WIRES
CABLES

FLEXFORCE®

FLEXIBLE POWER CABLES

axon'

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FLEXFORCE®

FLEXIBLE POWER CABLES

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CONSTRUCTION

THIS CATALOGUE IS INTENDED AS A GUIDE TO HELP SELECTION OF AXON' PRODUCTS.
THE INFORMATION IN THIS CATALOGUE IS ACCURATE TO THE BEST OF OUR KNOWLEDGE AT TIME OF GOING TO PRINT, HOWEVER, AXON' CANNOT BE HELD LIABLE FOR ANY ERRORS MADE AS A RESULT, INFORMATION CONTAINED HEREIN.
CHANGES AND MODIFICATIONS CAN BE MADE TO THIS BROCHURE AT ANY TIME WITHOUT PRIOR NOTICE.
FLEXFORCE®, CELLOFLON® & VIBRAFLAME® ARE REGISTERED TRADEMARKS OF AXON' CABLE -
DESIGN STUDIO NAD - PHOTOS: BASTIEN GILBERT - FRED LAURES - AXON' CABLE

GENERAL INFORMATION

AXON' CABLE has gathered more than 40 years of experience in the design and manufacture of wires, cables and interconnect solutions for advanced technologies.

FLEXFORCE® cables are intended for applications where high currents have to be carried. Insulated with special AXON' compounds, halogen free or FEP materials FLEXFORCE® are suited for use in the most severe environments.

APPLICATIONS

FLEXFORCE® flexible power cables have been designed for applications where high currents have to be carried, such as:

- Armoured vehicles (power distribution, help start cables, hybrid electric drives, auxiliary power and control systems, engine management, active armour, ...),
- Tanks,
- Remote weapon systems,
- Radar systems: high power radars, airborne radars, ...
- Mast systems,
- Public transport: tramways, metro, ...
- Cars (electric drives, ...)
- Robots,
- Ships, ...

FLEXFORCE® CABLE

BENEFITS

Flexibility better than IEC 228 class 6

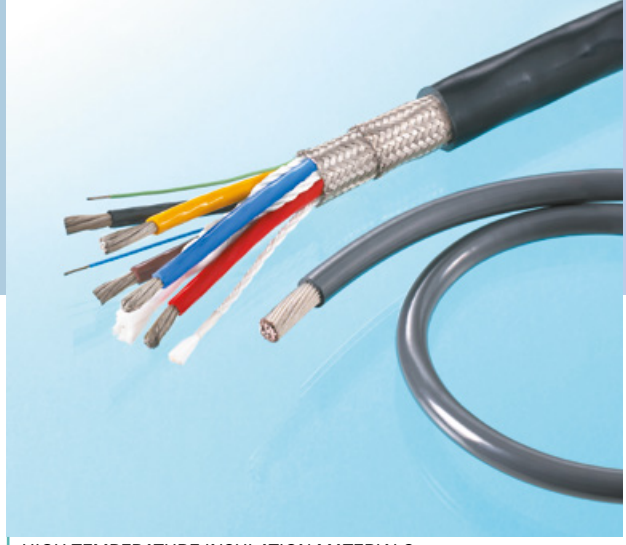
IEC 228 standard defines flexibility of cables by characterizing the conductor strands. The smallest and most flexible strands are defined as «class 6». AXON' uses strands which diameters are even smaller than the strands defined in «class 6».
In addition to extra-flexible tin plated multi-strand copper conductors and separating tapes under the outer jacket, AXON' uses special assembling techniques, improving the flexibility of FLEXFORCE®.
Flexibility is important to ease installation of FLEXFORCE® power cables in space reduced environments.
For dynamic applications AXON' has tested a 25 mm² halogen free FLEXFORCE® cable. With a bend radius of 80 mm and a bending angle of 90° this cable withstands more than 1 million flex cycles.

Big cross section areas

FLEXFORCE® power cables are available in sections 10/16/25/35/50/70/95/120/150/185 mm².

Increased current carrying capacity

The choice of AXON's flexible conductors and high temperature insulation materials (better than common insulation materials) allow high current carrying capacities. For example 330 Amps for a 50 mm² FLEXFORCE® wire FFR 050 at 30°C.



HIGH TEMPERATURE INSULATION MATERIALS

High and low temperature resistant, flame-retardant and halogen free insulation materials

FLEXFORCE® power cables are offered with three different high temperature insulation materials:

- Halogen free insulation: -40°C/ +125°C during 3 000h,
- ASC 15 (AXON' SPECIAL COMPOUND: special high temperature thermoplastic elastomer): -40°C/+150°C during 3 000 h,
- FEP: -90°C/+200°C during 20 000 h.

Voltage rating

Usually 600 VAC or 1000 VAC.
Cables suited for higher voltage ratings can be proposed on request.

Mechanical resistance

FLEXFORCE® power cables allow for excellent abrasion and cut-through resistance tested according to SEFT 027.

Chemical resistance

FLEXFORCE® power cables resist to different engine fluids:

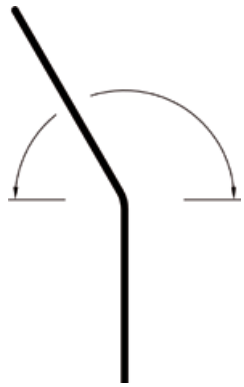
- Hydraulic liquid,
- Mineral oil,
- Gasoline,
- Diesel.

Specific marking

AXON ' can identify their cables with a custom marking: batch number, date, customer name, etc.

Reduced cable dimensions

As FLEXFORCE® cables are able to carry higher currents than common standard cables with the same conductor section, you can choose a FLEXFORCE® cable of smaller dimensions.



ALTERNATE MOVEMENT OF THE MECHANICAL TEST

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GENERAL INFORMATION

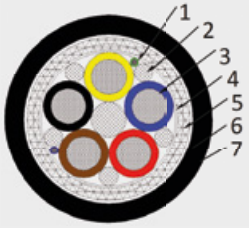
EXPERTISE IN CONDUCTOR

AXON' manufacture their own single-stranded or multi-stranded precision conductors made with different materials and platings which meet the most stringent electrical and mechanical requirements.

EXPERTISE IN PRIMARY INSULATION AND JACKETING

AXON' master different insulations techniques - thermoplastic extrusion, PTFE extrusion and taping – and are able to insulate their wires and cables with many different materials

- Fluorinated materials (PTFE, FEP, ETFE, PFA), PEEK, polyimide, ...
- Irradiated insulation (XI-ETFE),
- Metal free insulating materials,
- CELLOFLON® (patented expanded PTFE) with a low dielectric constant (1.35),
- Polyimide for radiation resistance,
- VITAX™ fluorinated elastomers for chemical and aggressive environments, including high temperatures (+ 230°C) and abrasion,
- Halogen free insulating materials,
- VIBRAFLAME® insulated composite cables able to withstand extreme temperatures (-196°C/+1565°C peak temperatures),
- Special materials developed by our plastics specialists.



1. Two insulated wires with TPC conductor.
2. Fillers.
3. Five insulated wires with TPC conductor.
4. Maintaining tape.
5. Optimized double braided tin plated copper shield.
6. Separating tape.
7. Extruded outer jacket.

TYPICAL HYBRID CABLE CONSTRUCTION

EQUIVALENCE TABLE

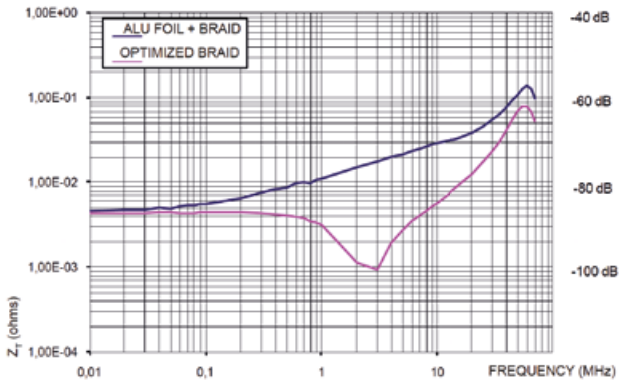
CROSS SECTION mm²	APPROXIMATE AWG
10	7
16	5
25	3
35	2
50	1/0
70	2/0
95	4/0
120	
150	
185	

EXPERTISE IN HYBRID CABLE CONSTRUCTION

Different custom designed cable configurations can be offered including several single power cables, braided tin plated copper shields and an extruded jacket.
In a composite cable, signal wires can be added to power wires. Depending on the type of connection, these wires can be used as pilot wires. They will drive power supply during connection and disconnection to avoid electric damages (e.g. sparks).

ELECTROMAGNETIC PROTECTION

AXON's expertise in EMI protection is based on different shielding techniques – helicoidal shielding, shielding braids or tapes.
Shielding efficiency can be improved by optimizing the shielding bundles, diameters of shielding strands as well as braiding angles. The AXON' EMI/EMC laboratory is equipped with comprehensive test benches to control transfer impedance and has been approved by the French Army to carry out EMC measurements.



TRANSFER IMPEDANCE FOR SHIELDED FFR 050

CABLE TERMINATION

FLEXFORCE® power cables can be terminated with standard cable lugs and power connectors.

FLEXFORCE® TERMINATION

QUALITY ASSURANCE

Approvals

- ISO 9001,
- ISO 14001,
- ISO 13485,
- EN 9100,
- ISO 45001.

In-house test equipment

- Physical characteristics: full material analysis.
- Chemical characteristics: resistance to oils, solvents, ...
- Electrical characteristics: automatic continuity and insulation testing, dielectric strength, current flow, transfer impedance (shield efficiency), ...
- Climatic characteristics: resistance to salt spray, thermal shock, flame, accelerated ageing, ...
- Mechanical characteristics: resistance to flexion, torsion, winding, vibration, shock, ...

GENERAL INFORMATION

CURRENT - CARRYING CAPACITY

The "current-carrying capacity" is the maximum electrical current a conductor can carry before being deteriorated. The current – carrying capacity of a cable depends on:

- the temperature rating of the insulation material,
- the electrical resistance of the different materials used,
- the frequency of the current, in the case of alternating current,
- the ability to dissipate heat, which depends on cable geometry and its surroundings,
- ambient temperature.

All electrical conductors have some resistance to the flow of electricity, and electric current flowing through them causes voltage drop and power dissipation, which heats the cable. Metal materials like copper or aluminum can conduct a large amount of current before melting, but long before the conductors melt, their insulation would be damaged by the heat.

The current carrying capacity of a power cable thus depends on:

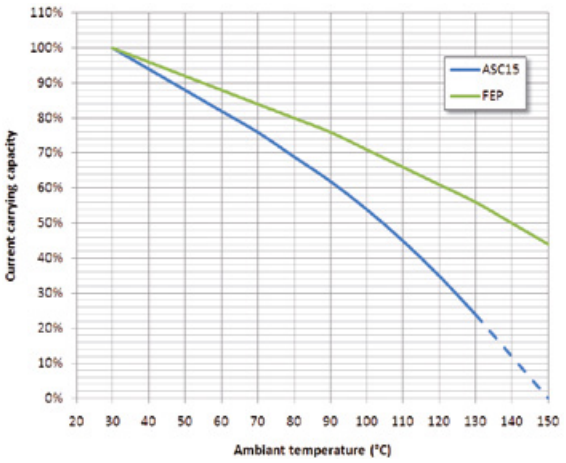
- the physical and electrical properties of the conductor and insulation materials,
- the cable's construction,
- ambient temperature,
- environmental conditions adjacent to the cable.

Having a large overall surface area may dissipate heat better if the environment can absorb the heat.

The following graphs help to choose the FLEXFORCE® cable taking into account these criteria.

Example 1

How to choose a Flexforce® single wire in function of the temperature ?

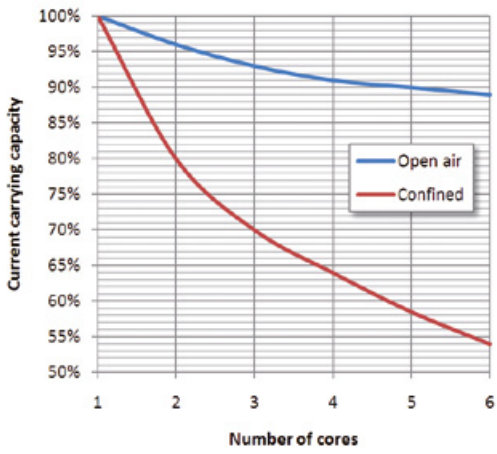


AN ASC 15 INSULATED SINGLE FFR WIRE, HAS TO CARRY A CURRENT OF 113A AT 100°C. REFERRING TO GRAPH 1, AT 100°C THE WIRE CAN ONLY CARRY 54% OF THE CURRENT, IT WOULD HAVE BEEN ABLE TO CARRY AT 30°C.

TO BE USED AT 100°C THE WIRE WILL NEED TO CARRY AROUND 210A (CALCULATION : 210 X 0.54 = 113A) AND A FFR025 WIRE WILL BE CHOSEN. ASC 15 INSULATION HAS GOT A TEMPERATURE RESISTANCE UP TO 150°C. FOR THIS APPLICATION, FEP IS ALSO LIMITED TO 150°C, DUE TO THE USE OF TPC CONDUCTORS.

Example 2

How to define the current carrying capacity of a Flexforce® bundle working in confined space ?



IN A VEHICLE, TWO FFR070 WIRES WITH 70 MM² CONDUCTOR SECTION ARE ROUTED IN A PIPE. AT 30°C, EACH OF THEM IS ABLE TO CARRY 420A. AS THE OPERATING TEMPERATURE IS 100°C, THE CURRENT CARRYING CAPACITY IS ONLY 54% (SEE GRAPH 1 ABOVE). CALCULATION: 0.54 X 420 A = 226A
IN ADDITION, DUE TO THE CONFINED INSTALLATION, THE TWO WIRES CAN ONLY WORK AT 80% OF THEIR CAPACITY (SEE GRAPH 2). AS A CONSEQUENCE, THE CURRENT SHOULD NOT EXCEED 180A. CALCULATION : 0.80 X 226A = 180A

AXON' REFERENCE IDENTIFICATION CODE

SHIELDED JACKETED CABLE

SINGLE WIRE

IDENTIFICATION CODE	FF	R	010	ST	R	1	(0 Hal)

SERIES

FF: Flexforce®

PRIMARY INSULATION MATERIAL

R: ASC 15 - 600 VAC
RR: ASC 15 - 1000 VAC
KK: FEP 1000 VAC

CONDUCTOR AREA

mm^2

STANDARD BRAID

Tin plated copper braid

OUTER JACKET

R: ASC 15

SINGLE CORE CABLE

IF «(0 Hal)» SPECIFIED

Primary insulation is different halogen free flexible thermplastic compound.
Separating tape is halogen free.

ASC 15 is not Halogen Free, but is flame retardant.

FOR FURTHER INFORMATION, OUR SALES TEAM IS AT YOUR DISPOSAL FOR ANY ADVICE YOU MAY REQUIRE.

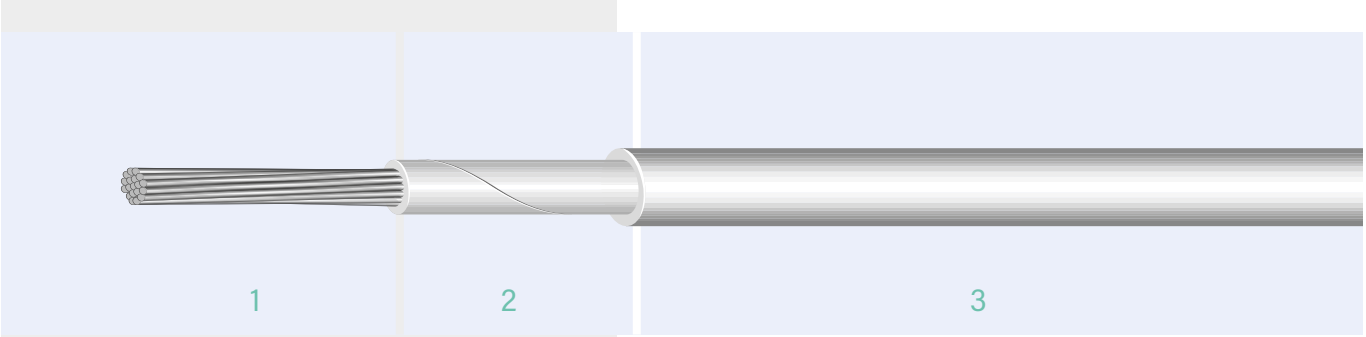
SINGLE WIRES ASC 15 INSULATED WIRES

TYPE FFR xxx

Insulation: ASC 15

Operating temperature: -40°C up to +150°C

Operating voltage: 600 VAC



Construction

1. Extra flexible tin plated copper conductor.
2. Separating tape.
3. ASC 15 (*) insulation.

Main characteristics

Bending radius
4 x outer diameter for static applications.
8 x outer diameter for dynamic applications.

AXON' REFERENCE	CONDUCTOR Ø (mm)	AREA (mm2)	OHMIC RESISTANCE (Ω/ 100m)	MAXIMUM CURRENT (A) @ 30°C	OUTER Ø (mm)	WEIGHT (g/m)
FFR010	4.59	10	0.202	120	6.50	110
FFR016	5.94	16	0.119	160	8.40	190
FFR025	7.25	25	0.077	210	9.80	280
FFR035	8.68	35	0.054	265	11.50	390
FFR050	10.15	50	0.040	330	13.00	520
FFR070	12.32	70	0.026	420	15.20	760
FFR095	13.50	95	0.021	500	16.50	950
FFR120	15.84	120	0.016	600	19.00	1220
FFR150	18.00	150	0.013	670	21.50	1520
FFR185	20.60	185	0.010	770	24.50	1910

(*) ASC = AXON' SPECIAL COMPOUND
ALL DATA ARE NOMINAL VALUES

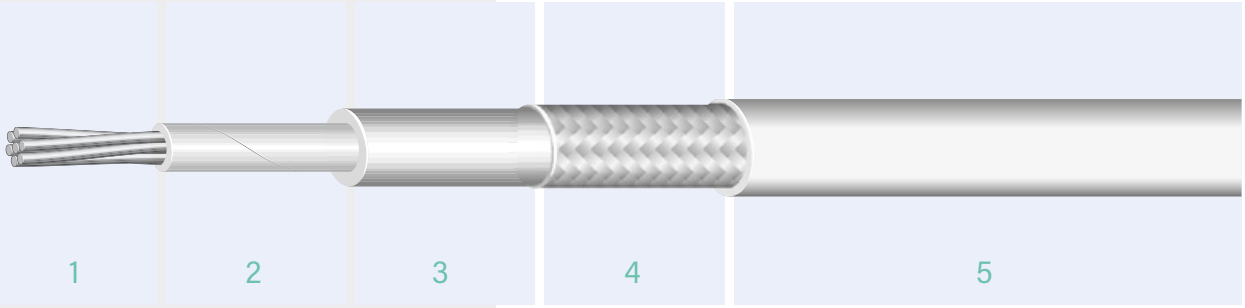
SHIELDED SINGLE WIRES ASC 15 INSULATED WIRES

TYPE FFR XXX STR1

Insulation: ASC 15

Operating temperature: -40°C up to +150°C

Operating voltage: 600 VAC



Construction

1. Extra flexible tin plated copper conductor.
2. Separating tape.
3. ASC 15 (*) insulation.
4. Tin plated copper braid.
5. ASC 15 (*) jacket.

AXON' REFERENCE	CONDUCTOR Ø (mm)	AREA (mm2)	INSULATED WIRE Ø (mm)	OVER SHIELD Ø (mm)	OVERALL OUTER Ø (mm)	WEIGHT (g/m)
FFR010 StR 1	4.59	10	6.50	7.10	9.10	170
FFR016 StR 1	5.94	16	8.40	9.30	11.50	290
FFR025 StR 1	7.25	25	9.80	10.70	13.10	405
FFR035 StR 1	8.68	35	11.50	12.20	14.80	510
FFR050 StR 1	10.15	50	13.00	13.70	16.50	690
FFR070 StR 1	12.32	70	15.20	15.90	19.10	980
FFR095 StR 1	13.50	95	16.50	17.40	20.40	1190
FFR120 StR 1	15.84	120	19.00	19.90	23.70	1550

(*) ASC = AXON' SPECIAL COMPOUND
ALL DATA ARE NOMINAL VALUES

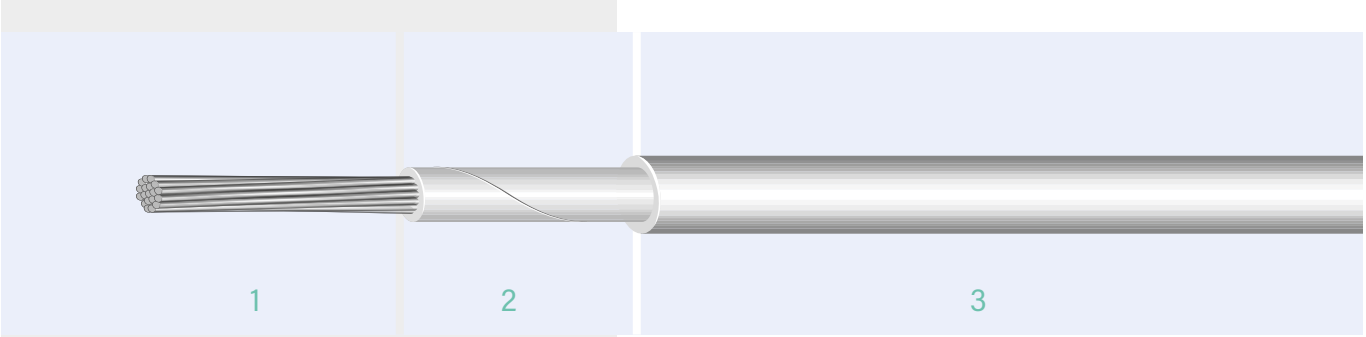
SINGLE WIRES ASC 15 INSULATED WIRES

TYPE FFRR xxx

Insulation: ASC 15

Operating temperature: -40°C up to +150°C

Operating voltage: 1000 VAC



Construction

1. Extra flexible tin plated copper conductor.
2. Separating tape.
3. ASC 15 (*) insulation.

Main characteristics

Bending radius
4 x outer diameter for static applications.
8 x outer diameter for dynamic applications.

AXON' REFERENCE	CONDUCTOR Ø (mm)	AREA (mm2)	OHMIC RESISTANCE (Ω/ 100m)	MAXIMUM CURRENT (A) @ 30°C	OUTER Ø (mm)	WEIGHT (g/m)
FFRR010	4.59	10	0.202	120	7.20	130
FFRR016	5.94	16	0.119	160	9.00	200
FFRR025	7.25	25	0.077	210	10.20	290
FFRR035	8.68	35	0.054	265	12.00	410
FFRR050	10.15	50	0.040	330	13.50	540
FFRR070	12.32	70	0.026	420	15.80	780
FFRR095	13.50	95	0.021	500	17.20	980

(*) ASC = AXON' SPECIAL COMPOUND
ALL DATA ARE NOMINAL VALUES

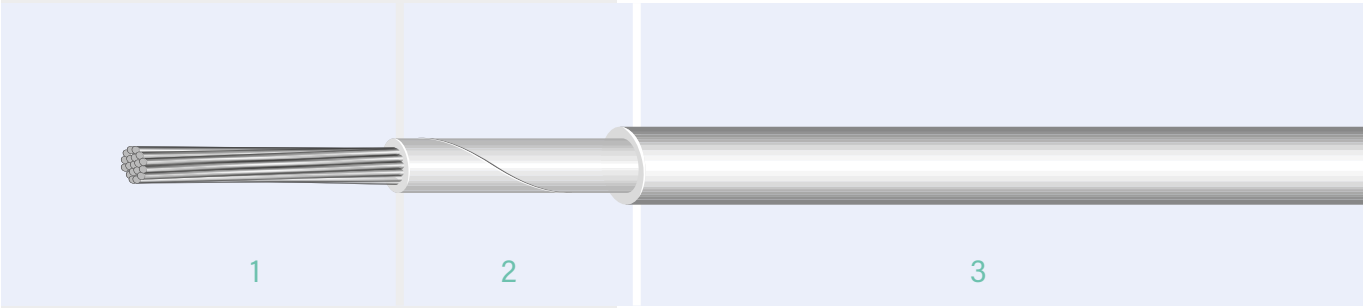
SINGLE WIRES FEP INSULATED WIRES

TYPE FFKK xxx

Insulation: FEP

Operating temperature: -90°C up to +150°C (*)

Operating voltage: 1000 VAC



Construction

1. Extra flexible tin plated copper conductor.
2. Separating tape.
3. FEP insulation.

AXON' REFERENCE	CONDUCTOR Ø (mm)	AREA (mm2)	OHMIC RESISTANCE (Ω/ 100m)	MAXIMUM CURRENT (A) @ 30°C	OUTER Ø (mm)	WEIGHT (g/m)
FFKK010	4.59	10	0.202	120	6.50	120
FFKK016	5.94	16	0.119	160	8.40	200
FFKK025	7.25	25	0.077	210	9.80	290
FFKK035	8.68	35	0.054	265	11.50	410
FFKK050	10.15	50	0.040	330	13.00	540
FFKK070	12.32	70	0.026	420	15.20	780
FFKK095	13.50	95	0.021	500	16.50	970
FFKK120	15.84	120	0.016	600	19.00	1250
FFKK150	18.00	150	0.013	670	21.50	1560
FFKK185	20.60	185	0.010	770	24.50	1970

ALL DATA ARE NOMINAL VALUES

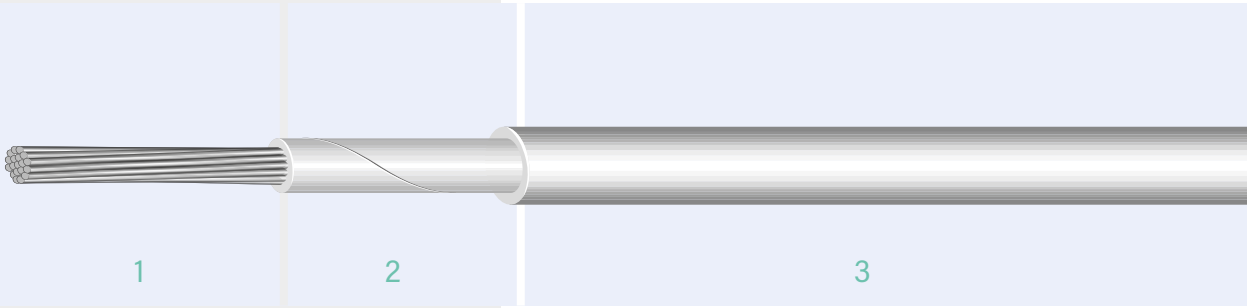
SINGLE WIRES HALOGEN FREE FLEXIBLE THERMOPLASTIC INSULATED WIRES

TYPE FFR xxx (0 HAL)

Insulation: Halogen free flexible thermplastic

Operating temperature: -40°C up to +125°C

Operating voltage: 600 VAC



Construction

1. Extra flexible tin plated copper conductor.
2. Halogen free separating tape.
3. Halogen free flexible thermoplastic insulation.

AXON' REFERENCE	CONDUCTOR Ø (mm)	AREA (mm2)	OHMIC RESISTANCE (Ω/ 100m)	MAXIMUM CURRENT (A) @ 30°C	OUTER Ø (mm)	WEIGHT (g/m)
FFR010 (0 Hal)	4.59	10	0.202	100	6.50	110
FFR016 (0 Hal)	5.94	16	0.119	140	8.40	190
FFR025 (0 Hal)	7.25	25	0.077	180	9.80	280
FFR035 (0 Hal)	8.68	35	0.054	220	11.50	390
FFR050 (0 Hal)	10.15	50	0.040	290	13.00	520
FFR070 (0 Hal)	12.32	70	0.026	350	15.20	760
FFR095 (0 Hal)	13.50	95	0.021	430	16.50	950
FFR120 (0 Hal)	15.84	120	0.016	510	19.00	1220
FFR150 (0 Hal)	18.00	150	0.013	580	21.50	1520
FFR185 (0 Hal)	20.60	185	0.010	670	24.50	1910

ALL DATA ARE NOMINAL VALUES

FLEXFORCE®

FLEXIBLE POWER CABLES

AXON' PRODUCTS

- Connectors
- < Cables
- Cable assemblies
- Contacts
- Metal-plastic parts
- Elastomer components
- Fiber optic

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