only

FIREROL Medium Wall
Multi Core Unscreened
300/500 V or 0.6/1 kV
to EN 50264-3-2 (FRL-MW-05M / FRL-MW-1M)



A. Conductor B. Insulation C. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.

-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5

Insulation

LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EI 104)

Outer sheath

LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V or 0.6/1 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

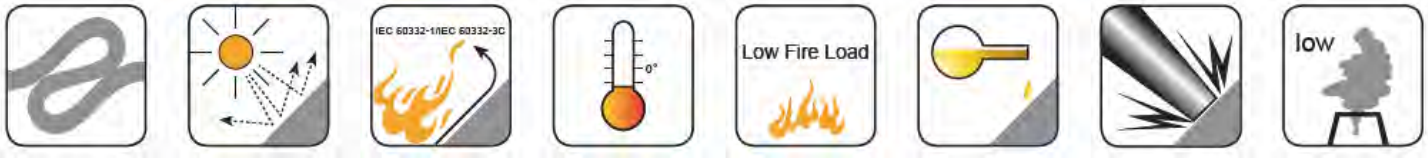
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-MW-05M 300/500V

NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (b)	MIN. MEAN THICKNESS OF INSULATION	CORE DIMENSIONS		MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	RESISTANCE OF CONDUCTOR AT +20°C	INSULATION RESISTANCE AT +20°C EI 110	INSULATION RESISTANCE AT +20°C EI 106/7/8/9
			MIN. ACC.TO EN	MAX. ACC.TO EN					max	min	min
mm^2	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2 x 1	1.25	0.4	2.0	2.4	0.6	5.3	6.2	40	20.0	15.0	7.5
4 x 1	1.25	0.4	2.0	2.4	0.6	6.1	7.2	70	20.0	15.0	7.5
7 x 1	1.25	0.4	2.0	2.4	0.7	7.5	8.7	120	20.0	15.0	7.5
9 x 1	1.25	0.4	2.0	2.4	0.7	9.1	10.6	160	20.0	15.0	7.5
12 x 1	1.25	0.4	2.0	2.4	0.7	9.8	11.5	190	20.0	15.0	7.5
19 x 1	1.25	0.4	2.0	2.4	0.8	11.7	13.7	290	20.0	15.0	7.5
24 x 1	1.25	0.4	2.0	2.4	1.0	14.1	16.5	390	20.0	15.0	7.5
32 x 1	1.25	0.4	2.0	2.4	1.0	15.5	18.2	490	20.0	15.0	7.5
37 x 1	1.25	0.4	2.0	2.4	1.0	16.1	18.9	550	20.0	15.0	7.5
40 x 1	1.25	0.4	2.0	2.4	1.0	16.7	19.6	600	20.0	15.0	7.5
4 x 1.5	1.5	0.5	2.4	2.9	0.7	7.3	8.6	110	13.7	14.0	7.0
7 x 1.5	1.5	0.5	2.4	2.9	0.7	8.7	10.2	170	13.7	14.0	7.0
9 x 1.5	1.5	0.5	2.4	2.9	0.8	10.9	12.7	230	13.7	14.0	7.0
12 x 1.5	1.5	0.5	2.4	2.9	0.8	11.8	13.8	280	13.7	14.0	7.0
19 x 1.5	1.5	0.5	2.4	2.9	1.0	14.2	16.6	440	13.7	14.0	7.0
24 x 1.5	1.5	0.5	2.4	2.9	1.0	16.6	19.5	560	13.7	14.0	7.0
32 x 1.5	1.5	0.5	2.4	2.9	1.2	18.7	21.9	720	13.7	14.0	7.0
37 x 1.5	1.5	0.5	2.4	2.9	1.2	19.5	22.8	820	13.7	14.0	7.0
4 x 2.5	1.95	0.5	2.9	3.4	0.7	8.3	9.8	150	8.21	13.0	6.5
7 x 2.5	1.95	0.5	2.9	3.4	0.8	10.2	11.9	240	8.21	13.0	6.5
9 x 2.5	1.95	0.5	2.9	3.4	1.0	12.9	15.1	350	8.21	13.0	6.5
12 x 2.5	1.95	0.5	2.9	3.4	1.0	13.9	16.3	420	8.21	13.0	6.5
19 x 2.5	1.95	0.5	2.9	3.4	1.0	16.3	19.1	640	8.21	13.0	6.5
24 x 2.5	1.95	0.5	2.9	3.4	1.2	19.6	22.9	840	8.21	13.0	6.5

(a)= One earth conductor (green/yellow) can be included upon request

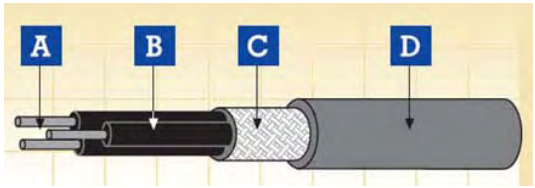
(b)= For information,indicative only

FRL-MW-1M 0.6/1kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	CORE DIMENSIONS		MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	RESISTANCE OF CONDUCTOR AT +20°C	INSULATION RESISTANCE AT +20°C EI 110	INSULATION RESISTANCE AT +20°C EI 106/7/8/9
			MIN. ACC.TO EN	MAX. ACC.TO EN					max	min	min
mm^2	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
TWO CORES											
1.5	1.5	0.7	2.8	3.3	0.70	7.2	9.0	70	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.70	8.0	10.0	100	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.70	9.1	11.3	130	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	0.80	10.1	12.4	170	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	1.00	12.5	15.4	290	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	1.00	14.9	18.4	390	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	1.20	18.7	23.0	590	0.795	7.3	3.6
35	7.7	0.9	9.0	10.6	1.20	21.2	25.9	790	0.565	6.7	3.3
50	9.2	1.0	10.6	12.4	1.40	25.1	30.7	1140	0.393	6.3	3.1
THREE CORES											
1.5	1.5	0.7	2.8	3.3	0.70	7.7	9.5	100	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.70	8.5	10.5	130	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.70	9.7	12.0	180	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	0.80	10.7	13.2	250	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	1.00	13.3	16.5	410	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	1.00	16.0	19.6	570	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	1.20	20.0	24.7	850	0.795	7.3	3.6
35	7.7	0.9	9.0	10.6	1.40	23.0	28.2	1160	0.565	6.7	3.3
50	9.2	1.0	10.6	12.4	1.60	26.3	32.2	1680	0.393	6.3	3.1
FOUR CORES											
1.5	1.5	0.7	2.8	3.3	0.70	8.5	10.5	120	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.70	9.4	11.6	170	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.80	10.9	13.4	240	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	1.00	12.2	14.9	330	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	1.00	14.7	18.2	540	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	1.20	18.0	22.1	750	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	1.40	22.6	27.6	1140	0.795	7.3	3.6
3 x 35 + 25	7.7/6.4	0.9/0.9	9.0/7.8	10.6/9.1	1.40	25.7	31.2	1486	0.565/0.795	6.7	3.3
3 x 50 + 25	9.2/6.4	1.0/0.9	10.6/7.8	12.4/9.1	1.60	30.0	36.5	2106	0.393/1.795	6.3	3.1

(a)= For information,indicative only

FIREROL Medium Wall
Multi Core Overall Screened
300/500 V or 0.6/1 kV
to EN 50264-3-2 (FRL-MW-05M-OS / FRL-MW-1M-OS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor.
-Used in control, auxillary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Flexible tinned annealed copper wires, stranded as per HD 383 (IEC 60228) class 5
Insulation
LSZH elastomeric compound as defined in EN 50264-1 (EI 106 to EI 110)
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH elastomeric compound as defined in EN 50264-1 (EM 101 to EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V or 0.6/1 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

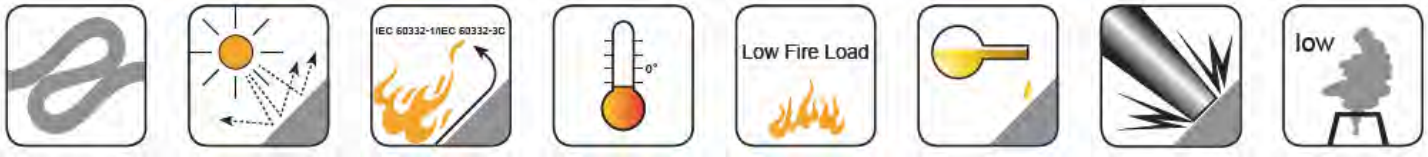
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-MW-05M-OS 300/500 V

NOMINAL CROSS -SECTIONAL AREA (a)	CONDUCTOR DIAMETER (b)	MIN. MEAN THICKNESS OF INSULATION	CORE DIMENSIONS		MIN. SCREEN WIRE DIAMETER	MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	RESISTANCE OF CONDUCTOR AT +20°C	INSULATION RESISTANCE AT +20°C EI 110	INSULATION RESISTANCE AT +20°C EI 106/7/8/9
			MIN.	MAX.						max	min	min
mm^2	mm	mm	mm	mm	mm	mm	mm	mm	kg/km	Ω/km	MΩ·km	MΩ·km
2x1	1.25	0.4	2.0	2.4	0.16	0.6	6.0	7.1	70	20.0	15.0	7.5
4x1	1.25	0.4	2.0	2.4	0.16	0.7	7.0	8.2	110	20.0	15.0	7.5
7x1	1.25	0.4	2.0	2.4	0.16	0.7	8.2	9.6	150	20.0	15.0	7.5
9x1	1.25	0.4	2.0	2.4	0.21	0.8	10.2	11.9	220	20.0	15.0	7.5
12x1	1.25	0.4	2.0	2.4	0.21	0.8	10.9	12.7	260	20.0	15.0	7.5
19x1	1.25	0.4	2.0	2.4	0.26	1.0	13.2	15.4	400	20.0	15.0	7.5
24x1	1.25	0.4	2.0	2.4	0.26	1.0	15.2	17.8	500	20.0	15.0	7.5
32x1	1.25	0.4	2.0	2.4	0.26	1.0	16.6	19.4	610	20.0	15.0	7.5
37x1	1.25	0.4	2.0	2.4	0.26	1.0	17.2	20.1	670	20.0	15.0	7.5
40x1	1.25	0.4	2.0	2.4	0.26	1.2	18.2	21.3	740	20.0	15.0	7.5
4x1.5	1.5	0.5	2.4	2.9	0.16	0.7	8.0	9.4	140	13.7	14.0	7.0
7x1.5	1.5	0.5	2.4	2.9	0.21	0.7	9.6	11.3	220	13.7	14.0	7.0
9x1.5	1.5	0.5	2.4	2.9	0.21	1.0	12.1	14.2	290	13.7	14.0	7.0
12x1.5	1.5	0.5	2.4	2.9	0.21	1.0	13.0	15.2	360	13.7	14.0	7.0
19x1.5	1.5	0.5	2.4	2.9	0.26	1.0	15.3	17.9	540	13.7	14.0	7.0
24x1.5	1.5	0.5	2.4	2.9	0.26	1.2	18.1	21.2	700	13.7	14.0	7.0
32x1.5	1.5	0.5	2.4	2.9	0.26	1.2	19.8	23.2	860	13.7	14.0	7.0
37x1.5	1.5	0.5	2.4	2.9	0.26	1.2	20.5	24.0	960	13.7	14.0	7.0
4x2.5	1.95	0.5	2.9	3.4	0.21	0.7	9.2	10.8	200	8.21	13.0	6.5
7x2.5	1.95	0.5	2.9	3.4	0.21	0.8	11.1	13.0	310	8.21	13.0	6.5
9x2.5	1.95	0.5	2.9	3.4	0.26	1.0	13.9	16.3	440	8.21	13.0	6.5
12x2.5	1.95	0.5	2.9	3.4	0.26	1.0	15.0	17.5	520	8.21	13.0	6.5
19x2.5	1.95	0.5	2.9	3.4	0.26	1.2	17.8	20.8	770	8.21	13.0	6.5
24x2.5	1.95	0.5	2.9	3.4	0.26	1.2	20.6	24.1	970	8.21	13.0	6.5

(a)= One earth conductor (green/yellow) can be included upon request

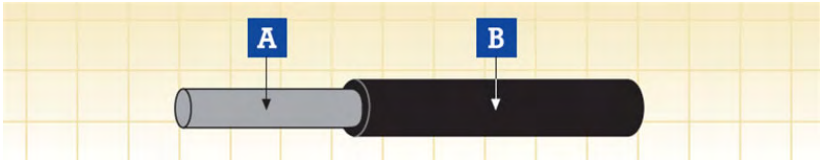
(b)= For information,indicative only

FRL-MW-1M-OS 0.6/1kV

NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	CORE DIMENSIONS		MIN. SCREEN WIRE DIAMETER	MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER MIN.	OVERALL DIAMETER MAX.	WEIGHT	RESISTANCE OF CONDUCTOR AT +20°C	INSULATION RESISTANCE AT +20°C EI 105	INSULATION RESISTANCE AT +20°C EI 101-EI 104
			MIN.	MAX.						max	min	min
mm^2	mm	mm	mm	mm	mm	mm	mm	mm	Kg/km	Ω/km	MΩ·km	MΩ·km
TWO CORES												
1.5	1.5	0.7	2.8	3.3	0.16	0.70	7.9	9.9	90	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.16	0.70	8.7	10.7	120	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.21	0.80	10.2	12.7	170	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	0.21	0.80	10.9	13.6	210	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	0.21	1.00	13.4	16.6	320	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	0.26	1.00	16.0	19.8	470	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	0.26	1.20	19.8	24.6	690	0.795	7.3	3.6
35	7.7	0.9	9.0	10.6	0.31	1.40	22.8	27.9	940	0.565	6.7	3.3
50	9.2	1.0	10.6	12.4	0.31	1.40	26.4	32.3	1260	0.393	6.3	3.1
THREE CORES												
1.5	1.5	0.7	2.8	3.3	0.16	0.70	8.4	10.4	120	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.16	0.70	9.2	11.4	160	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.21	0.80	10.8	13.3	230	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	0.21	0.80	11.6	14.3	300	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	0.26	1.00	14.4	18.0	500	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	0.26	1.20	17.4	21.3	680	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	0.26	1.20	21.3	26.1	970	0.795	7.3	3.6
35	7.7	0.9	9.0	10.6	0.31	1.40	24.5	29.8	1330	0.565	6.7	3.3
50	9.2	1.0	10.6	12.4	0.31	1.60	28.3	34.6	1820	0.393	6.3	3.1
FOUR CORES												
1.5	1.5	0.7	2.8	3.3	0.16	0.70	9.1	11.3	150	13.7	21.0	10.5
2.5	1.95	0.7	3.2	3.8	0.21	0.80	10.4	12.9	220	8.21	17.2	8.6
4	2.5	0.7	3.8	4.4	0.21	0.80	11.8	14.5	290	5.09	14.2	7.1
6	3.0	0.7	4.2	5.0	0.21	1.00	13.1	16.1	400	3.39	12.2	6.1
10	3.9	0.7	5.1	5.9	0.26	1.00	15.9	19.5	640	1.95	9.8	4.9
16	5.0	0.7	6.1	7.2	0.26	1.20	19.3	23.6	860	1.24	7.9	3.9
25	6.4	0.9	7.8	9.1	0.31	1.40	24.0	29.3	1290	0.795	7.3	3.6
3x35+25	7.7/6.4	0.9/0.9	9.0/7.8	10.6/9.1	0.31	1.4	26.9	32.9	1910	0.565/0.795	6.7	3.3
3x50+25	9.2/6.4	1.0/0.9	10.6/7.8	12.4/9.1	0.31	1.6	31.5	38.2	2560	0.393/0.795	6.3	3.1

(a)= For information,indicative only

FIREROL Thin Wall
Single Core Unsheathed
300/500 V to EN 50306-2 (FRL-TW-05SU)



A Conductor B. Insulation

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter

Chemical & Environmental Properties

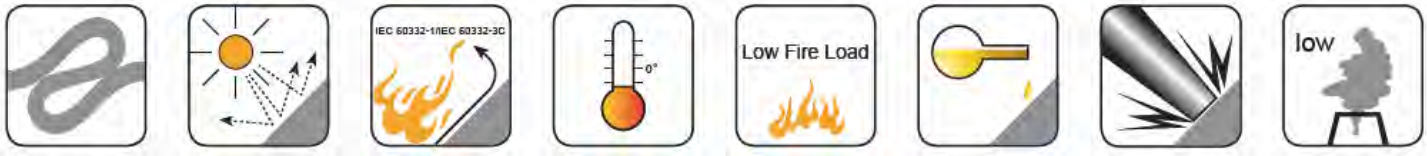
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

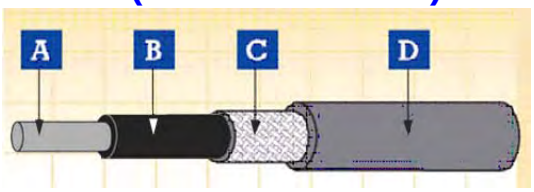


FRL-TW-05SU 300/500 V

NOMINAL CROSS SECTIONAL AREA	NUMBER X NOMINAL DIAMETER OF WIRE	DIAMETER		THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C
		min	max	min	min	max		max
mm^2	mm	mm	mm	mm	mm	mm	kg/km	Ω/km
0.5	19 x 0.18	0.80	0.95	0.18	1.15	1.45	7	40.1
0.75	37 x 0.16(a)	1.00	1.15	0.18	1.35	1.65	8	26.7
1.0	37 x 0.18(a)	1.10	1.30	0.18	1.45	1.80	10	20.0
1.5	37 x 0.23(a)	1.45	1.65	0.22	1.95	2.30	20	13.7
2.5	37 x 0.30(a)	1.85	2.15	0.28	2.50	2.85	25	8.21

-This cable may be supplied in 19 strand conductor providing all product performance requirements in the specification are met

FIREROL Thin Wall
Single Core Overall Screened
300/500V to EN 50306-3 (FRL-TW-05S-OS)



A Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH special compound (S1 & S2)

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

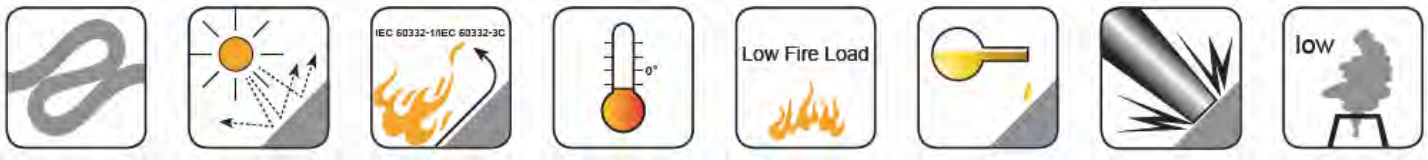
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

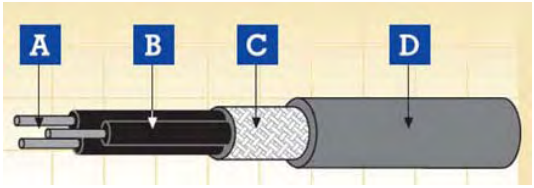
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05S-OS 300/500V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
1 x 0.5	0.20	2.3	2.8	10
1 x 0.75	0.20	2.5	3.0	20
1 x 1	0.20	2.7	3.2	25
1 x 1.5	0.20	3.1	3.6	30
1 x 2.5	0.20	3.6	4.4	40

FIREROL Thin Wall
Multi-Core Overall Screened
300/500V to EN 50306-3 (FRL-TW-05M-OS)



A Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH special compound (S1 & S2)

Electrical & Mechanical Properties

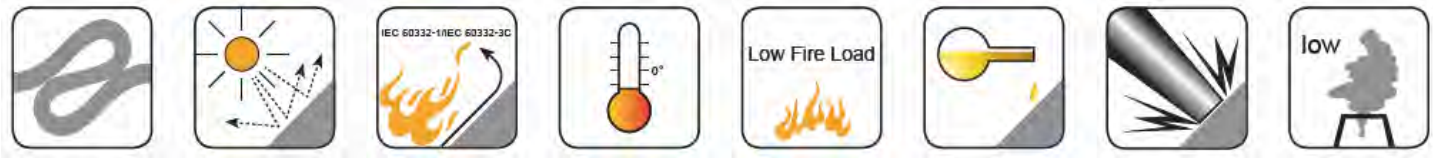
Nominal Voltage	300/500V
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter
Chemical & Environmental Properties	
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

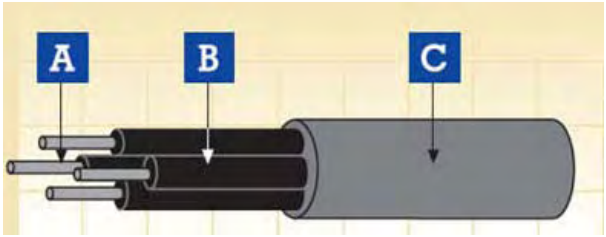
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05M-OS 300/500 V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
2 x 0.5	0.20	3.5	4.3	30
3 x 0.5	0.20	3.7	4.5	30
4 x 0.5	0.20	4.0	5.0	40
2 x 0.75	0.20	3.9	4.7	30
3 x 0.75	0.20	4.0	5.0	40
4 x 0.75	0.20	4.5	5.5	60
2 x 1	0.20	4.2	5.2	40
3 x 1	0.20	4.5	5.5	55
4 x 1	0.20	5.0	6.0	70
2 x 1.5	0.20	5.1	6.1	60
3 x 1.5	0.20	5.4	6.4	80
4 x 1.5	0.20	6.0	7.0	100
2 x 2.5	0.20	6.4	7.4	90
3 x 2.5	0.20	6.8	7.8	120
4 x 2.5	0.20	7.5	8.5	140

FIREROL Thin Wall
Multi-Core Cables with Standard Wall Sheath
300/500 V to EN 50306-4 (FRL-TW-05MSW)



A. Conductor B. Insulation C Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Outer sheath
LSZH special compound (S2. EM101- EM104)

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

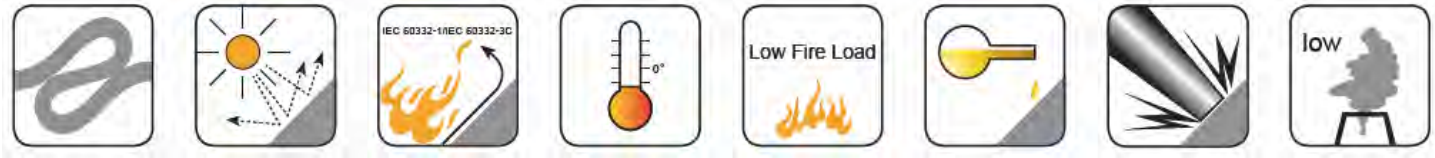
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

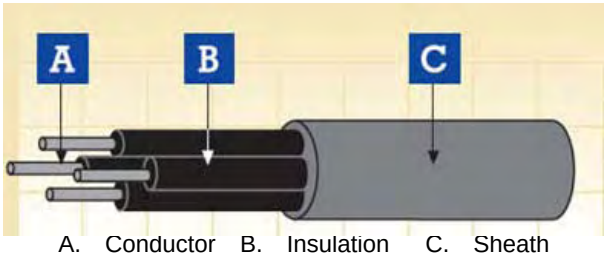
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05MSW 300/500 V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
4 x 0.5	0.42	4.1	5.1	30
7 x 0.5	0.42	4.9	5.9	50
13 x 0.5	0.56	7.3	8.3	100
19 x 0.5	0.56	8.1	9.1	140
37 x 0.5	0.56	10.8	12.0	250
4 x 0.75	0.42	4.6	5.6	40
7 x 0.75	0.42	5.5	6.5	70
13 x 0.75	0.56	8.2	9.2	130
19 x 0.75	0.56	9.0	10.2	180
37 x 0.75	0.56	12.2	13.4	340
48 x 0.75	0.56	13.9	15.5	440
4 x 1.0	0.42	4.9	5.9	50
7 x 1.0	0.42	6.0	7.0	90
13 x 1.0	0.56	8.7	9.9	160
19 x 1.0	0.56	9.8	11.0	230
37 x 1.0	0.56	13.3	14.5	430
4 x 1.5	0.42	6.0	7.0	80
7 x 1.5	0.56	7.7	9.8	140
13 x 1.5	0.56	10.7	11.9	250
19 x 1.5	0.56	12.0	13.2	350
37 x 1.5	0.56	16.2	17.8	650
2 x 2.5	0.56	6.7	7.7	70
3 x 2.5	0.56	7.7	8.1	110
4 x 2.5	0.56	7.9	8.9	140

FIREROL Thin Wall
Multi-Core Cables with Exposed Standard Wall Sheath
300/500 V to EN 50306-4 (FRL-TW-05MESW)



A. Conductor B. Insulation C. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Outer sheath
LSZH special compound (S2. EM101-EM104)

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

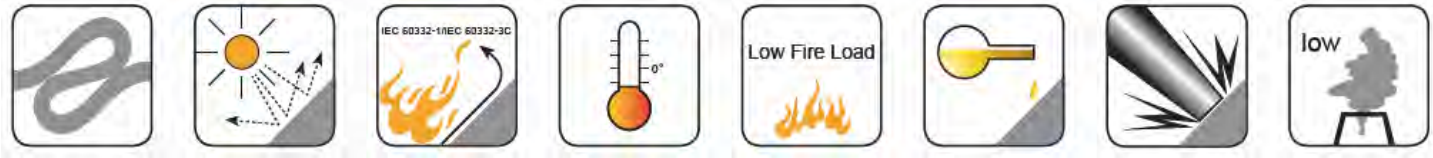
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

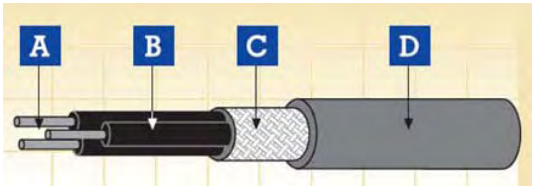
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05MESW 300/500V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
4 x 0.5	1.0	5.5	6.5	50
7 x 0.5	1.0	6.3	7.3	70
13 x 0.5	1.0	8.3	9.3	120
19 x 0.5	1.0	9.0	10.2	150
37 x 0.5	1.0	12.3	13.5	290
4 x 0.75	1.0	6.0	7.0	60
7 x 0.75	1.0	6.9	7.9	90
13 x 0.75	1.0	9.1	10.3	150
19 x 0.75	1.0	10.0	11.2	200
37 x 0.75	1.0	13.2	14.4	360
48 x 0.75	1.0	14.8	16.4	460
4 x 1.0	1.0	6.3	7.3	70
7 x 1.0	1.0	7.3	8.3	110
13 x 1.0	1.0	9.7	10.9	180
19 x 1.0	1.0	10.7	11.9	250
37 x 1.0	1.0	14.0	15.6	450
4 x 1.5	1.0	7.4	8.4	100
7 x 1.5	1.0	8.6	9.8	150
13 x 1.5	1.0	11.7	12.9	270
19 x 1.5	1.0	13.0	14.2	370
37 x 1.5	1.0	17.2	18.8	690
2 x 2.5	1.0	7.7	8.7	90
3 x 2.5	1.0	8.1	9.1	120
4 x 2.5	1.0	8.8	10.0	150

FIREROL Thin Wall
Multi-Core Overall Screened Cables with Standard Wall Sheath
300/500 V
to EN 50306-4 (FRL-TW-05MSW-OS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH special compound as defined in EN 50264-1 (S2. EM 101 - EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V
Maximum Conductor Temperature	+90/+105 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

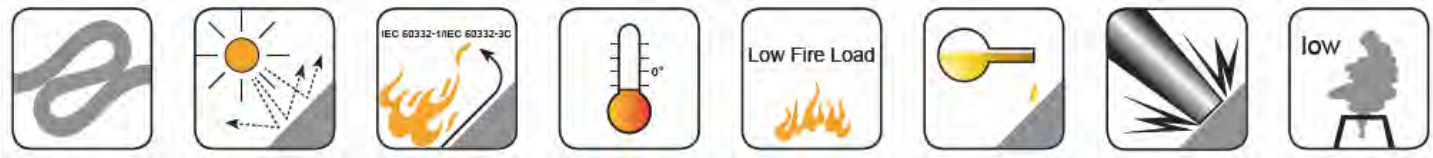
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

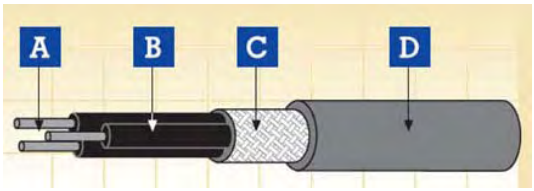
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05MSW-OS 300/500V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
2 x 0.5	0.42	4.1	5.1	30
3 x 0.5	0.42	4.3	5.3	40
4 x 0.5	0.42	4.7	5.7	50
6 x 0.5	0.42	5.5	6.5	70
8 x 0.5	0.42	6.0	7.0	90
2 x 0.75	0.42	4.5	5.5	40
3 x 0.75	0.42	4.7	5.7	50
4 x 0.75	0.42	5.2	6.2	60
6 x 0.75	0.42	6.1	7.1	90
8 x 0.75	0.42	6.6	7.6	110
2 x 1.0	0.42	4.7	5.7	50
3 x 1.0	0.42	5.1	6.0	60
4 x 1.0	0.42	5.5	6.5	80
6 x 1.0	0.42	6.6	7.6	110
8 x 1.0	0.56	7.7	8.7	140
2 x 1.5	0.42	5.7	6.7	70
3 x 1.5	0.42	6.0	7.0	90
4 x 1.5	0.42	6.6	7.6	100
6 x 1.5	0.56	8.3	9.3	160
8 x 1.5	0.56	8.9	10.1	200
2 x 2.5	0.56	7.3	8.3	100
3 x 2.5	0.56	7.7	8.7	130
4 x 2.5	0.56	8.4	9.6	160

FIREROL Thin Wall Multi-Core Overall Screened with Exposed Standard Wall Sheath 300/500 V to EN 50306-4 (FRL-TW-05MESW-OS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overal screen
Tinned annealed copper wires
Outer sheath
LSZH special compound as defined in EN 50264-1 (S2. EM 101 - EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V
Maximum Conductor Temperature	+90/+105 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

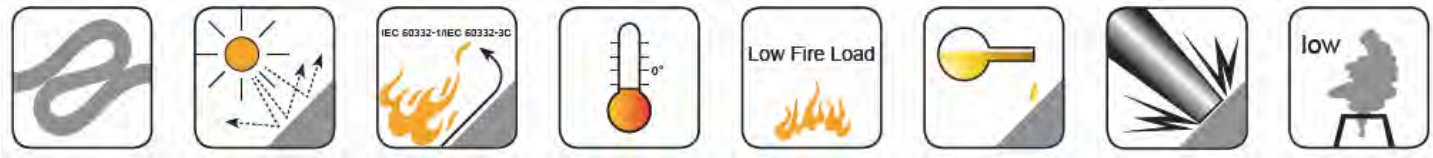
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

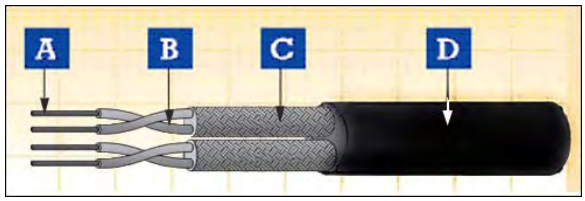
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05MESW-OS 300/500 V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
2 x 0.5	1.0	5.5	6.5	50
3 x 0.5	1.0	5.7	6.7	50
4 x 0.5	1.0	6.1	7.1	60
6 x 0.5	1.0	6.9	7.9	90
8 x 0.5	1.0	7.5	8.5	110
2 x 0.75	1.0	5.9	6.9	60
3 x 0.75	1.0	6.2	7.2	70
4 x 0.75	1.0	6.5	7.5	80
6 x 0.75	1.0	7.5	8.5	110
8 x 0.75	1.0	8.2	9.2	130
2 x 1.0	1.0	6.2	7.2	60
3 x 1.0	1.0	6.5	7.5	80
4 x 1.0	1.0	6.9	7.9	90
6 x 1.0	1.0	8.0	9.0	130
8 x 1.0	1.0	8.6	9.8	160
2 x 1.5	1.0	7.1	8.1	90
3 x 1.5	1.0	7.4	8.4	110
4 x 1.5	1.0	8.0	9.0	130
6 x 1.5	1.0	9.2	10.4	170
8 x 1.5	1.0	10.2	11.4	220
2 x 2.5	1.0	8.3	9.3	120
3 x 2.5	1.0	8.6	9.8	150
4 x 2.5	1.0	9.4	10.6	180

FIREROL Thin Wall Multipair Individually Screened & Sheathed, Overall Screened with Standard Wall sheath 300/500 V to EN 50306-4 (FRL-TW-05MPSW-IOS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overall screen
Tinned annealed copper wires
Pair screen
Individual screened and sheathed. Screened according to EN 50306-3; Sheathed according to EN 50306-3 (S1. S2)
Pair Identification
Pairs numbered according to EN 50306-4
Outer sheath
LSZH special compound (S2. EM 101 - EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500 V
Maximum Conductor Temperature	+90/+105 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

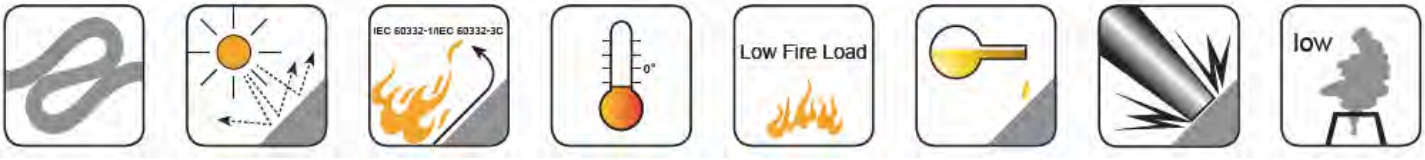
EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

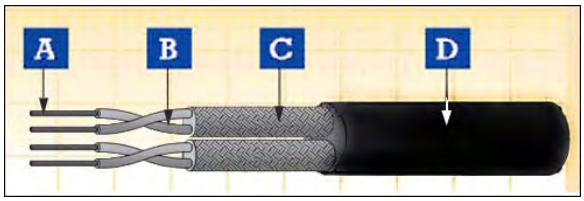
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

FRL-TW-05MPSW-IOS 300/500 V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
2 x 2 x 0.5	0.56	9.0	10.2	90
3 x 2 x 0.5	0.56	9.6	10.8	120
4 x 2 x 0.5	0.56	10.7	11.9	160
7 x 2 x 0.5	0.56	13.0	14.2	240
2 x 2 x 0.75	0.56	9.8	11.0	90
3 x 2 x 0.75	0.56	10.5	11.7	150
4 x 2 x 0.75	0.56	11.6	12.8	180
7 x 2 x 0.75	0.56	14.0	15.6	290
2 x 2 x 1.0	0.56	10.2	11.6	110
3 x 2 x 1.0	0.56	10.9	12.1	160
4 x 2 x 1.0	0.56	12.1	13.3	200
7 x 2 x 1.0	0.56	14.6	16.2	330
2 x 2 x 1.5	0.56	12.2	13.4	150
3 x 2 x 1.5	0.56	13.1	14.3	230
4 x 2 x 1.5	0.56	14.3	15.9	290
7 x 2 x 1.5	0.56	17.6	19.2	490



FIREROL Thin Wall
Multipair Individually Screened & Sheathed, with Exposed Standard Wall Sheath 300/500V to EN 50306-4 (FRL-TW-05MPESW-IOS)



A. Conductor B. Insulation C. Screen D. Sheath

Application

-Used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor.
-Used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Tinned annealed copper wires as defined in EN 50306-2
Insulation
LSZH special compound
Overall screen
Tinned annealed copper wires
Pair screen
Individual screened and sheathed. Screened according to EN 50306-3; Sheathed according to EN 50306-3 (S1. S2)
Pair Identification
Pairs numbered according to EN 50306-4
Outer sheath
LSZH special compound (S2. EM 101 - EM 104)

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Maximum Conductor Temperature	+90/+105 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	10 x Overall Diameter

Chemical & Environmental Properties

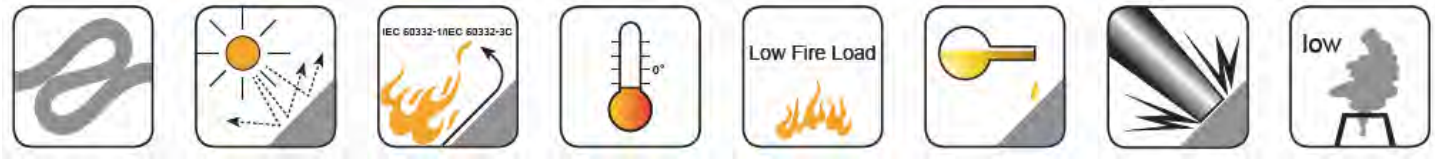
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

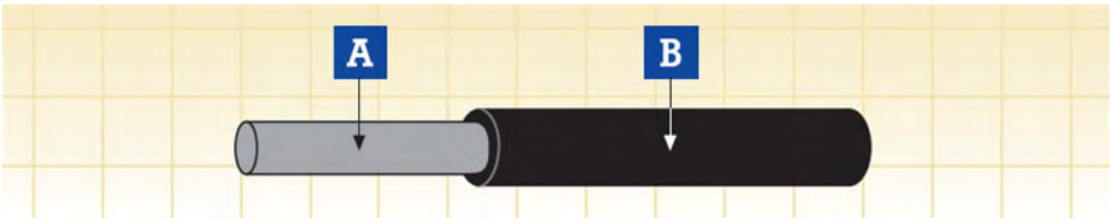
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-TW-05MPESW-IOS 300/500 V

NUMBER OF CORES AND NOMINAL CROSS SECTION	MINIMUM THICKNESS OF SHEATH AT ANY POINT	OVERALL DIAMETER		WEIGHT
(mm^2)	(mm)	min. (mm)	max. (mm)	(kg/km)
2 x 2 x 0.5	1.0	10.1	11.3	100
3 x 2 x 0.5	1.0	10.8	12.0	150
4 x 2 x 0.5	1.0	11.8	13.0	180
7 x 2 x 0.5	1.0	13.9	15.5	270
2 x 2 x 0.75	1.0	10.9	12.1	120
3 x 2 x 0.75	1.0	11.6	12.8	170
4 x 2 x 0.75	1.0	12.8	14.0	220
7 x 2 x 0.75	1.0	15.1	16.7	330
2 x 2 x 1.0	1.0	11.3	12.5	130
3 x 2 x 1.0	1.0	12.0	13.2	190
4 x 2 x 1.0	1.0	13.2	14.4	235
7 x 2 x 1.0	1.0	15.7	17.3	370
2 x 2 x 1.5	1.0	13.3	14.5	180
3 x 2 x 1.5	1.0	14.0	15.6	260
4 x 2 x 1.5	1.0	15.5	17.1	340
7 x 2 x 1.5	1.0	18.7	20.3	540

FIREROL High Temperature
Single Core Unsheathed cables
1.8/3 kV or 3.6/6 kV
to EN 50382-2 (FRL-HT-3SU / FRL-HT-6SU)



A. Conductor B. Insulation

Construction

Conductor
flexible tinned annealed copper wires (red copper only for 150° C core temperature) class 5 according to HD 383
Insulation
silicon rubber according to EN 50382-1 (EI 111)

Electrical & Mechanical Properties

Nominal Voltage	1.8/3 kV or 3.6/6 kV
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

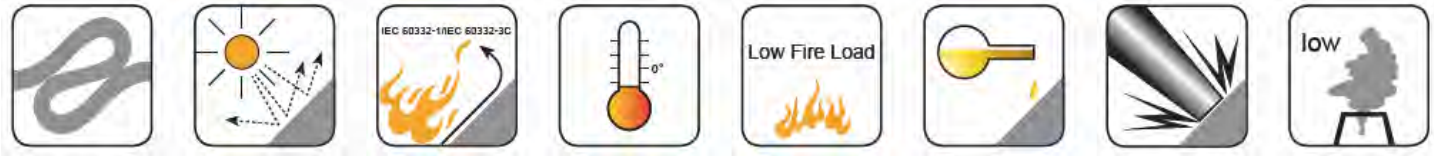
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-HT-3SU 1.8/3 kV

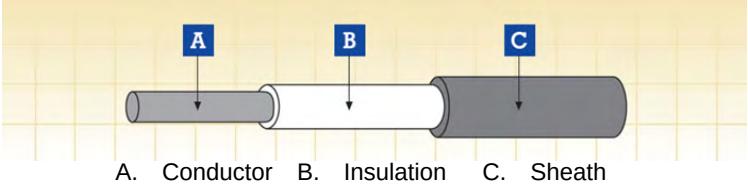
NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C		MIN. INSULATION RESISTANCE	
			min	max		TINNED CONDUCTOR	PLAIN CONDUCTOR	AT +20℃ MIN.	AT +150℃ MIN.
mm^2	mm	mm	mm	mm	kg/km	Ω/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	2.5	6.3	7.3	50	13.7	13.3	970	1.90
2.5	1.95	2.5	6.7	7.8	70	8.21	7.98	840	1.60
4	2.5	2.5	7.2	8.4	80	5.09	4.95	720	1.40
6	3.0	2.5	7.7	9.0	100	3.39	3.30	650	1.30
10	3.9	2.5	8.5	10.0	160	1.95	1.91	540	1.00
16	5.0	2.5	9.6	11.2	210	1.24	1.21	460	0.90
25	6.4	2.5	10.9	12.7	290	0.795	0.780	380	0.70
35	7.7	2.5	12.1	14.1	380	0.565	0.554	330	0.60
50	9.2	2.5	13.5	15.8	520	0.393	0.386	290	0.50
70	11.0	2.5	15.2	17.8	720	0.277	0.272	250	0.50
95	12.5	2.7	17.0	19.9	930	0.210	0.206	230	0.40
120	14.2	2.7	18.6	21.7	1140	0.164	0.161	210	0.40
150	15.8	2.7	20.1	23.5	1430	0.132	0.129	190	0.30
185	17.5	2.7	21.7	25.4	1720	0.108	0.106	170	0.30
240	20.1	2.7	24.1	28.2	2270	0.0817	0.0801	150	0.30
300	22.5	2.7	26.4	30.9	2750	0.0654	0.0641	140	0.20
400	25.8	2.9	29.9	34.9	3730	0.0495	0.0486	130	0.20

FRL-HT-6SU 3.6/6kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C		MIN. INSULATION RESISTANCE	
			min	max		TINNED CONDUCTOR	PLAIN CONDUCTOR	AT +20℃ MIN.	AT +150℃ MIN.
mm^2	mm	mm	mm	mm	kg/km	Ω/km	Ω/km	MΩ·km	MΩ·km
2.5	1.95	3.0	7.6	8.9	80	8.21	7.98	920	1.80
4	2.5	3.0	8.1	9.5	100	5.09	4.95	800	1.60
6	3.0	3.0	9.0	10.6	120	3.39	3.30	750	1.50
10	3.9	3.0	9.5	11.1	180	1.95	1.91	610	1.20
16	5.0	3.0	10.5	12.3	230	1.24	1.21	520	1.00
25	6.4	3.0	11.8	13.8	310	0.795	0.780	430	0.80
35	7.7	3.0	13.0	15.2	410	0.565	0.554	380	0.70
50	9.2	3.0	14.4	16.9	550	0.393	0.386	330	0.60
70	11.0	3.0	16.1	18.9	740	0.277	0.272	280	0.50
95	12.5	3.0	17.5	20.5	940	0.210	0.206	260	0.50
120	14.2	3.1	19.3	22.6	1170	0.164	0.161	240	0.40
150	15.8	3.1	20.8	24.4	1460	0.132	0.129	220	0.40
185	17.5	3.2	22.6	26.5	1760	0.108	0.106	200	0.40
240	20.1	3.4	25.4	29.8	2340	0.0817	0.0801	190	0.30
300	22.5	3.4	27.7	32.4	2820	0.0654	0.0641	170	0.30
400	25.8	3.4	30.8	36.0	3780	0.0495	0.0486	150	0.30

(a)= For information,indicative only

FIREROL High Temperature
Single Core Sheathed cables
1.8/3kV or 3.6/6 kV
to EN 50382-2 (FRL-HT-3S / FRL-HT-6S)



A. Conductor B. Insulation C. Sheath

Construction

Conductor
flexible tinned annealed copper wires(red copper only for 150° C core temperature)class 5 according to HD 383
Insulation
silicon rubber according to EN 50382-1 (EI 112)
Outer sheath
LSZH elastomeric compound according to EN 50382-1 (EM 105. EM 106 or EM 107)

Electrical & Mechanical Properties

Nominal Voltage	1.8/3kV or 3.6/6 kV
Maximum Conductor Temperature	+90 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

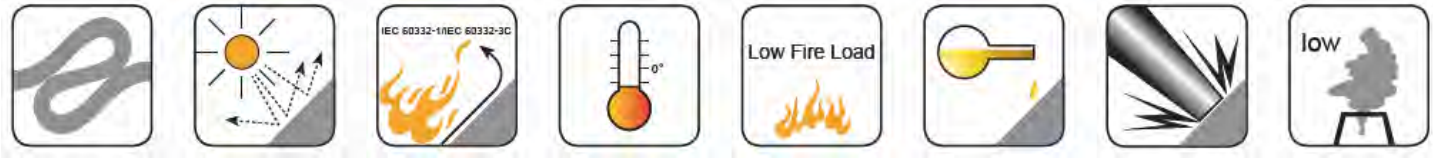
EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



FRL-HT-3S 1.8/3 kV

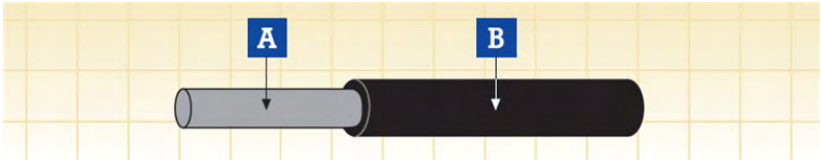
NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C		MIN. INSULATION RESISTANCE	
				min	max		TINNED CONDUCTOR	PLAIN CONDUCTOR	AT 20℃ MIN.	AT 150℃ MIN.
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	Ω/km	MΩ·km	MΩ·km
1.5	1.5	1.3	1.4	6.8	7.9	70	13.7	13.3	670	1.30
2.5	1.95	1.3	1.4	7.2	8.4	80	8.21	7.98	570	1.10
4	2.5	1.3	1.4	7.7	9.0	100	5.09	4.95	480	0.90
6	3.0	1.3	1.4	8.2	9.6	120	3.39	3.30	420	0.80
10	3.9	1.5	1.4	9.4	11.0	190	1.95	1.91	380	0.70
16	5.0	1.5	1.4	10.5	12.2	240	1.24	1.21	310	0.60
25	6.4	1.8	1.4	12.3	14.4	340	0.795	0.780	300	0.60
35	7.7	1.8	1.4	13.6	15.9	440	0.565	0.554	250	0.50
50	9.2	1.8	1.4	15.0	17.5	580	0.393	0.386	220	0.40
70	11.0	1.8	1.5	16.8	19.7	780	0.277	0.272	200	0.40
95	12.5	2.2	1.5	19.0	22.2	1020	0.210	0.206	190	0.40
120	14.2	2.2	1.6	20.8	24.3	1270	0.164	0.161	180	0.30
150	15.8	2.2	1.6	22.3	26.1	1560	0.132	0.129	160	0.30
185	17.5	2.4	1.7	24.5	28.6	1890	0.108	0.106	160	0.30
240	20.1	2.4	1.8	27.1	31.7	2480	0.0817	0.0801	140	0.20
300	22.5	2.4	1.9	29.5	34.6	2990	0.0654	0.0641	120	0.20
400	25.8	2.6	2.0	33.2	38.9	4010	0.0495	0.0486	120	0.20

FRL-HT-6S 3.6/6 kV

NOMINAL CROSS-SECTIONAL AREA	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	MIN. AVERAGE SHEATH THICKNESS	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C		MIN. INSULATION RESISTANCE	
				min	max		TINNED CONDUCTOR	PLAIN CONDUCTOR	AT 20℃ MIN.	AT 150℃ MIN.
mm^2	mm	mm	mm	mm	mm	kg/km	Ω/km	Ω/km	MΩ·km	MΩ·km
2.5	1.95	2.6	1.4	9.9	11.6	130	8.21	7.98	870	1.70
4	2.5	2.6	1.4	10.4	12.2	150	5.09	4.95	750	1.50
6	3.0	2.6	1.4	10.9	12.8	180	3.39	3.30	670	1.30
10	3.9	2.6	1.4	11.8	13.8	240	1.95	1.91	570	1.10
16	5.0	2.6	1.4	12.8	15.0	300	1.24	1.21	480	0.90
25	6.4	2.9	1.4	14.7	17.2	410	0.795	0.780	430	0.80
35	7.7	2.9	1.4	15.9	18.6	510	0.565	0.554	380	0.70
50	9.2	2.9	1.5	17.5	20.5	660	0.393	0.386	330	0.60
70	11.0	2.9	1.5	19.2	22.4	870	0.277	0.272	280	0.50
95	12.5	2.9	1.6	20.8	24.3	1100	0.210	0.206	250	0.50
120	14.2	2.9	1.6	22.4	26.2	1330	0.164	0.161	230	0.40
150	15.8	2.9	1.7	24.1	28.2	1640	0.132	0.129	210	0.40
185	17.5	3.2	1.8	26.4	30.9	1990	0.108	0.106	210	0.40
240	20.1	3.4	1.9	29.4	34.4	2620	0.0817	0.0801	190	0.30
300	22.5	3.4	1.9	31.7	37.1	3120	0.0654	0.0641	170	0.30
400	25.8	3.4	2.0	35.0	40.9	4150	0.0495	0.0486	150	0.30

(a)= For information,indicative only

FIREROL High Temperature
Single core cables with Reinforced Insulation
3.6/6 kV to EN 50382-2 (FRL-HT-6SURI)



A. Conductor B. Insulation

Construction

Conductor
extra flexible tinned annealed copper wires(red copper only for 150° C core temperature)class 6 according to HD 383
Insulation
silicon rubber according to EN 50382-1 (EI 112)

Electrical & Mechanical Properties

Nominal Voltage	3.6/6kV
Maximum Conductor Temperature	+120/+150 °C (fixed installation)
Minimum Permissible Ambient Temperature	-25/-40 °C (fixed installation)
Bending Radius	3 x Overall Diameter (D<12mm); 4 x Overall Diameter (D>12mm)

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

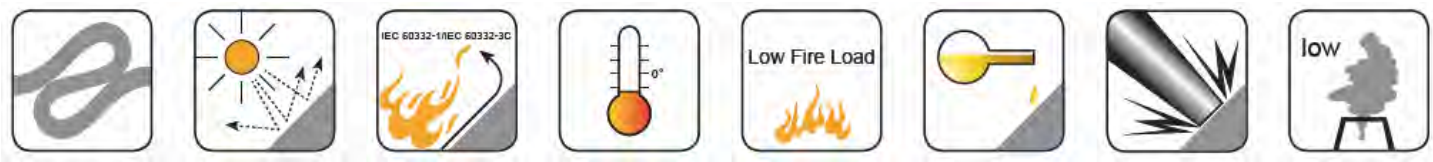
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

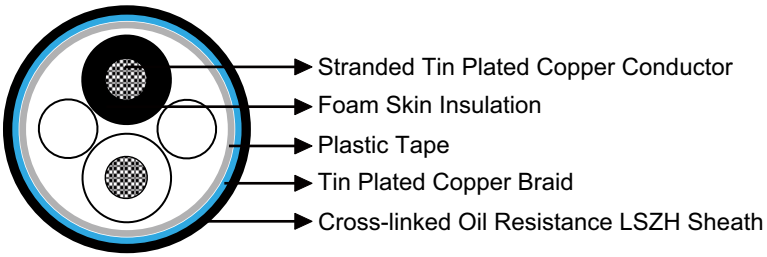
FRL-HT-6SURI 3.6/6 kV

NOMINAL CROSS-SECTIONAL AREA (a)	CONDUCTOR DIAMETER (a)	MIN. MEAN THICKNESS OF INSULATION	OVERALL DIAMETER		WEIGHT	RESISTANCE OF CONDUCTOR AT 20°C		MIN. INSULATION RESISTANCE	
			min	max		TINNED CONDUCTOR	PLAIN CONDUCTOR	AT +20 ℃ MIN.	AT +150℃ MIN.
mm^2	mm	mm	mm	mm	kg/km	Ω/km	Ω/km	MΩ·km	MΩ·km
50	9.2	3.0	15.2	17.8	560	0.393	0.386	340	0.70
70	11.0	3.0	16.9	19.8	770	0.277	0.272	300	0.60
95	12.5	3.0	18.3	21.4	970	0.210	0.206	270	0.55
120	14.2	3.1	20.1	23.5	1200	0.164	0.161	250	0.50
150	15.8	3.1	21.6	25.3	1480	0.132	0.129	220	0.45
185	17.5	3.2	23.4	27.4	1800	0.108	0.106	210	0.40

(a)= For information,indicative only



WTB (Wired Train Bus) Cables
FRA-WTB-02YCH-2C0.75S/FRA-WTB-02YSCH-1P0.75S



Application

The cables are designed for permanent installation inside of rolling stock to connect fixed parts. A typical application is a communication system in a locomotive. The system uses a wire backed bus system to the TCN standard for control and instrumentation and for diagnostics. This bus system consists of the rail bus WTB (Wired Train Bus) and the road bus MVB (Multifunction Vehicle Bus) which are connected via redundant gateways.

Construction

Conductors
Stranded tin plated copper conductor according to IEC 60228 class 5

Insulation
Foam skin-composite PE made of inner cellular layer and outer solid skin

Core Wrapping
Plastic tape(s)

EMC Screen
Tin plated copper braid

Outer Sheath
Cross-linked oil resistant LSZH compound

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+100℃
Minimum Temperature	-40℃
Bending Radius	10OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C;	Fire propagation of bunched wires and cables

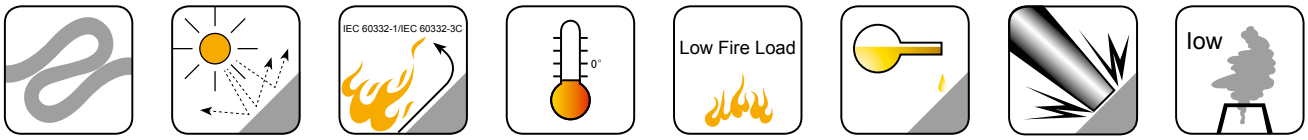
VDE 0472 Teil 804; BS 4066-3; NFC 32070
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816 — Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815 — Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813 — Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853 — Toxicity index
NFF 16101; NFF 63808; BS6853 — Smoke index

FRA-WTB-02YSCH-2C0.75S

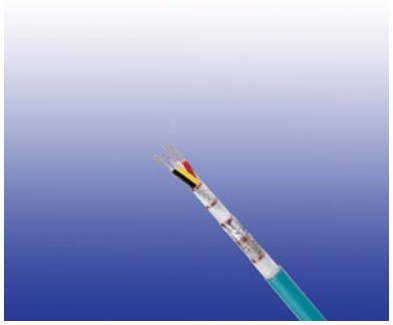
Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Transfer Impedance	Maximum Attenuation			
					20℃	@1-10MHz	f<=30MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm^2	**No/mm^2**	mm	mm	kg/km	Ω/km	Ω	mΩ/m	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.4	8.3	97	26.7	120+/-12	30	10	13	14	18

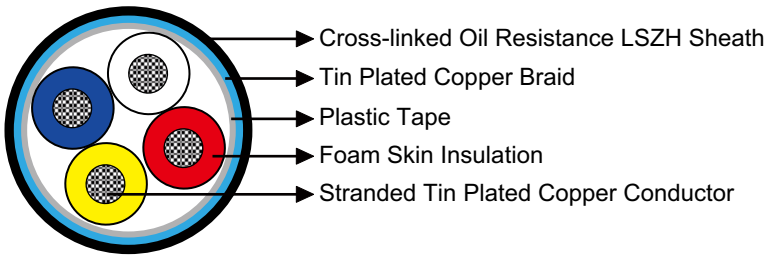
FRA-WTB-02YSCH-1P0.75S

Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Transfer Impedance	Maximum Attenuation			
					20℃	@1-10MHz	f<=30MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm^2	**No/mm^2**	mm	mm	kg/km	Ω/km	Ω	mΩ/m	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.4	9.0	110	26.7	120+/-12	30	10	13	14	18



MVB(Multifunction Vehicle Bus)Cables
FRA-MVB-02YS(ST+C)H-1P0.5S+1C0.5S
FRA-MVB-02YS(ST+C)H-2P0.5S





Application

The cables are designed for permanent installation inside of rolling stock to connect fixed parts. A typical application is a communication system in a locomotive. The system uses a wire backed bus system to the TCN standard for control and instrumentation and for diagnostics. This bus system consists of the rail bus WTB (Wired Train Bus) and the road bus MVB (Multifunction Vehicle Bus) which are connected via redundant gateways.

Construction

Conductor
Stranded tin plated copper conductor according to IEC 60228 class 5

Insulation
Foam skin-composite PE made of inner cellular layer and outer solid skin

Core Wrapping
Plastic tape(s)

EMC Screen
Tin plated copper braid

Outer Sheath
Cross-linked oil resistant LSZH compound

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+90℃
Minimum Temperature	-40℃
Bending Radius	10OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	nterior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

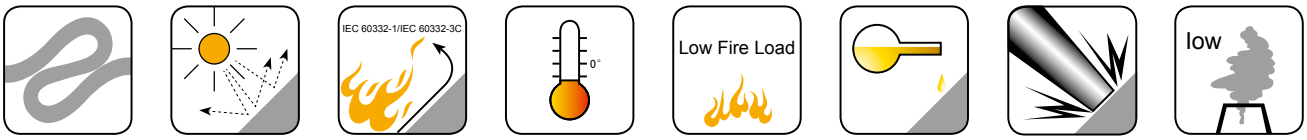
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

FRA-MVB-02YS(ST+C)H-1P0.5S+1C0.5S

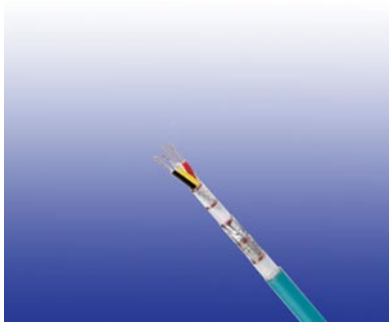
Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Transfer Impedance	Maximum Attenuation			
					20℃	@0.5-2MHz	f<=20MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm^2	**No/mm^2**	mm	mm	kg/km	Ω/km	Ω	mΩ/m	dB/km	dB/km	dB/km	dB/km
0.5	19/0.18	1.2	6.8	62	41	120+/-12	20	12.5	15	18	21

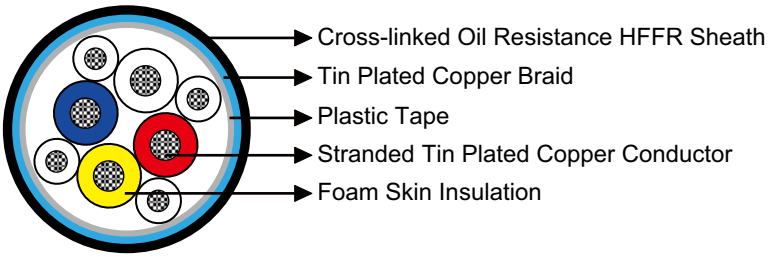
FRA-MVB-02YS(ST+C)H-2P0.5S

Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Transfer Impedance	Maximum Attenuation			
					20℃	@1-10MHz	f<=20MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm^2	**No/mm^2**	mm	mm	kg/km	Ω/km	Ω	mΩ/m	dB/km	dB/km	dB/km	dB/km
0.5	19/0.18	1.2	8.3	100	41	120+/-12	20	12.5	15	18	21



MVB(Multifunction Vehicle Bus)Cables(Redundant Version)
FRA-MVB-02YS(ST+C)H-1Q0.5S+4C0.25S





Application

The cables are designed for permanent installation inside of rolling stock to connect fixed parts. A typical application is a communication system in a locomotive. The system uses a wire backed bus system to the TCN standard for control and instrumentation and for diagnostics. This bus system consists of the rail bus WTB (Wired Train Bus) and the road bus MVB (Multifunction Vehicle Bus) which are connected via redundant gateways.

Construction

Conductor
Stranded tin plated copper conductor according to IEC 60228 class 5

Insulation
Foam skin-composite PE made of inner cellular layer and outer solid skin

Core Wrapping
Plastic tape(s)

EMC Screen
Tin plated copper braid

Outer Sheath
Cross-linked oil resistant LSZH compound.

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+100℃
Minimum Temperature	-40℃
Bending Radius	10OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

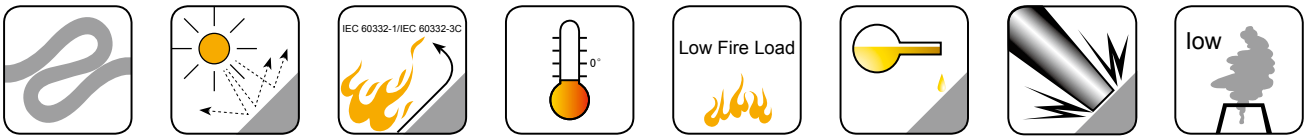
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable

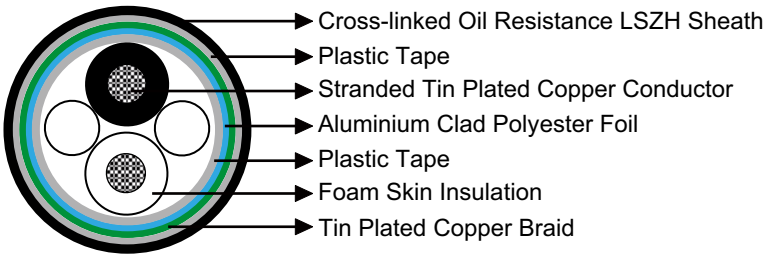
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

FRA-MVB-02YS(ST+C)H-1Q0.5S+4C0.25S

Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Transfer Impedance	Maximum Attenuation	
					20℃	@0.75-3MHz	f<=20MHz	@1.5MHz	@3MHz
mm^2	**No/mm^2**	mm	mm	kg/km	Ω/km	Ω	mΩ/m	dB/km	dB/km
0.5	19/0.18	1.2	7.9	95	41	120+/-12	20	17	25



WTB(Wired Train Bus)/MVB(Multifunction Vehicle Bus)Cables
FRA-WTB/MVB-02YS(ST+C)H-1P20A



Application

The cables are designed for permanent installation inside of rolling stock to connect fixed parts. A typical application is a communication system in a locomotive. The system uses a wire backed bus system to the TCN standard for control and instrumentation and for diagnostics. This bus system consists of the rail bus WTB (Wired Train Bus) and the road bus MVB (Multifunction Vehicle Bus) which are connected via redundant gateways.

Construction

Conductor
Stranded tin plated copper conductor according to IEC 60228 class 5

Insulation
Foam skin-composite PE made of inner cellular layer and outer solid skin

Cable Element
Twisted pair

Core Wrapping
Plastic tape(s)

EMC Screen1
Aluminium clad polyester foil

EMC Screen2
Tin plated copper braid

Core Wrapping
Plastic tape(s)

Outer Sheath
Cross-linked oil resistant LSZH compound

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+100℃
Minimum Temperature	-40℃
Bending Radius	12OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

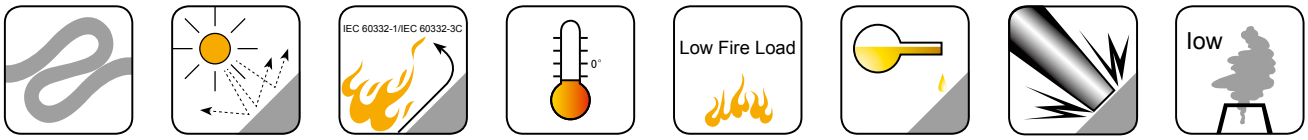
EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

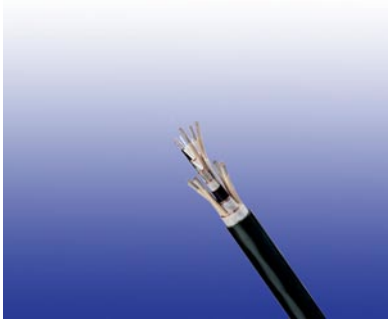
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

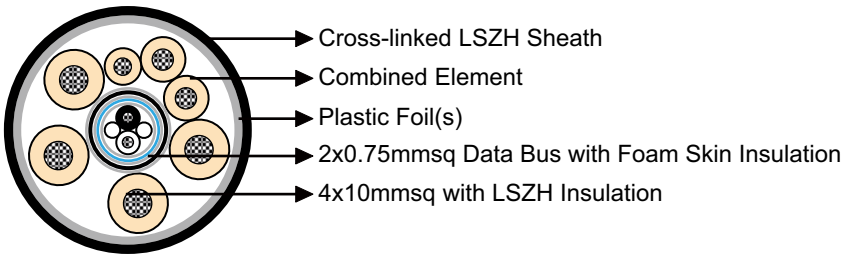
FRA-WTB/MVB-02YS(ST+C)H-1P20A

Nominal Cross Sectional Area	Nominal Diameter of Strands	AWG	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Attenuation	
						20℃	@0.75-3MHz	@1MHz	@2MHz
mm^2	**No/mm**		mm	mm	kg/km	Ω/km	Ω	dB/km	dB/km
0. 62	19/0.2	20	1.2	8.3	80	33.1	120+/-12	10	15



Integrated 9/11/18/20 Cores 0.75mm sq UIC Databus Cables
FRA-UIC-4C10S+2C6S+1C2.5S+2C0.75S
FRA-UIC-4C10S+2C6S+1C2.5S+2C1S+2C0.75S
FRA-UIC-4Q1S+2C0.75S/FRA-UIC-4Q1S+2P0.75S





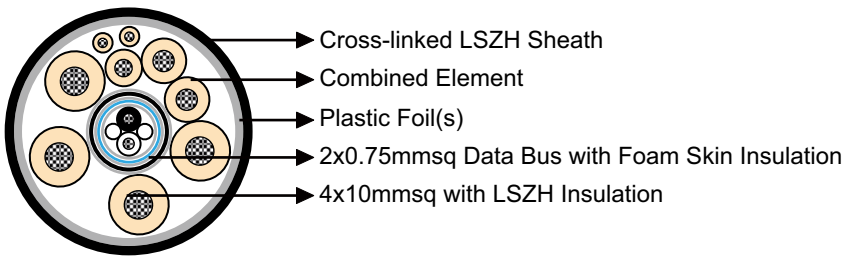
Application

The cables are used as connecting cables to transmit digital signals inside railway rolling stocks

Construction

For 9 cores UIC databus cables

4 cores: 10 mm^2 stranded tinned copper conductor with LSZH insulation..
Combined Element: 3 cores (with Cu-strand 2 x 6mm^2, 1 x 2.5mm^2) are twisted with a filling element to a combined element.
Core Wrapping:Overlapped plastic-foil(s).
Elements sheaths:TPE
UIC Data Bus 0.75mm^2: Two foam skin insulated tinned copper stranded conductors are twisted together with two filling elements to a pair.
Core Wrapping:Overlapped plastic-foil(s).
Screen:Tin plated copper braid
Elements sheaths:TPE
Core Wrapping:Overlapped plastic-foil(s).
Stranding: 4 strands are twisted to a core together with 3 cored element, the UIC data bus and two fillers
Core Wrapping:Overlapped plastic-foil(s).
Outer Sheath:Cross-linked oil resistant LSZH compound.



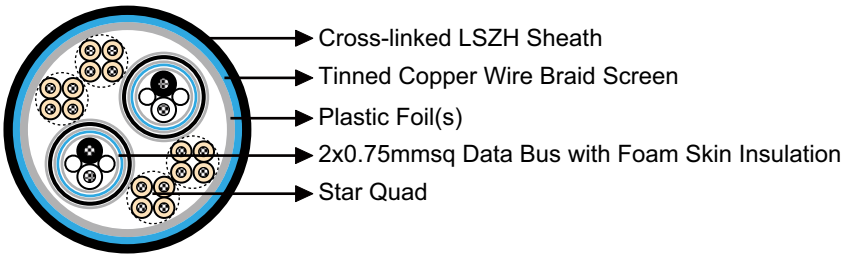
For 11 cores UIC databus cables

4 cores: 10 mm^2 stranded tinned copper conductor with LSZH insulation
Combined Element: 5 cores (with Cu-strand 2 x 6mm^2, 1 x 2.5mm^2 and 2 x 1.0 mm^2) are twisted with a filling element to form a combined element.
Core Wrapping:Overlapped plastic-foil(s).

Element sheaths:TPE

UIC Data Bus 0.75mm²: Two foam skin insulated tinned copper r stranded conductors are twisted together with two filling elements to a pair.
Core Wrapping:Overlapped plastic-foil(s).
Screen:Tin plated copper braid.
Element sheaths:TPE
Core Wrapping:Overlapped plastic-foil(s).

Stranding:4 strands are twisted to a core together with 5 cored element, the UIC data bus and two fillers.
Core Wrapping:Overlapped plastic-foil(s).
Outer Sheath:Cross-linked oil resistant LSZH compound.



For 18/20 cores UIC databus cables

Star Quad: Four LSZH insulated 1mm2 stranded tinned copper conductors are twisted to form a star quad.
UIC Data Bus 0.75mm²: Two foam skin insulated tinned copper stranded conductors are twisted together with two filling elements to form a pair.
Core Wrapping：Overlapped plastic-foil(s).
Screen：Tin plated copper braid
Element sheaths：TPE.
Core Wrapping：Overlapped plastic-foil(s).
Stranding: 4 star quads are stranded together with 2 or 4 UIC data bus cable and several fillers.
Core Wrapping：Overlapped plastic-foil(s).
Screen:Tin plated copper braid.
Outer Sheath:Cross-linked oil resistant LSZH compound.

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+90℃
Minimum Temperature	-40℃
Bending Radius	12OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density

EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853
NFF 16101; NFF 63808; BS6853

Halogen Free
Corrosivity of gases (Acidity & Conductivity)
Toxicity index
Smoke index

FRA-UIC-4C10S+2C6S+1C2.5S+2C0.75S

Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Attenuation			
					20℃	@0.75-3MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm²	**No/mm**	mm	mm	kg/km	Ω/km	Ω	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.8	25	917	26.7	120+/-12	10	13	14	18
10	80/0.4				1.95	-	-	-	-	-
6	84/0.3				3.39	-	-	-	-	-
2.5	37/0.29				8.21	-	-	-	-	-

FRA-UIC-4C10S+2C6S+1C2.5S+2C1S+2C0.75S

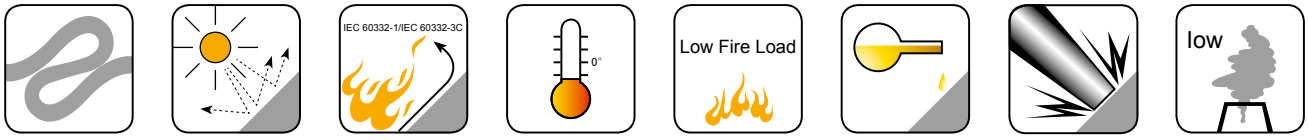
Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Attenuation			
					20℃	@0.75-3MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm²	**No/mm**	mm	mm	kg/km	Ω/km	Ω	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.8	25	969	26.7	120+/-12	10	13	14	18
10	80/0.4				1.95	-	-	-	-	-
6	84/0.3				3.39	-	-	-	-	-
2.5	37/0.29				8.21	-	-	-	-	-

FRA-UIC-4Q1S+2C0.75S

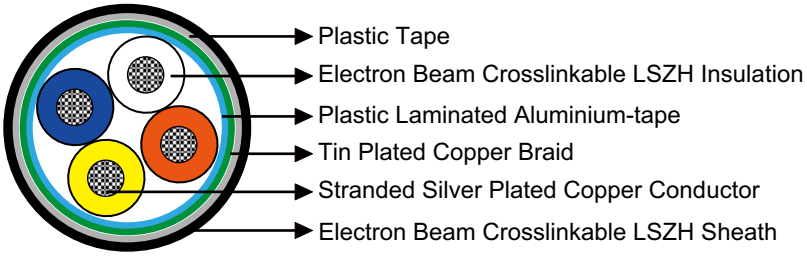
Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Attenuation			
					20℃	@0.75-3MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm²	**No/mm**	mm	mm	kg/km	Ω/km	Ω	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.8	18.5	498	26.7	120+/-12	10	13	14	18
1	19/0.25				20	-	-	-	-	-

FRA-UIC-4Q1S+2P0.75S

Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance	Impedance	Maximum Attenuation			
					20℃	@0.75-3MHz	@1MHz	@1.5MHz	@2MHz	@3MHz
mm²	**No/mm**	mm	mm	kg/km	Ω/km	Ω	dB/km	dB/km	dB/km	dB/km
0.75	19/0.22	1.5	23	530	26.7	120+/-12	10	13	14	18
1	19/0.25				20	-	-	-	-	-



Category 5E Databus Cables
FRA-Cat5E-4C0.5S/FRA-Cat5E-4C22A
FRA-Cat5E-4P22A



Application

The cables are designed for permanently protected installation, inside and outside railway rolling stock, buses and other vehicles to connect fixed parts. Ethernet based networks as: infotainment, multimedia, passenger information system etc.

Construction

For 4 x 0.5, 4 x 22AWG cables

Conductors: Stranded tin plated copper conductor (for 0.5mm2 cables) or stranded silver plated copper conductor (for 22AWG cables) according to IEC 60228 class 5.
Insulation:Electron beam crosslinkable compound.
Cable Element: Individual conductor stranded together
EMC Screen1:Plastic laminated aluminium-tape.
EMC Screen2:Tin plated copper braid
Core Wrapping:Plastic tape(s).
Outer Sheath:Electron beam crosslinkable compound.

For 4 x 2 x 22AWG cables

Center: PE filler.
4 pairs 2 x 22AWG: Stranded tin plated copper conductor according to IEC 60228 class 5
Insulation:Electron beam crosslinkable compound.
EMC Screen1:Plastic laminated aluminium-tape.
EMC Screen2:Tin plated copper braid
Core Wrapping:Plastic tape(s).
Outer Sheath:Electron beam crosslinkable compound.

Electrical & Mechanical Properties

Nominal Voltage	300V
Maximum Temperature	+90℃
Minimum Temperature	-40℃
Bending Radius	6OD

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4

BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

FRA-Cat5E-4C0.5S

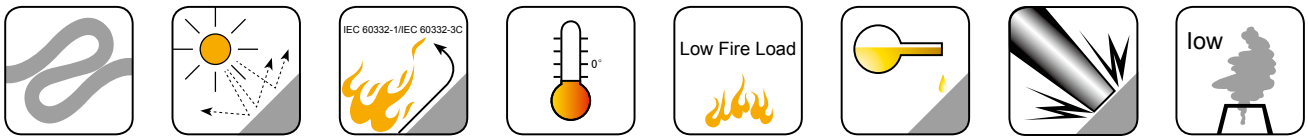
Nominal Cross Sectional Area	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance 20℃	Maximum Resistance Unbalance	Characteristic Impedance	Transfer Impedance	Maximum Capacitance	
						@100MHz	f<=30MHz	core to core	Core to screen
mm^2	mm	mm	kg/km	Ω/km	Ω/km	Ω	mΩ/m	pF/m	pF/m
0.5	1.2	8.3	102	40.1	1.1	100+/-5	200	65	100

FRA-Cat5E-4C22A

AWG	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance 20℃	Maximum Resistance Unbalance	Characteristic Impedance	Transfer Impedance	Maximum Capacitance	
						@100MHz	f<=30MHz	core to core	Core to screen
	mm	mm	kg/km	Ω/km	Ω/km	Ω	mΩ/m	pF/m	pF/m
22	1.2	7.25	81	54.4	1.1	100+/-5	200	65	100

FRA-Cat5E-4P22A

AWG	Nominal Sheath Thickness	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance 20℃	Maximum Resistance Unbalance	Characteristic Impedance	Transfer Impedance	Maximum Capacitance	
						@100MHz	f<=30MHz	core to core	Core to screen
	mm	mm	kg/km	Ω/km	Ω/km	Ω	mΩ/m	pF/m	pF/m
22	1.2	12.6	174	54.4	1.1	100+/-5	200	65	100



DATABUS RS 485 CABLE 300/500V

Application

120Ohm data transmission cables

Construction

Multipair Databus RS 485 Double screened Cable

Conductor: Stranded tin plated copper conductor according to IEC 60228 class 5(0.22mm^2-1mm^2).
Insulation: Cross linked Foam PE.
Cable Element:Twisted pair.
Individual Screen:Individual Aluminium Tape.
Overall Screen: Copper Wire Braid
Outer Sheath:Cross linked EVA rubber type EM 104 or equivalent, in accordance with EN 50264-1.

Multipair Databus RS 485 Single screened Cable

Conductor: Stranded tin plated copper conductor according to IEC 60228 class 5(0.22mm^2-1mm^2).
Insulation: Cross linked Foam PE.
Cable Element:Twisted pair.
Overall Screen: Copper Wire Braid
Outer Sheath:Cross linked EVA rubber type EM 104 or equivalent, in accordance with EN 50264-1.

Electrical & Mechanical Properties

Nominal Voltage	300/500V
Impedance	120Ω+/-15%
Capacitance@1KHz	41nF/km
Insulation Resistance	5000MΩ

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density

EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853
NFF 16101; NFF 63808; BS6853

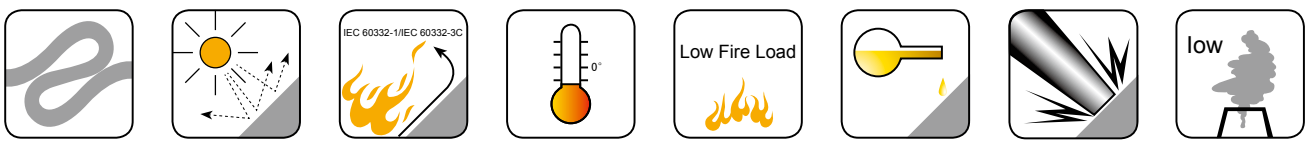
Halogen Free
Corrosivity of gases (Acidity & Conductivity)
Toxicity index
Smoke index

300/500V Multipair Databus RS 485 Double screened Cable

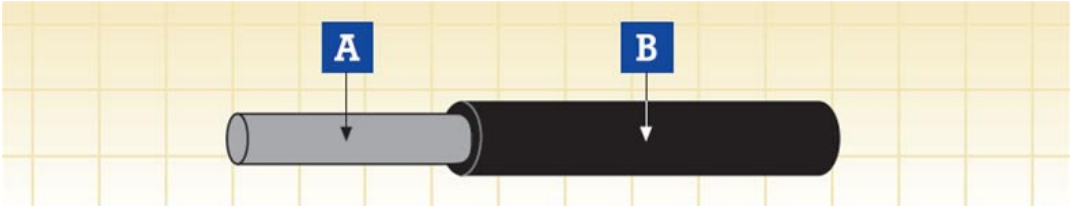
No.of pair	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight
	mm^2	**No/mm**	mm	kg/km
1	0.22	7/0.2	4.5	58
2	0.22	7/0.2	6.2	79
4	0.22	7/0.2	6.5	118
1	0.5	16/0.2	6.6	79
2	0.5	16/0.2	9.0	105
4	0.5	16/0.2	9.8	145
1	0.75	24/0.2	9.5	115
2	0.75	24/0.2	10.3	135
4	0.75	24/0.2	11.6	182
1	1	30/0.2	11.5	125
2	1	30/0.2	12.5	150
4	1	30/0.2	13.5	180

300/500V Multipair Databus RS 485 Single screened Cable

No.of pair	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight
	mm^2	**No/mm**	mm	kg/km
1	0.22	7/0.2	4.2	55
2	0.22	7/0.2	5.9	75
4	0.22	7/0.2	6.2	115
1	0.5	16/0.2	6.3	75
2	0.5	16/0.2	8.5	100
4	0.5	16/0.2	9.4	140
1	0.75	24/0.2	9.0	110
2	0.75	24/0.2	9.7	130
4	0.75	24/0.2	11.1	178
1	1	30/0.2	11.0	120
2	1	30/0.2	12.0	145
4	1	30/0.2	13.0	175



RSE/STD/024 Part 6 Types IV Rolling Stock Cables
30/50V Singlecore Reduced Wall Unsheathed Cables



A.Conductor B.Insulation

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction

Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

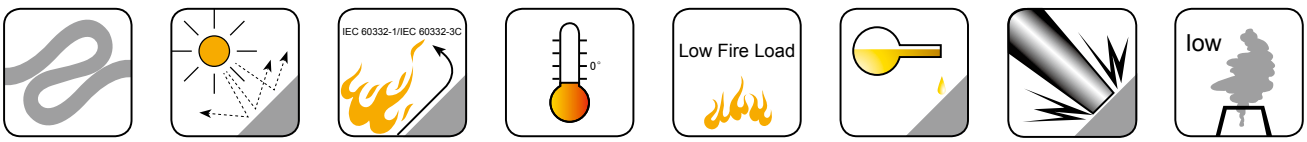
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

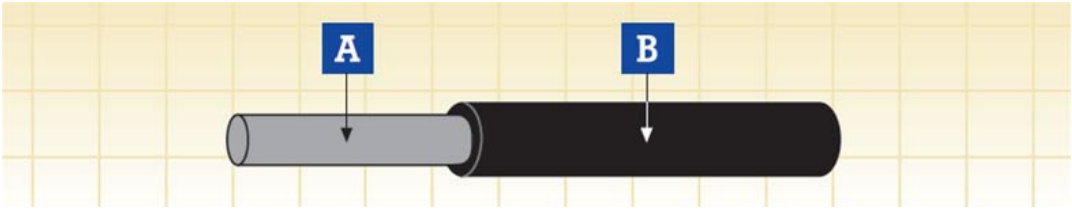
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.5	19/0.18	1.34	6	40.1
1	0.75	37/0.16	1.56	8	26.7
1	1.0	37/0.18	1.69	10	20.0
1	1.5	37/0.23	2.07	16	13.7
1	2.5	37/0.30	2.66	27	8.21
1	4.0	37/0.37	3.32	41	5.09



RSE/STD/024 Part 6 Types V Rolling Stock Cables
30/50V Singlecore Standard Wall Unsheathed Cables



A.Conductor B.Insulation

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction
Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

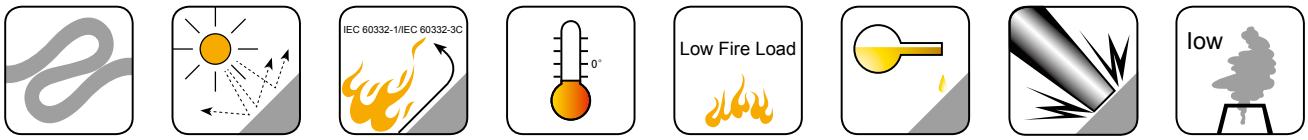
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

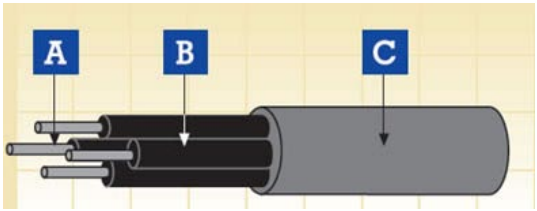
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.5	16/0.2	2.32	10	40.1
1	0.75	24/0.2	2.53	13	26.7
1	1.0	32/0.2	2.71	15	20.0
1	1.5	30/0.25	3.23	22	13.7
1	2.5	50/0.25	3.7	34	8.21
1	4.0	56/0.3	4.5	50	5.09
1	6.0	84/0.3	5.09	75	3.39
1	10.0	80/0.4	6.3	123	1.95



RSE/STD/024 Part 6 Types VII Rolling Stock Cables 30/50V Multicore Standard Wall Cables



A.Conductor B.Insulation C.Sheath

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction

Conductor

Flexible Stranded Tinned Copper

Insulation

Cross linked EPR rubber type EI 107

Sheath

Cross linked EVA rubber type EM 104

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

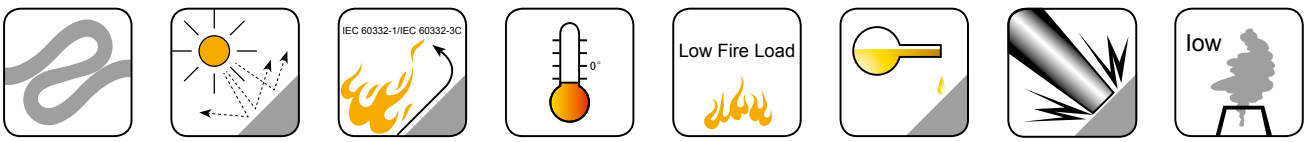
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

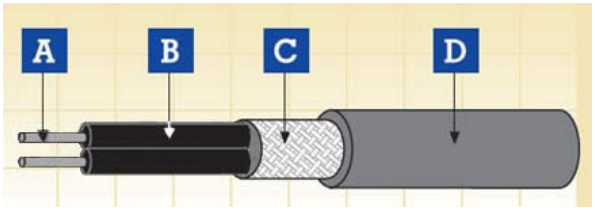
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
12	1.0	32/0.20	20.25	309	20.0
42	1.5	30/0.25	38.35	1661	13.7

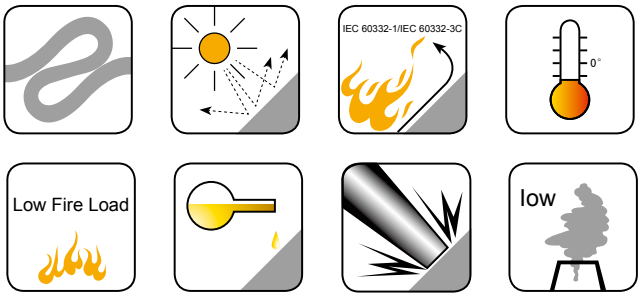


RSE/STD/024 Part 6 Types VIII Rolling Stock Cables
30/50V Multipair Screened Standard Wall Cables



A.Conductor B.Insulation C.Screen D.Sheath

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction


Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Screen
Copper Braid Screen

Sheath
Cross linked EVA rubber type EM 104

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

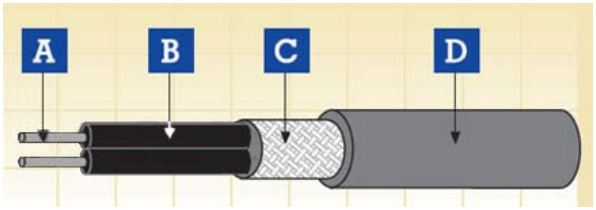
EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of Pair	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.5	16/0.2	8.45	99	40.1
1	0.75	24/0.2	9.2	110	26.7
1	1.0	32/0.2	9.5	139	20.0
1	1.0	32/0.2	11.7	186	20.0
1	1.0	32/0.2	15.6	306	20.0
2	1.0	32/0.2	15.7	443	20.0
3	1.0	32/0.2	21.7	662	20.0

RSE/STD/024 Part 6 Types IX Rolling Stock Cables
30/50V Multipair Reduced Wall Screened Cables

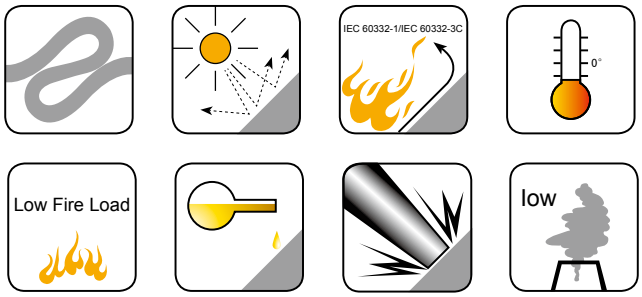


A.Conductor B.Insulation C.Screen D.Sheath

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles□

Construction



Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Screen
Copper Braid Screen

Sheath
Cross linked EVA rubber type EM 104

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

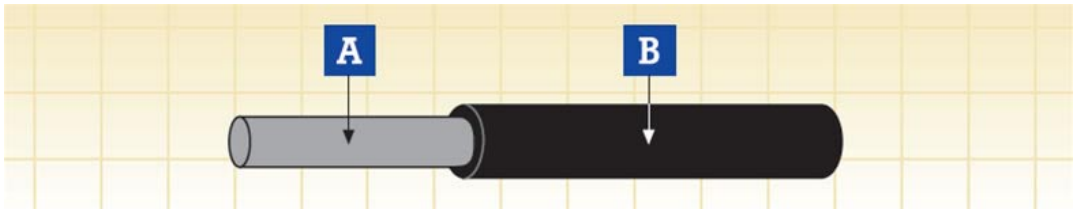
EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of pair	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.5	19/0.18	6.1	57	40.1
2	0.5	19/0.18	10.2	110	40.1
1	1.0	37/0.18	7.0	86	20.0
2	1.0	37/0.18	12.2	188	20.0
3	1.0	37/0.18	12.9	217	20.0
4	1.0	37/0.18	14.0	290	20.0

RSE/STD/024 Part 6 Types XII Rolling Stock Cables
300/500V Multicore Standard Wall Unsheathed Cables



A.Conductor B.Insulation

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction
Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

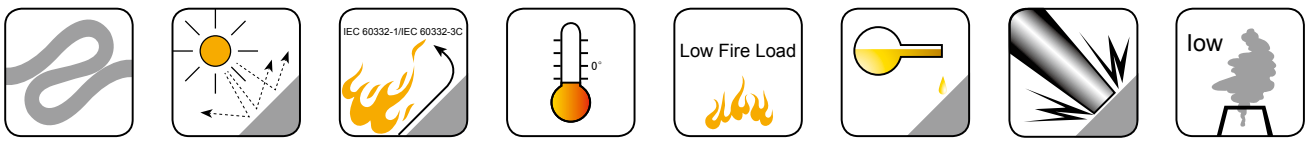
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

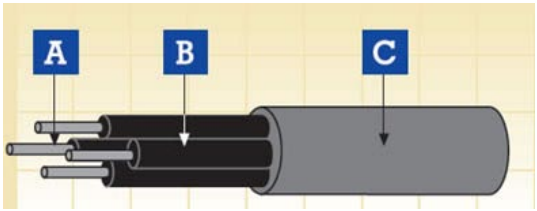
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	1.0	32/0.2	3.3	19	20.0
1	1.5	30/0.25	3.7	26	13.7
1	2.5	50/0.25	4.2	38	8.21
1	4.0	56/0.3	5.0	57	5.09
1	6.0	84/0.3	5.6	80	3.39



RSE/STD/024 Part 6 Types XIII Rolling Stock Cables 300/500V Multicore Standard Wall Cables



A.Conductor B.Insulation C.Sheath

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction

Conductor

Flexible Stranded Tinned Copper

Insulation

Cross linked EPR rubber type EI 107

Sheath

Cross linked EVA rubber type EM 104

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

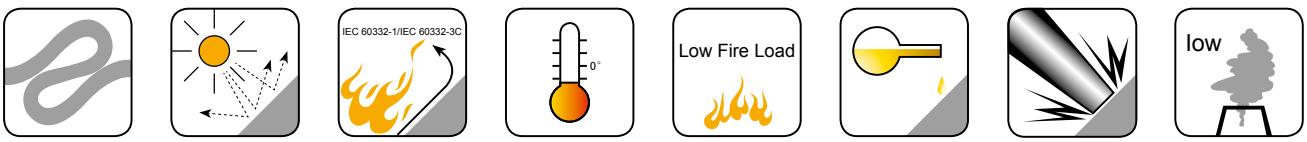
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

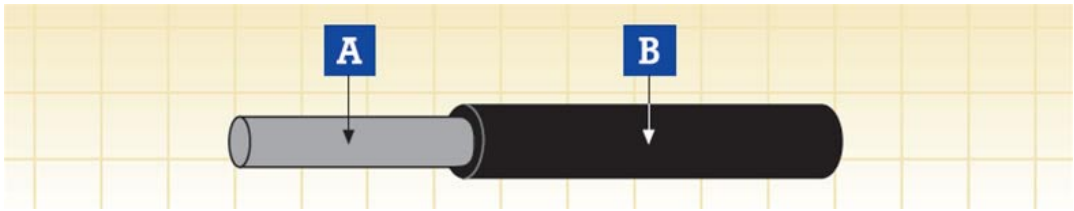
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
12	1.0	32/0.2	20.3	309	20.0
42	1.5	30/0.25	38.1	1775	13.7



RSE/STD/024 Part 6 Types I Rolling Stock Cables
600/1000V Multicore Reduced Wall Unsheathed Cables



A.Conductor B.Insulation

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction
Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

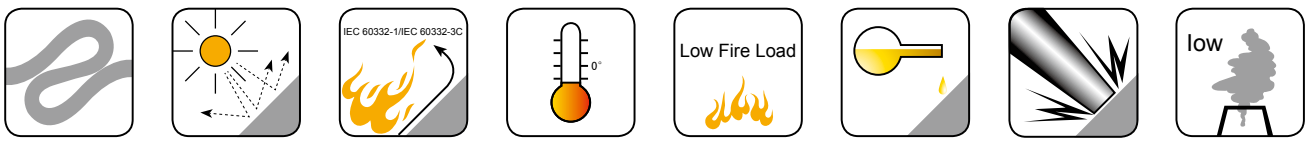
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

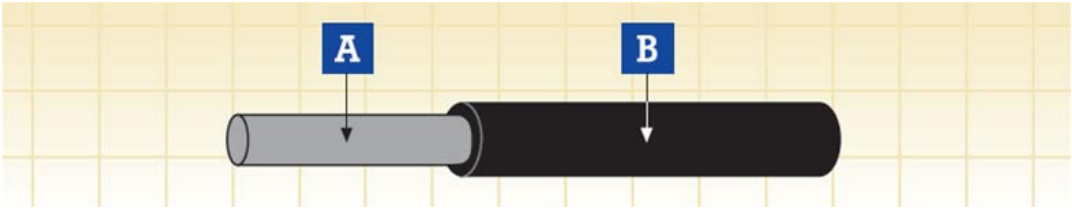
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.5	19/0.18	1.5	6	40.1
1	0.75	37/0.16	1.76	9	26.7
1	1.0	37/0.18	1.9	11	20.0
1	1.5	37/0.23	2.25	17	13.7
1	2.5	37/0.30	2.84	28	8.21
1	4.0	37/0.37	3.44	42	5.09



RSE/STD/024 Part 6 Types II Rolling Stock Cables
600/1000V Multicore Standard Wall Unsheathed Cables



A.Conductor B.Insulation

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction
Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

Fire Performance for rolling stock application

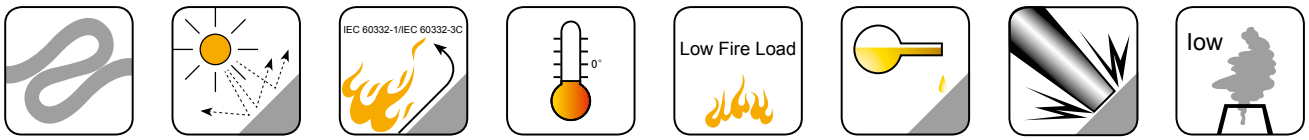
EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

Fire Performance in general

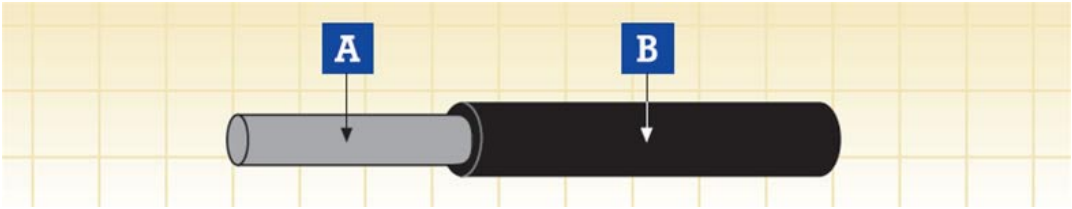
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	0.75	24/0.20	2.99	15	26.7
1	1.0	32/0.20	3.3	19	20.0
1	1.5	30/0.25	3.69	26	13.7
1	2.5	50/0.25	4.16	38	8.21
1	4.0	56/0.30	4.95	57	5.09
1	6.0	84/0.30	5.55	81	3.39
1	10.0	80/0.40	7.0	135	1.94
1	16.0	128/0.40	8.35	202	1.24
1	25.0	196/0.40	10.2	309	0.795
1	35.0	276/0.40	11.75	404	0.565

1	50.0	396/0.40	13.7	562	0.393
1	70.0	360/0.50	16.25	768	0.277
1	95.0	476/0.50	18.05	1003	0.210
1	150.0	756/0.50	22.95	1583	0.132
1	240.0	1221/0.50	27.9	2516	0.0817
1	300.0	1525/0.50	31.35	3089	0.0654



RSE/STD/024 Part 6 Types III Rolling Stock Cables
600/1000V Multicore Enhanced Wall Unsheathed Cables



A.Conductor B.Insulation

Application
These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction
Conductor
Flexible Stranded Tinned Copper

Insulation
Cross linked EPR rubber type EI 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

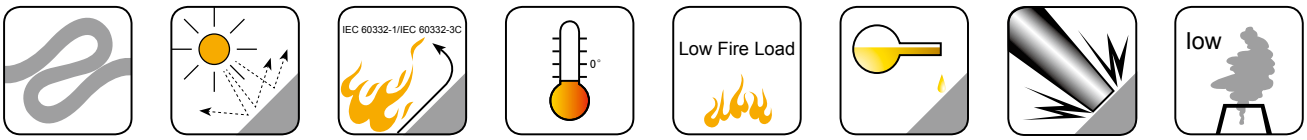
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

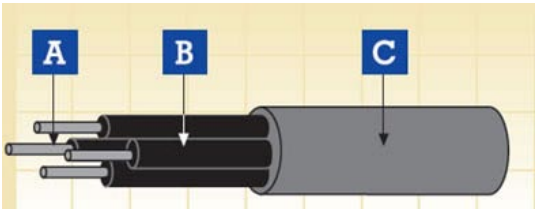
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
1	50.0	396/0.40	16.45	657	0.393
1	70.0	360/0.50	18.35	873	0.277
1	95.0	476/0.50	19.5	1108	0.210
1	150.0	756/0.50	24.1	1663	0.132
1	185.0	925/0.50	26.5	2024	0.108
1	240.0	1221/0.50	29.0	2598	0.0817
1	300.0	1525/0.50	31.0	3181	0.0654



RSE/STD/024 Part 6 Types VI Rolling Stock Cables 600/1000V Multicore Standard Wall Cables



A.Conductor B.Insulation C.Sheath

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction

Conductor

Flexible Stranded Tinned Copper

Insulation

Cross linked EPR rubber type EI 107

Sheath

Cross linked EVA rubber type EM 104

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

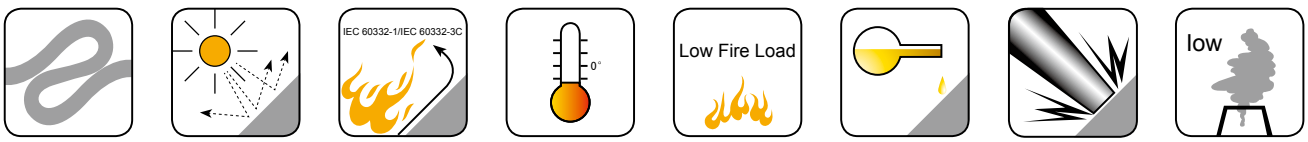
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

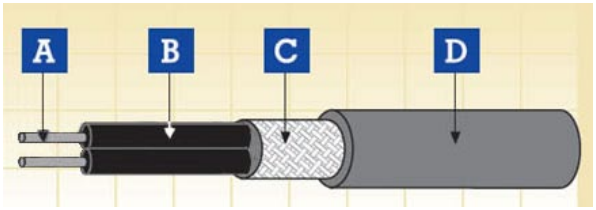
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of core	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm^2	No/mm	mm	kg/km	Ω/km
10	2.5	50/0.25	28.1	1148	8.21
20	4.0	56/0.30	42.7	2421	5.09



RSE/STD/024 Part 6 Types XI Rolling Stock Cables 600/1000V Singlepair Reduced Wall Screened Cables



A.Conductor B.Insulation C.Screen D.Sheath

Application

These cables are used as power and control cables for protected, fixed installation inside railway vehicles

Construction

Conductor

Flexible Stranded Tinned Copper

Insulation

Cross linked EPR rubber type EI 107

Screen

Copper Braid Screen

Sheath

Cross linked EPR rubbe type EM 107

Chemical & Environmental Properties

EN 60684-2	No fluorine
EN 50305; EN 60811-2-1	Resistance to oil & fuel
EN 50305	Resistance to ozone

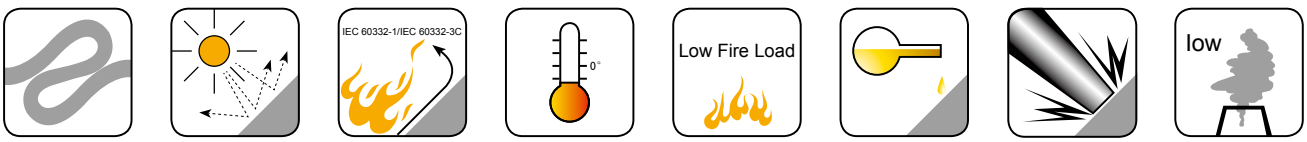
Fire Performance for rolling stock application

EN 50306-2	Hazard levels HL1, HL2/HL3, HL4
DIN 5510-2	Protection level 1/2/3/4
BS 6853	Interior use 1a, 1b, II; Exterior use 1a, 1b, II
NF F 16-101	FO

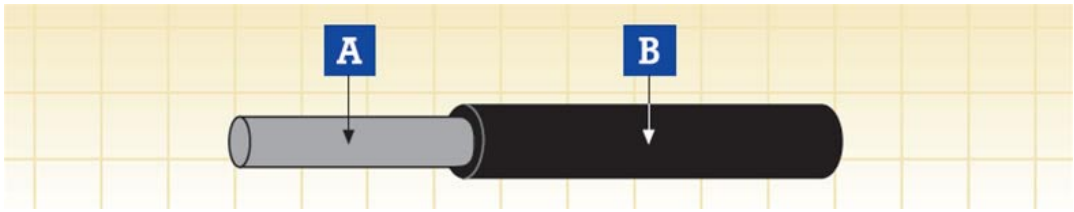
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propogation for a single insulated wire/cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

No.of Pair	Nominal Cross Sectional Area	Nominal Diameter of Strands	Nominal Overall Diameter	Nominal Weight	Maximum Conductor Resistance@20℃
	mm²	No/mm	mm	kg/km	Ω/km
1	1.0	37/0.18	7.3	76	20.0



NF F 63-808 Thin Wall Unsheathed Single Core 250 V



A. Conductor B. Insulation

Application

These cables are used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor, suitable for used in cable harnesses, switchboards and control panels, driver desks etc

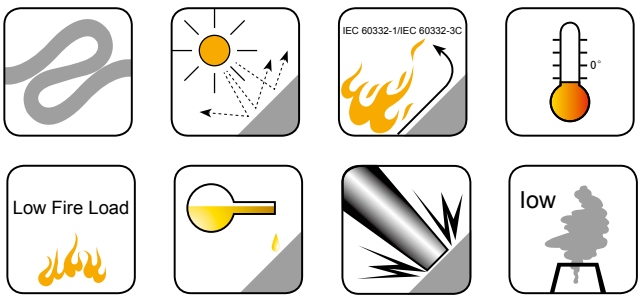
Construction

Conductor

Stranded tinned copper wires

Insulation

Radiation crosslinkable LSZH compound



Electrical & Mechanical Properties

Nominal Voltage	250V
Maximum Conductor Temperature	+105/+125℃
Temperature Range	-40℃ ~105℃
Bending Radius	5×OD

Standards

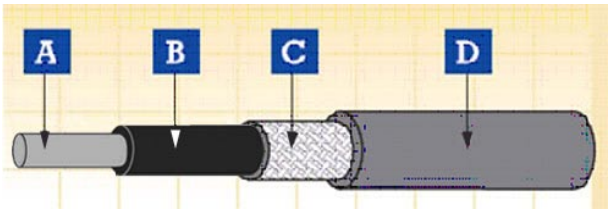
NF F 63-808
NF F 16-101
BS 6853
DIN 5510

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Overall Diameter		Weight
		Min.	Max.	
mm²	No/mm	mm	mm	kg/km
0.38	19/0.16	1.15	1.35	4.7
0.60	19/0.20	1.30	1.55	6.5
0.93	19/0.25	1.55	1.80	9.9
1.34	19/0.30	1.80	2.00	14.0
1.82	37/0.25	2.10	2.40	18.4
2.61	37/0.30	2.50	2.80	27.8
4.32	61/0.30	3.00	3.30	44.2

NF F 63-808 Thin Wall Screened Single Core 250 V

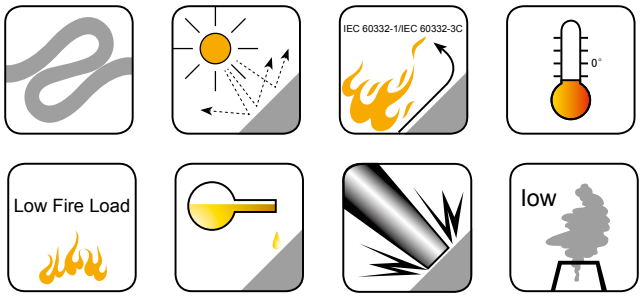


A. Conductor B. Insulation C. Screen D. Sheath

Application

These cables are used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor, suitable for used in cable harnesses, switchboards and control panels, driver desks etc

Construction



Conductor
Stranded tinned copper wires

Insulation
Radiation crosslinkable LSZH compound

Screen
Tinned copper braid

Sheath
Radiation crosslinkable LSZH compound

Electrical & Mechanical Properties

Nominal Voltage	250 V
Maximum Conductor Temperature	+105/+125℃
Temperature Range	-40℃ ~105℃
Bending Radius	5×OD

Standards

NF F 63-808
NF F 16-101
BS 6853
DIN 5510

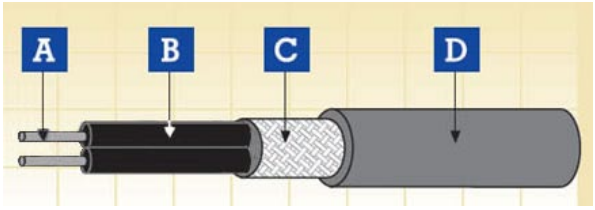
Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

NF F 63-808 Rolling Stock Cables

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Overall Diameter		Weight
		Min.	Max.	
mm²	No/mm	mm	mm	kg/km
0.38	19/0.16	2.05	2.55	11.5
0.60	19/0.20	2.30	2.80	15.0
0.93	19/0.25	2.50	3.00	18.8
1.34	19/0.30	2.70	3.20	24.2
1.82	37/0.25	3.30	3.75	32.0
2.61	37/0.30	3.60	4.20	43.0
4.32	61/0.30	4.15	4.75	63.0

NF F 63-808 Thin Wall Screened Multicore 250 V



A. Conductor B. Insulation C. Screen D. Sheath

Application

These cables are used as signal and control cable for protected installations inside and outside of rail and transport vehicles, where space and weight are an important factor, suitable for used in cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor
Stranded tinned copper wires

Insulation
Radiation crosslinkable LSZH compound

Screen
Tinned copper braid

Sheath
Radiation crosslinkable LSZH compound

Electrical & Mechanical Properties

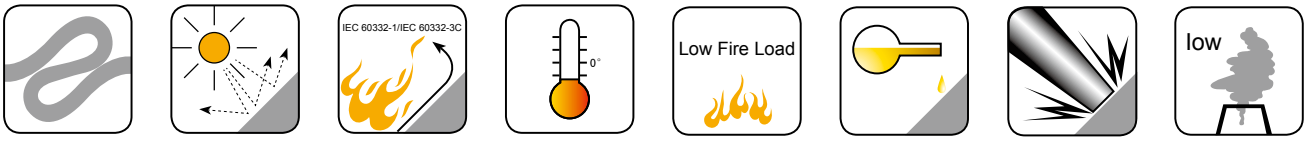
Nominal Voltage	250 V
Maximum Conductor Temperature	+105/+125℃
Temperature Range	-40℃ ~105℃
Bending Radius	5×OD

Standards

NF F 63-808
NF F 16-101
BS 6853
DIN 5510

Fire Performance in general

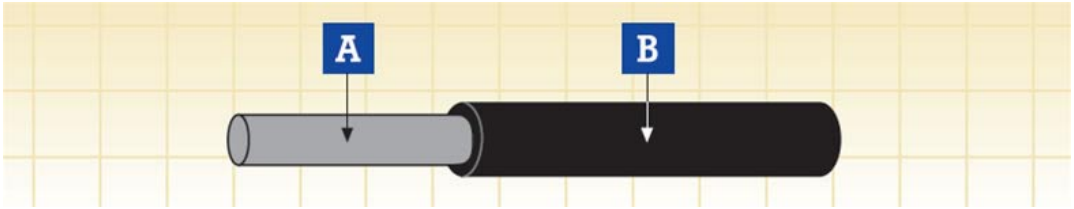
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



NF F 63-808 Rolling Stock Cables

Number of Cores	Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Overall Diameter		Weight
			Min.	Max.	
-	mm²	No/mm	mm	mm	kg/km
2	0.38	19/0.16	3.20	4.00	20.0
2	0.60	19/0.20	3.70	4.50	32.0
2	0.93	19/0.25	4.25	5.05	39.5
2	1.34	19/0.30	4.80	5.60	54.0
2	1.82	37/0.25	5.55	6.35	66.0
2	2.61	37/0.30	6.35	7.15	87.0
2	4.32	61/0.30	7.50	8.30	128.0
3	0.38	19/0.16	3.55	4.35	30.0
3	0.60	19/0.20	4.00	4.80	39.0
3	0.93	19/0.25	4.50	5.30	55.0
3	1.34	19/0.30	5.10	5.90	66.0
3	1.82	37/0.25	4.80	6.60	84.0
3	2.61	37/0.30	6.80	7.60	117.0
3	4.32	61/0.30	8.10	8.90	182.0
4	0.38	19/0.16	4.05	4.85	39.0
4	0.60	19/0.20	4.50	5.30	51.0
4	0.93	19/0.25	5.00	5.80	70.0
4	1.34	19/0.30	5.70	6.50	89.0
4	1.82	37/0.25	6.45	7.25	109.0
4	2.61	37/0.30	7.65	8.45	157.0
4	4.32	61/0.30	9.05	9.85	237.0

NF F 63-826 Standard Wall Unsheathed Single Core 500V, 1000V, 1500V, 3000V



A. Conductor B. Insulation

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

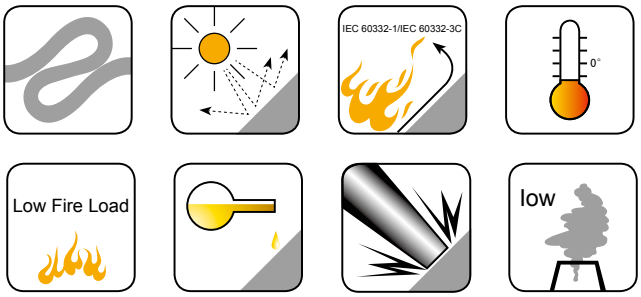
Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 5

Insulation

Special halogen free compound



Electrical & Mechanical Properties

Nominal Voltage	500V, 1000V, 1500V, 3000V
Maximum Conductor Temperature	+90/+105℃
Temperature Range	-25℃ ~90℃
Bending Radius	4×OD

Standards

NF F 63-826
NF F 16-101
BS 6853

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index

500V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
1.0	32/0.20	1.3	3.8	4.5	26
1.5	30/0.25	1.3	4.1	4.8	33
2.5	50/0.25	1.3	4.5	5.2	43
4.0	56/0.30	1.3	5.0	5.8	59
6.0	84/0.30	1.4	5.7	6.5	82
10.0	80/0.40	1.5	6.9	8.1	135
16.0	126/0.40	1.5	8.2	9.2	210

1000V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
1.5	30/0.25	1.5	4.4	5.2	42
2.5	50/0.25	1.5	4.8.	5.6	55
4.0	56/0.30	1.5	5.4	6.2	72
6.0	84/0.30	1.6	6.1	6.9	96
10.0	80/0.40	1.6	7.0	8.3	154
16.0	126/0.40	1.6	8.3	9.4	218
25.0	196/0.40	1.7	9.8	11.0	316
35.0	276/0.40	1.8	11.2	12.5	440
50.0	396/0.40	1.9	13.0	14.3	580
70.0	360/0.50	2.0	14.7	16.3	830
95.0	475/0.50	2.0	16.6	18.4	1040
120.0	608/0.50	2.1	18.6	20.5	1310

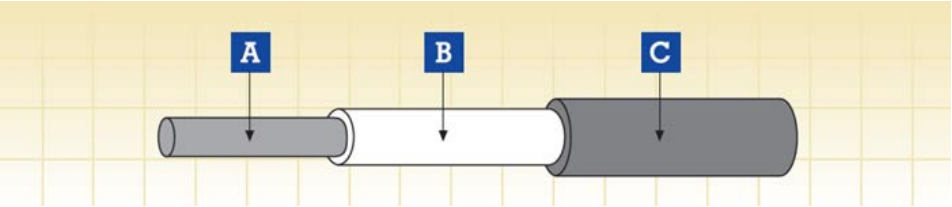
1500V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
1.5	30/0.25	2.3	6.0	6.8	59
2.5	50/0.25	2.3	6.4	7.2	73
4.0	56/0.30	2.3	7.0	7.8	91
6.0	84/0.30	2.3	7.5	8.3	120
10.0	80/0.40	2.3	8.4	9.7	160
16.0	126/0.40	2.3	9.7	10.8	235
25.0	196/0.40	2.3	11.0	12.2	330
35.0	276/0.40	2.4	12.4	13.7	480
50.0	396/0.40	2.5	14.2	15.5	610
70.0	360/0.50	2.7	16.1	17.7	860
95.0	475/0.50	2.7	18.0	19.8	1070
120.0	608/0.50	2.8	20.0	21.9	1340
150.0	756/0.50	2.8	21.8	23.8	1620
185.0	925/0.50	2.9	23.7	25.9	1940
240.0	1221/0.50	3.1	26.6	29.1	2550
300.0	1525/0.50	3.45	29.4	31.9	2950

3000V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
2.5	50/0.25	3.1	8.0	8.8	94
4.0	56/0.30	3.1	8.5	9.5	124
6.0	84/0.30	3.1	8.8	9.9	135
10.0	80/0.40	3.1	10.0	11.3	200
16.0	126/0.40	3.1	11.2	12.4	265
25.0	196/0.40	3.1	12.5	13.8	375
35.0	276/0.40	3.2	13.9	15.3	493
50.0	396/0.40	3.3	15.7	17.2	680
70.0	360/0.50	3.4	17.5	19.1	930
95.0	475/0.50	3.5	19.5	21.4	1066
120.0	608/0.50	3.6	21.6	23.5	1530
150.0	756/0.50	3.6	23.3	25.5	1740
185.0	925/0.50	3.7	25.2	27.6	2100
240.0	1221/0.50	3.9	28.1	31.7	2460
300.0	1525/0.50	4.45	31.4	35.0	3050

NF F 63-826 Standard Wall Sheathed Single Core 1500V, 3000V



A. Conductor B. Insulation C. Sheath

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 5

Insulation

Halogen free compound

Sheath

Halogen free compound

Electrical & Mechanical Properties

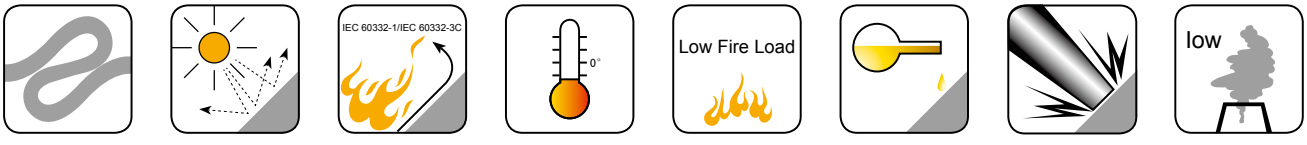
Nominal Voltage	1500V, 3000V
Maximum Conductor Temperature	+90/+105℃
Temperature Range	-25℃ ~90℃
Bending Radius	4×OD

Standards

NF F 63-826
NF F 16-101
BS 6853

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



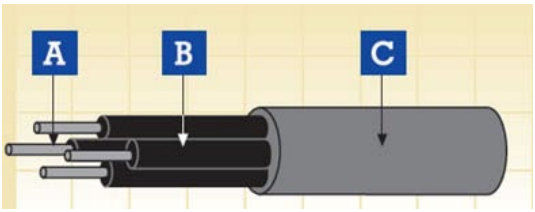
1500V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Nominal Sheath Thickness	Overall Diameter		Weight
				Min.	Max.	
mm²	No/mm	mm	mm	mm	mm	kg/km
1.5	30/0.25	2.3	1.5	8.9	9.9	130
2.5	50/0.25	2.3	1.5	9.3	10.3	145
10.0	80/0.40	2.3	1.8	11.9	13.3	290
50.0	396/0.40	2.5	2.2	18.3	20.3	850
120.0	608/0.50	2.8	2.6	25.0	27.5	1770
150.0	756/0.50	2.8	2.6	26.7	29.3	2150
185.0	925/0.50	2.9	2.8	29.0	31.8	2530

3000V

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Nominal Sheath Thickness	Overall Diameter		Weight
				Min.	Max.	
mm²	No/mm	mm	mm	mm	mm	kg/km
150.0	756/0.50	3.6	2.6	28.2	30.9	2270
185.0	925/0.50	3.7	2.8	30.5	33.4	2660

NF F 63-826 Standard Wall Unscreened Multicore 500V



A. Conductor B. Insulation C. Sheath

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 5

Insulation

Halogen free compound

Sheath

Halogen free compound

Electrical & Mechanical Properties

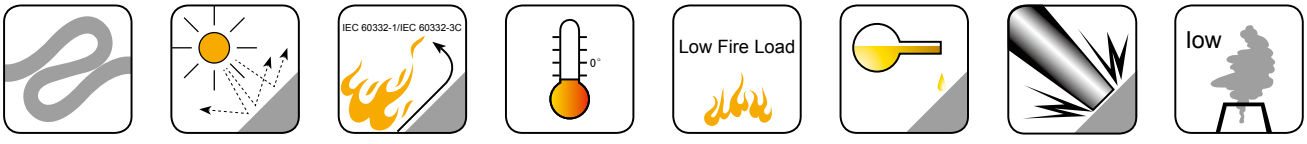
Nominal Voltage	500V
Maximum Conductor Temperature	+90/+105℃
Temperature Range	-25℃ ~90℃
Bending Radius	4×OD

Standards

NF F 63-826
NF F 16-101
BS 6853

Fire Performance in general

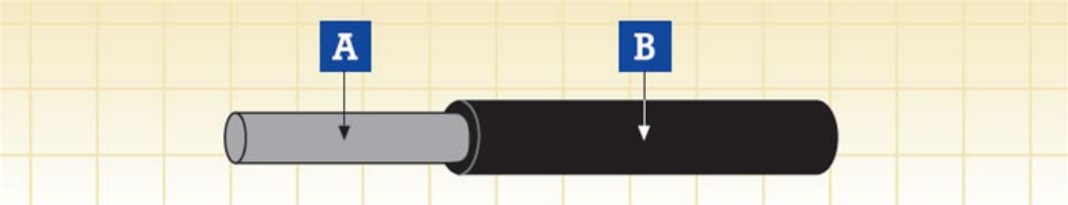
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



NF F 63-826 Rolling Stock Cables

Number of Cores	Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Sheath Thickness	Overall Diameter		Weight
				Min.	Max.	
-	mm²	No/mm	mm	mm	mm	kg/km
2	1.5	30/0.25	1.0	8.6	9.9	115
4	1.5	30/0.25	1.1	10.1	11.4	160
7	1.5	30/0.25	1.1	11.9	13.3	245
13	1.5	30/0.25	1.2	16.5	18.0	425
19	1.5	30/0.25	1.2	18.3	19.9	675
37	1.5	30/0.25	1.5	25.1	27.1	1170
2	2.5	50/0.25	1.1	10.0	11.3	185
4	2.5	50/0.25	1.2	11.7	13.1	275
13	2.5	50/0.25	1.4	19.5	21.1	750
19	2.5	50/0.25	1.4	21.6	23.4	980

NF F 63-826 Extra-Flexible Standard Wall Unsheathed Single Core 1500V



A. Conductor B. Insulation

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 6

Insulation

Special halogen free compound

Electrical & Mechanical Properties

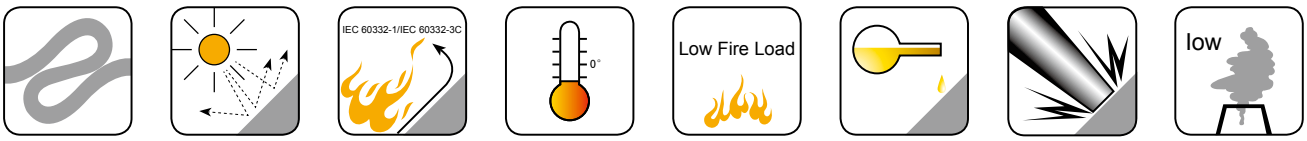
Nominal Voltage	1500V
Maximum Conductor Temperature	+90/+105℃
Temperature Range	-25℃ ~90℃
Bending Radius	3×OD

Standards

NF F 63-826
NF F 16-101
BS 6853

Fire Performance in general

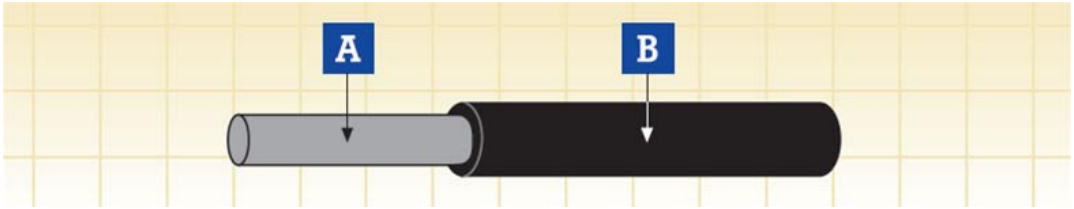
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



NF F 63-826 Rolling Stock Cables

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
10.0	320/0.20	2.3	8.4	9.5	187
16.0	512/0.20	2.3	9.7	10.8	266
25.0	800/0.20	2.3	11.0	12.2	354
35.0	1120/0.20	2.4	12.4	13.7	440
50.0	705/0.30	2.5	14.2	15.5	613
70.0	990/0.30	2.7	16.1	17.7	875
95.0	1340/0.30	2.7	18.0	19.8	1045
120.0	1690/0.30	2.8	20.0	21.9	1350
150.0	2123/0.30	2.8	21.8	23.8	1650
185.0	1470/0.40	2.9	23.7	25.9	2130

NF F 63-827 High Temperature Unsheathed Single Core 3000V



A. Conductor B. Insulation

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 5

Separator

Polyester tape

Insulation

Silicone halogen free rubber

Electrical & Mechanical Properties

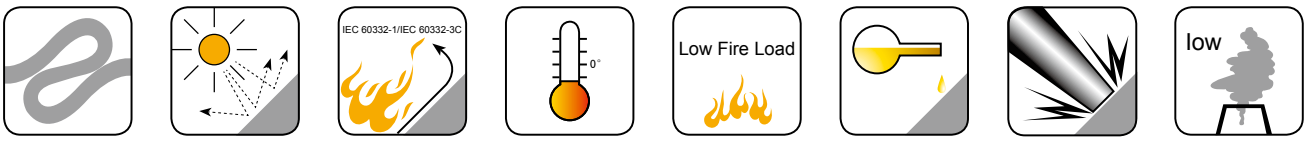
Nominal Voltage	3000V
Maximum Conductor Temperature	+120/+140℃
Temperature Range	-40℃ ~135℃
Bending Radius	4×OD

Standards

NF F 63-827
NF F 16-101

Fire Performance in general

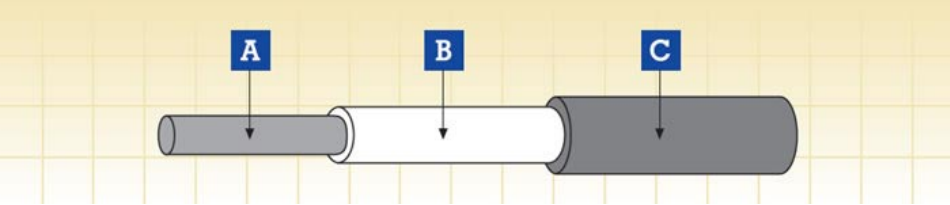
EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



NF F 63-827 Rolling Stock Cables

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
2.5	50/0.25	2.3	6.4	7.2	65
4.0	56/0.30	2.3	7.0	7.8	85
6.0	84/0.30	2.3	7.5	8.3	108
10.0	80/0.40	2.3	8.4	9.5	160
16.0	126/0.40	2.3	9.7	10.8	230
25.0	196/0.40	2.3	11.0	12.2	310
35.0	276/0.40	2.4	12.2	13.5	420
50.0	396/0.40	2.5	14.2	15.5	580
70.0	360/0.50	2.7	16.1	17.7	790
95.0	475/0.50	2.7	18.0	19.8	1030
120.0	608/0.50	2.8	20.0	21.9	1250
150.0	756/0.50	2.8	21.8	23.8	1560
185.0	925/0.50	2.9	23.7	25.9	1880
240.0	1221/0.50	3.1	26.6	29.1	2420

NF F 63-827 Extra-Flexible High Temperature Sheathed Single Core 3000V



A. Conductor B. Insulation C. Sheath

Application

These cables are used as power and control cable for protected installations inside and outside of rail and transport vehicles, where handling and installation cost are an important factor, suitable for used in control, auxiliary and main circuit wiring such as cable harnesses, switchboards and control panels, driver desks etc.

Construction

Conductor

Stranded tinned copper wires to IEC 60228 Class 6

Insulation

Silicone halogen free rubber

Reinforcement

Textile braid

Sheath

Silicone halogen free rubber

Electrical & Mechanical Properties

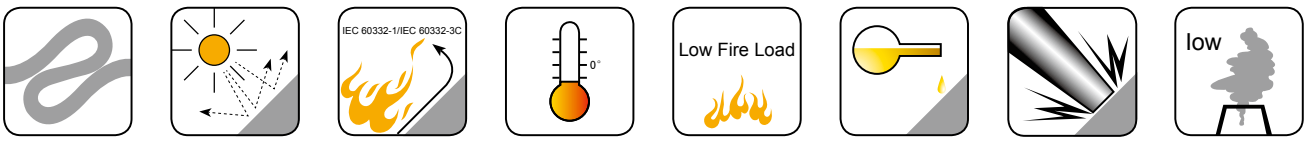
Nominal Voltage	3000V
Maximum Conductor Temperature	+120/+140℃
Temperature Range	-40℃ ~135℃
Bending Radius	3×OD

Standards

NF F 63-827
NF F 16-101

Fire Performance in general

EN 50265-2-1; IEC 60332-1; BS 4066-1	Vertical flame propagation for a single insulated wire or cable
EN 50266-2-4 + EN 50305; IEC 60332-3C; VDE 0472 Teil 804; BS 4066-3; NFC 32070	Fire propagation of bunched wires and cables;
EN 50268-2; IEC 61034-2; VDE 0472 Teil 816	Smoke density
EN 50267-2-1; IEC 60754-1; VDE 0472 Teil 815	Halogen Free
EN 50267-2-2/3; IEC 60754-2; VDE 0472 Teil 813	Corrosivity of gases (Acidity & Conductivity)
EN 50305; NFX 70-100; NFF 63808; TM1-04; BS6853	Toxicity index
NFF 16101; NFF 63808; BS6853	Smoke index



NF F 63-827 Rolling Stock Cables

Nominal Cross Sectional Area	Number & Nominal Diameter of Strands	Nominal Insulation Thickness	Overall Diameter		Weight
			Min.	Max.	
mm²	No/mm	mm	mm	mm	kg/km
25.0	800/0.20	2.8	12.0	13.2	390
35.0	1120/0.20	2.8	13.2	14.7	500
50.0	705/0.30	3.0	15.2	16.7	680
70.0	990/0.30	3.2	17.1	18.8	930
95.0	1340/0.30	3.2	19.0	21.0	1150
120.0	1690/0.30	3.3	21.0	23.1	1470
150.0	2123/0.30	3.3	22.8	25.0	1800
185.0	1470/0.40	3.4	24.7	27.1	2240
240.0	1905/0.40	3.6	27.6	31.2	2820

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