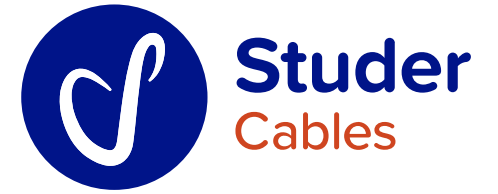




PRODUCT PRESENTATION
ROLLING STOCK

PRODUCT PRESENTATION: ROLLING STOCK

scope



- Introduction
- Application
- Materials & services
- Overview product portfolio
- Signal and control cables
- Power 600 V cables
- Power 1800 V & 3600 V cables
- Data, video and speech cables
- Others (silicone, hybrid, UIC...)
- Summary
- Our customers
- References

ROLLING STOCK

Introduction

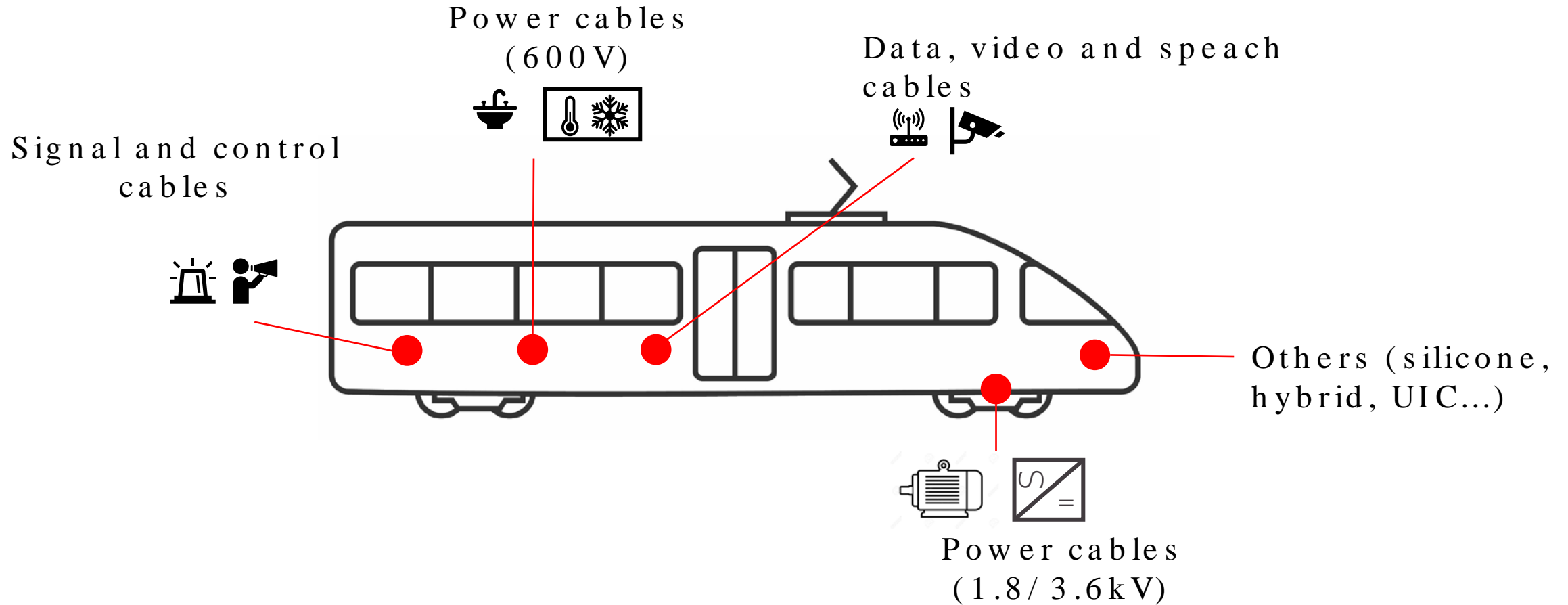
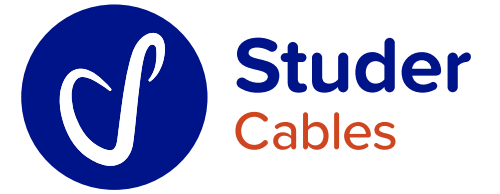


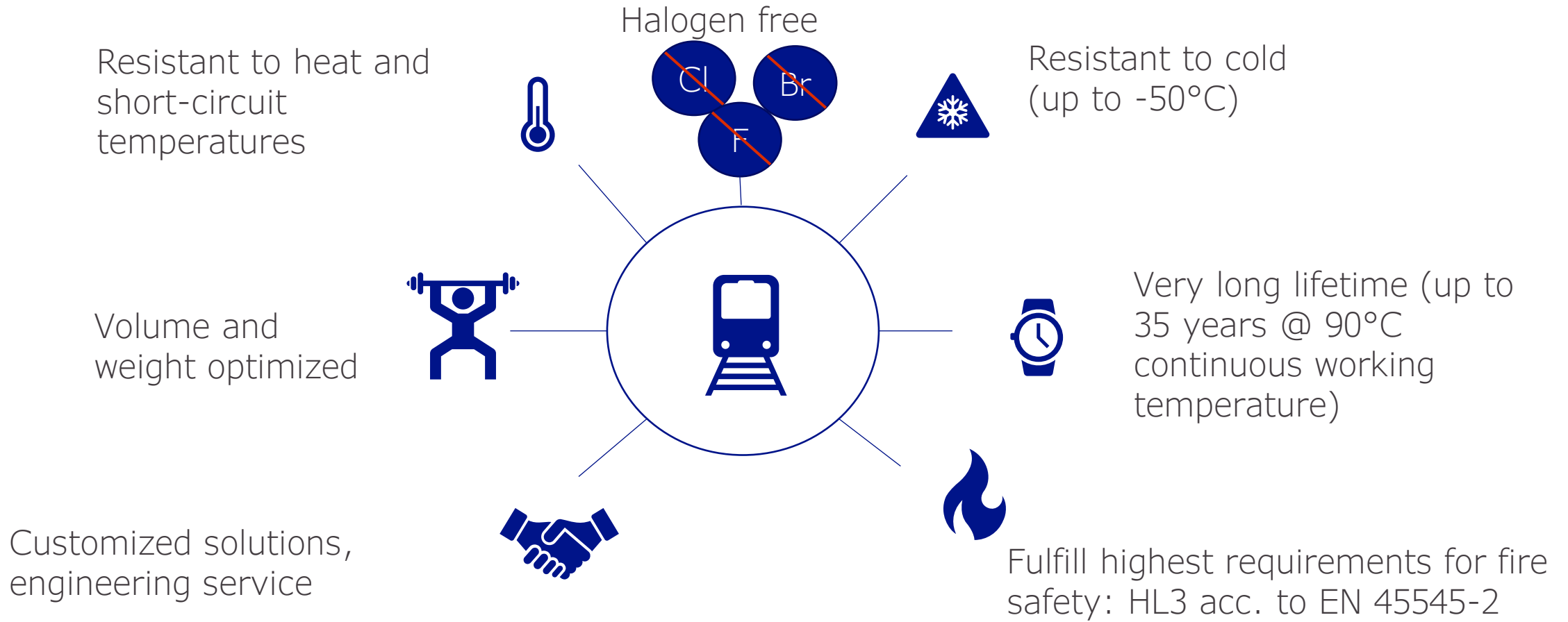
- High-end swiss made rolling stock cables for internal and external wiring of trains, metros, e-busses, trams
- Qualified supplier at Siemens, Stadler, Alstom, Mitsubishi, Toshiba, Hyundai Rotem, Hitachi, Hess, SBB (Swiss federal railways), ÖBB (Austrian railways) and many more



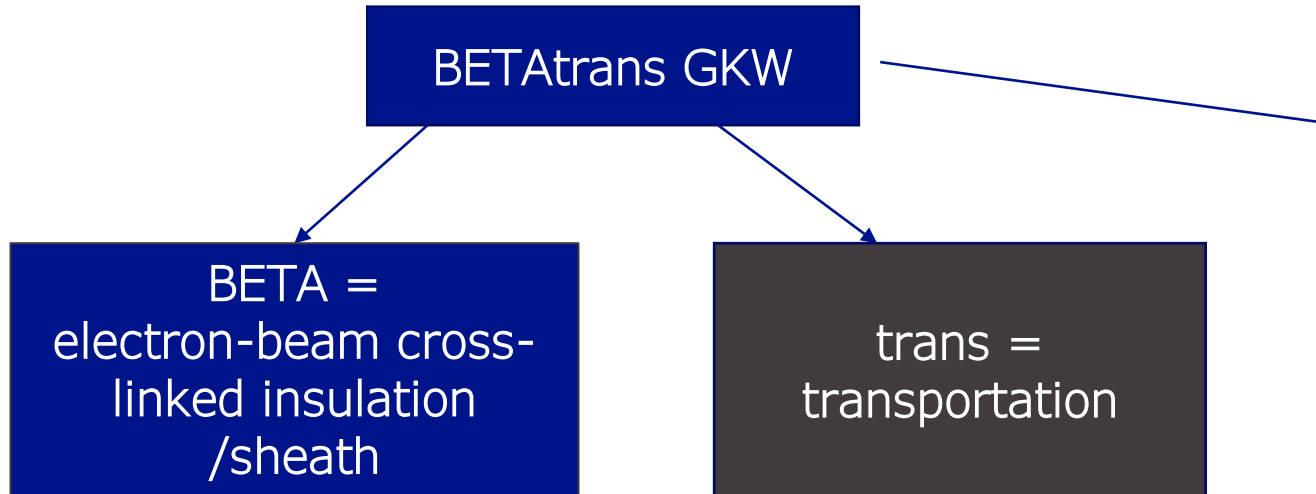
- Broad product range, covering all customer needs.
- Brand: BETAtrans[®]

ROLLING STOCK Application





INTRODUCTION



G = halogen free co-polymer, irradiation cross-linked

K = low temperature resistance (up to -40°C)

W = resistance to heat (temperature index 120°C (20'000 hours) at 50% remaining elongation at break)

Technical specification of Swiss Federal Railways (SBB) for rolling stock cables inside SBB trains. GKW (1980)

- BETAtrans GKW-ENX EN 50306 cables: fulfil rolling stock EN 50306 standard
- BETAtrans 3 GKW-ENX EN 50264 cables: fulfil rolling stock EN 50264 standard for 600/1000 V applications
- BETAtrans 4 GKW-ENX EN 50264 cables: fulfil rolling stock EN 50264 standard for 1800/3000 V applications
- BETAtrans 9 GKW-ENX EN 50264 cables: fulfil rolling stock EN 50264 standard for 3600/6000 V applications

INTRODUCTION

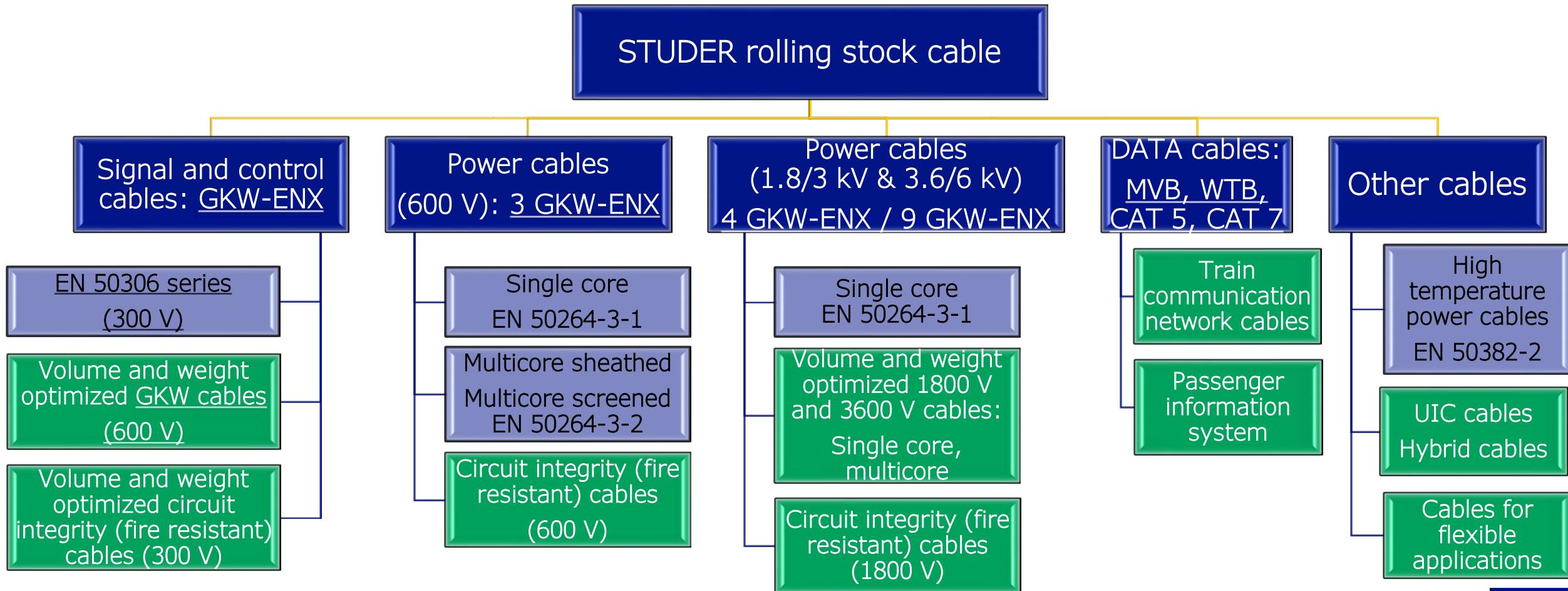


- GKW-ENX – control and signal cables (testing 2 kV AC)
- 3 GKW-ENX – power 600 V cables (testing 3.5 kV AC)
- 4 GKW-ENX – power 1800 V cables (testing 6.5 kV AC)
- 9 GKW-ENX – power 3600 V cables (testing 11 kV AC)
- flex – multicore, sheathed cable
- C-flex – multicore cable with EMC shielding
- FE180 – cables with circuit integrity
- FM – cables for flexible and mobile applications
- R – volume and weight optimized
- RI - reduced insulation (for FE180 cables)
- DATA-ENX – Data transmission cables



OVERVIEW PRODUCT PORTFOLIO

Rolling Stock



SIGNAL AND CONTROL CABLES

BETAtrans®



EN 50306 Series (300V)
compliant to
EN 50306-2, EN 50306-3,
EN 50306-4

GKW-ENX EN 50306-2,
single core

GKW-ENX C-flex EN
50306-3 multicore
screened

GKW-ENX flex EN
50306-4 multicore

GKW-ENX C-flex EN
50306-4 multicore
screened

600 V volume and weight
optimised
(GKW-ENX R Series)

GKW-ENX R
single core

GKW-ENX flex R
multicore

GKW-ENX C-flex
multicore screened

300 V fire resistant cables
(reduced insulation)
(GKW-ENX RI FE180 Series)

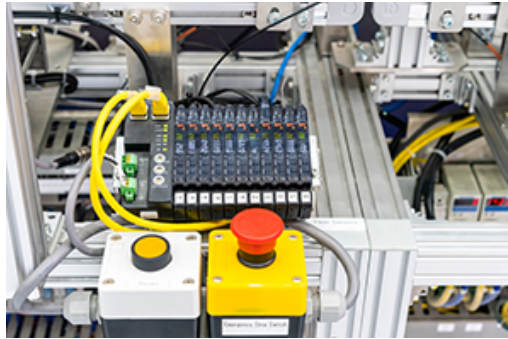
GKW-ENX RI FE180
single core

GKW-ENX flex RI FE180
multicore

GKW-ENX C-flex RI FE180
multicore screened

SIGNAL AND CONTROL CABLES

Application



Connecting of sensors, tabs, switches with the main board



Wiring of electric components inside the cockpit

- Infusible due to e-beam crosslinked insulation and sheath materials
- Volume and weight optimized
- Capable of working at elevated conductor temperature of 105 °C (expected lifetime: 80'000 hours)
- The insulation and sheath materials fulfil EN 50306-4 requirements for classification MM (highest resistance to cold, to diesel, oil, alkali and acids).

SIGNAL AND CONTROL CABLES

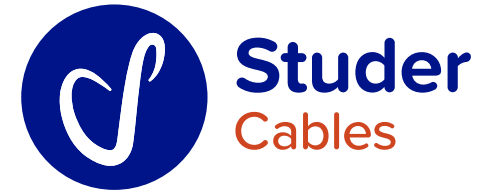
Main features



	EN 50306 Series	GKW-ENX R Series	GKW-ENX RI FE180 Series
Op. voltage : U0/U, AC, 50 Hz	300V / 500V	600V / 1000V	300V / 500V
Max. conductor temperature	125°C		
Min. ambient temperature	-40°C		
Fire safety			
EN 45545-2	✓	✓	✓
NFPA 130	✓	✓	
UN/ECE-R 118		✓	
Cable standard			
EN 50306-2; EN 50306-3; EN 50306-4	✓	in accordance	in accordance
Circuit integrity			
EN 50200			✓

POWER 600 V CABLES

BETAtrans®



3 GKW-ENX Series (600V)
compliant to
EN 50264-3-1, EN 50264-3-2

3 GKW-ENX EN 50264-3-1
single core

3 GKW-ENX flex
EN 50264-3-2 multicore

3 GKW-ENX C-flex
EN 50264-3-2 multicore
screened

600 V fire resistant cables
(3 GKW-ENX FE180 Series)
EN 50200

3 GKW-ENX FE180
single core

3 GKW-ENX flex FE180
multicore

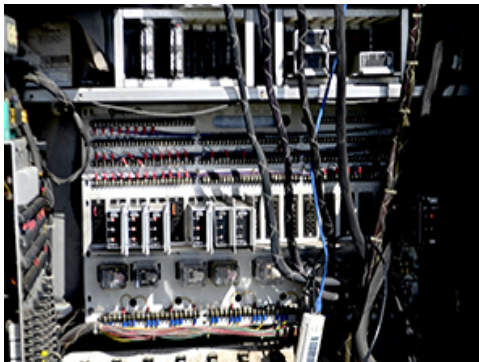
3 GKW-ENX C-flex FE180
multicore screened

POWER 600 V CABLES

Application



Connecting of lamps, heaters, switchgear, large powerful equipment: air conditioning, heating...



Wiring of electric components inside the electrical cabinets, powering the electrical systems

- Infusible due to e-beam crosslinked insulation and sheath materials
- Volume and weight optimized
- Very long expected lifetime: 220'000 hours @90°C working temperature
- The insulation and sheath materials fulfil EN 50264-1 requirements for classification MM (highest resistance to cold, to diesel, oil, alkali and acids).

POWER 600 V CABLES

Main features



	3 GKW-ENX EN 50264 Series	3 GKW-ENX FE180 Series
Op. voltage: U ₀ /U, AC, 50 Hz	600V / 1000V	600V / 1000V
Max. conductor temperature	120/125°C	120/125°C
Min. ambient temperature	-40°C	-40°C
Fire safety		
EN 45545-2	✓	✓
NFPA 130	✓	
UN/ECE-R 118	✓	
Cable standard		
EN 50264-3-1; EN 50264-3-2	✓	in accordance
Circuit integrity		
EN 50200		✓

POWER 1800 V & 3600 V CABLES BETAtrans®



Single core
compliant to
EN 50264-3-1

4 GKW-ENX EN 50264-3-1
1800V

9 GKW-ENX EN 50264-3-1
3600V

R-Version
volume and weight optimized

4 GKW-ENX R

- Single core
- Single core screened
- Multicore screened

9 GKW-ENX R

- Single core
- Single core screened
- Multicore screened

FE180
Circuit integrity

4 GKW-ENX R FE180

- Single core

4 GKW-ENX FE180 C-
flex R

- Single core

POWER 1800 V & 3600 V CABLES

Application



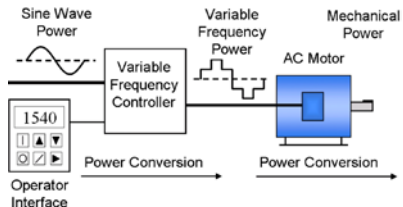
Auxiliary cables and main power cables



- Connecting of high voltage and current circuits
- Wiring inside AC/DC converters, electric cabinets

- Infusible due to e-beam crosslinked insulation and sheath materials
- Volume and weight optimized
- Very long expected lifetime: 220'000 hours @90°C working temperature
- The insulation and sheath materials fulfil EN 50264-1 requirements for classification MM (highest resistance to cold, to diesel, oil, alkali and acids).

Main supply



- Supply electrical currents to equipment
- Wiring motors
- Wiring electrical units

POWER 1800 V & 3600 V CABLES

Main features



	4 GKW-ENX EN 50264-3-1	4 GKW-ENX R	9 GKW-ENX EN 50264-3-1	9 GKW-ENX R	4 GKW-ENX FE180
Op. voltage : U0/U	1800V / 3000V	1800V / 3000V	3600V / 6000V	3600V / 6000V	1800V / 3000V
Max. conductor temperature	120°C				
Min. ambient temperature	-50°C				
Fire safety					
EN 45545-2	✓	✓	✓	✓	✓
NFPA 130		✓		✓	
UN/ECE-R 118		✓			
Circuit integrity					
EN 50200					✓

DATA, VIDEO AND SPEECH CABLES

BETAtrans®



Cables for train communication network (TCN)

Multivehicle Bus (MVB)
Wire Train Bus (WTB)

DATA-ENX C-flex 120 Ω
MVB FOAM
2x0.5 – 4x0.5 mm²

DATA-ENX C-flex 120 Ω
WTB FOAM
2x0.75 mm²

Cables for passenger information system (PIS),
EN 50288-2-2 (CAT 5)
IEC 61156-6

DATA-ENX C-flex 100 Ω
CAT 5
1x4xAWG 22/19

DATA-ENX C-flex 100 Ω
CAT 5 FOAM
1x4xAWG 22/7

Cables for passenger information system (PIS),
EN 50288-2-4 (CAT 7)
IEC 61156-6

DATA-ENX C-flex 100 Ω
GigaCAT 7 FOAM
4x2xAWG 24/7

DATA-ENX C-flex R 100 Ω
GigaCAT 7 FOAM
4x2xAWG 26/7

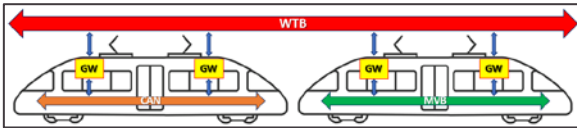
DATA-ENX C-flex 100 Ω
SilverCAT 7 FOAM
4x2xAWG 24/19

DATA, VIDEO AND SPEECH CABLES

Application & features



MVB & WTB Data cables



- Connecting sensors, data transmitters
- Wiring train communication network over the complete train

DATA cables

- Halogen free, electron-beam cross-linked up to 1200 MHz (bandwidth) databus cable with improved fire performance.
- Better than category 7 according to EN 50288 and IEC 61156, excellent NEXT, low attenuation, excellent screening characteristics (pair - and overall screen), low skew and excellent long term performance.
- Current supply (up to 350/600 mA) and voltage (up to 48 V) can be provided via PoE/PoE+ (according to IEEE 802.3af/at)
- The sheath materials fulfil EN 50264-1 requirements for classification M (highest resistance to cold, to diesel, oil, alkali and acids).

Video, speech, PIS Data cables



- Wiring of components in passenger information systems
- Wiring video, speech, Ethernet devices up to 10 GbE

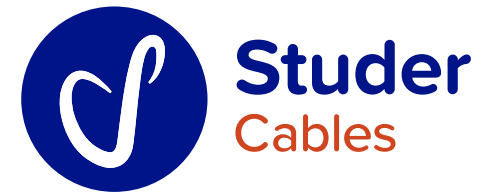
DATA, VIDEO AND SPEECH CABLES

Main features



	MVB FAOM	WTB FOAM	CAT 5; CAT 5 FOAM	GigaCAT 7
Op. voltage : U0/U	125 V	125 V	300 V 125 V (FOAM)	125 V
Max. conductor temperature	80 °C			
Min. ambient temperature	-40 °C			
Fire safety				
EN 45545-2	✓	✓	✓	✓
NFPA 130			✓	✓
UN/ECE-R 118				✓
Data Transmission	1 Mbps	1 Mbps	1 Gbps	10 Gbps
Impedance	120 Ω	120 Ω	100 Ω	100 Ω

OTHERS (SILICONE, HYBRID, UIC...) BETAtrans[®]



High temperature silicone power cables

Compliant to EN 50382-2

Silitherm FRNC-F
EN50382-2 1800 V

- Single insulated (F)
- Sheathed (FF)

Silitherm FRNC-F
EN50382-2 3600 V

- Single insulated (F)
- Sheathed (FF)

Flexible-mobile cables

1800 V
3600 V

4 GKW-ENX FM

- Single core
- Single core screened
- Multicore screened

9 GKW-ENX FM

- Single core
- Single core screened
- Multicore screened

UIC & Hybrid cables

UIC cables

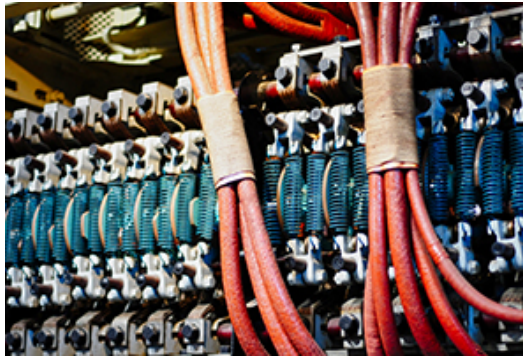
- 18 cores
- 16 cores
- 11 cores ...

Hybrid cables

- Customised power, control, data cables with an overall screen and sheath

OTHERS (SILICONE, HYBRID, UIC...)

Application & features



EN 50382-2

- Wiring of heating elements, electric engines, break resistance, batteries, switch boards, converters, distribution boxes



Flexible Mobile

- cables are suitable for applications with continuous bending yet limited torsional stresses
- Wiring inside and outside of rail cars, electric buses

Silicone cables

- Extremely flexible at very harsh environmental conditions (from -60°C up to 150°C)
- Very long lifetime: up to 25 years @ 120°C continuous working temperature
- Excellent electrical properties

Flexible mobile & hybrid cables

- Extremely resistance to UV, sun, rain, snow.
- Suitable for moving applications
- Fully customized cables fulfilling customer requirements

SUMMARY

Rolling Stock



- Saving of space and weight of the trains thanks to volume and weight optimized Studer rolling stock products
- The expected lifetime of the cable over 35 years thanks to advanced insulation and sheath materials
- Safety in operation: infusible even at the short circuit conditions thanks to e-beam cross-linked insulation
- Thanks to UV resistance the cables can be used for outside applications without any protections.
- Approved for other markets: comply to international standard as NFPA 130, UN/ ECE-R 118
- Excellent fire safety properties thanks to very low fire load



Technisches Datenblatt

BETAtrans® DATA flex FM 6x(4x0.5mm²)C + 1x(4xAWG22/19)C + 4x(2x0.5mm²)C + (3x2x0.5mm²)C

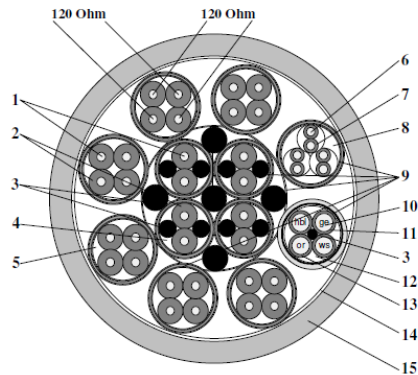
Produkt-Beschreibung

Halogenfreie, elektronenstrahlvernetzte Datenleitung mit verbessertem Verhalten im Brandfall und erhöhter Temperaturbeständigkeit.

Anwendung

Für den bewegten Einsatz in Wagenübergängen innerhalb und ausserhalb auf Schienenfahrzeugen und andere Fahrzeugen. Unter Berücksichtigung definierter Befestigungs- und Leitungsführungstechnologien müssen diese Leitungen berührungsgeschützt verlegt werden.

Kabelbild



Technisches Datenblatt

BETAtrans® 3 GKW flex FM 36 x 1.5 mm² + 2 x (2 x 1.5 mm²) C



Art.-Nr.: 226052

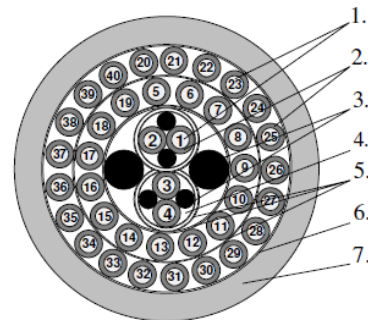
Produkt-Beschreibung

Halogenfreie, elektronenstrahlvernetzte Anschluss- und Versorgungsleitung mit verbessertem Verhalten im Brandfall und erhöhter Temperaturbeständigkeit.

Anwendung

Für den bewegten Einsatz in Wagenübergängen innerhalb und ausserhalb auf Schienenfahrzeugen und anderen Fahrzeugen. Unter Berücksichtigung definierter Befestigungs- und Leitungsführungstechnologien müssen diese Leitungen berührungsgeschützt verlegt werden.

Kabelbild



Technisches Datenblatt

BETAtrans® GKW flex R FM 5x(2x0.75)C+5x(4x0.75)C+19x1.5 mm²

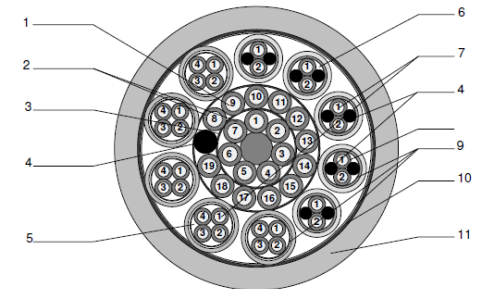
Produkt-Beschreibung

Halogenfreie, elektronenstrahlvernetzte Anschluss- und Versorgungsleitung mit verbessertem Verhalten im Brandfall und erhöhter Temperaturbeständigkeit.

Anwendung

Für den bewegten Einsatz in Wagenübergängen innerhalb und ausserhalb auf Schienenfahrzeugen und anderen Fahrzeugen. Unter Berücksichtigung definierter Befestigungs- und Leitungsführungstechnologien müssen diese Leitungen berührungsgeschützt verlegt werden.

Kabelbild



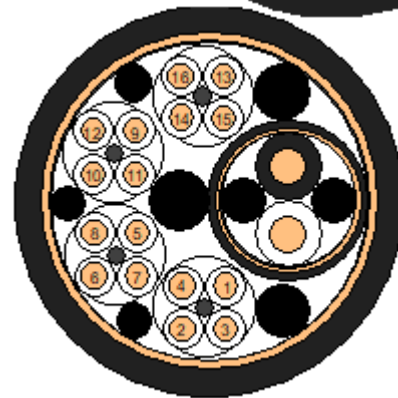
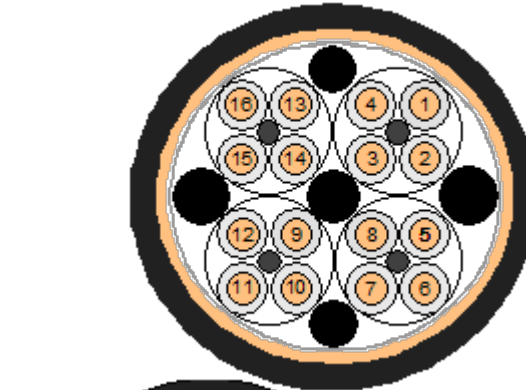
UIC AND HYBRID CABLES

UIC 16 cores and 18 cores

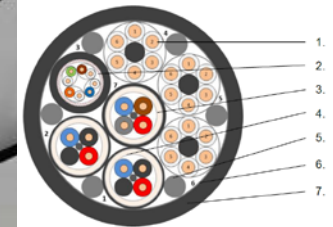
Advantages:

- Saving place, weight and volume
- Strictly comply EN 45545-2
- Easy to install and connect through single connector
- Long service lifetime

Sheath: e-beam cross-linked & comply requirements of class M acc. to EN 50264

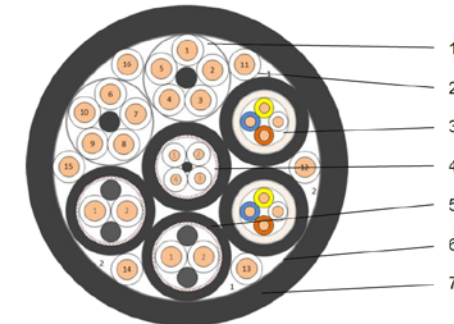
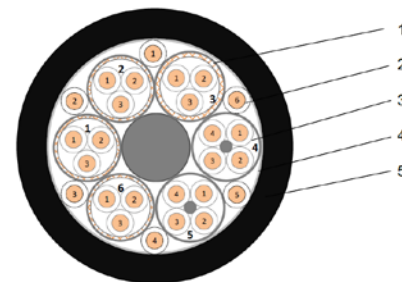


BETAtans® GKW flex R schwarz UV
3X(6X1,5) + 1X(4X(2XAWG 26/7)S)C 100 Ω GigaCAT 7 + 1X(4X0,50)C 120 Ω MVB + 2X(2X0,50 + 1X0,50 mm²)C 120 Ω MVB



BETAtans® GKW flex R schwarz UV
4X(3X1,0 mm²)C + 2X(4X1,0 mm²) + 6X1,0 mm²

BETAtans® GKW flex R UV schwarz
2X(5X1,5) + 6X(1X1,5) + 2X(4XAWG22)C 100 Ω CAT 5/5e + 1X(4X0,75)C + 2X(2X1,5 mm²)C



OUR CUSTOMERS



SIEMENS
STADLER



ALSTOM

and many more...



TOSHIBA

HITACHI
Inspire the Next



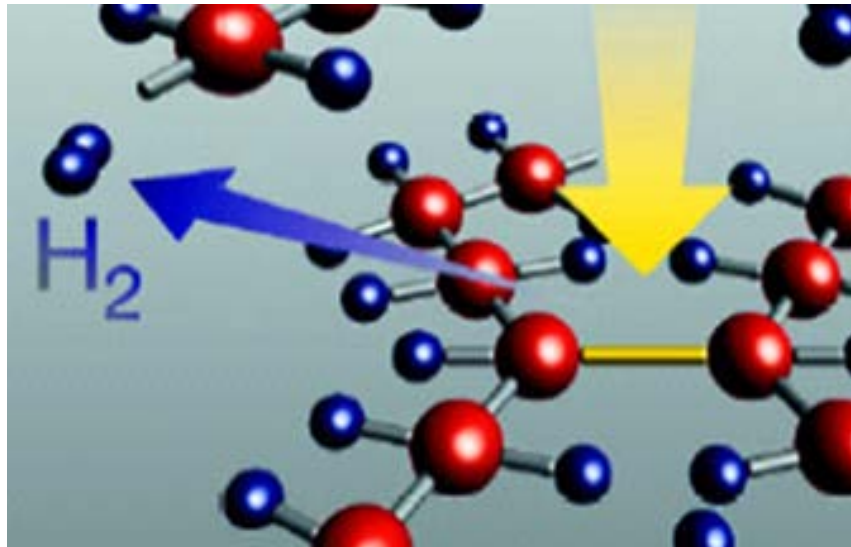
HYUNDAI
Rotem

Thank you very much

For questions please do not hesitate to contact us

ELECTRON BEAM CROSSLINKING

Cross -linking is a treatment to create the thermosetting material which do not melt up to 350 °C!



BETA electron -beam cross -linking

STUDER CABLES:

**INFUSIBLE: SHORT CIRCUIT
PROOF**

RELIABLE

LONG - LIFE TIME

VOLUME AND WEIGHT OPTIMISED

BETATRANS CABLES

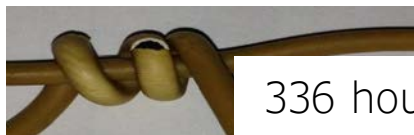
Expected Lifetime



72 hours

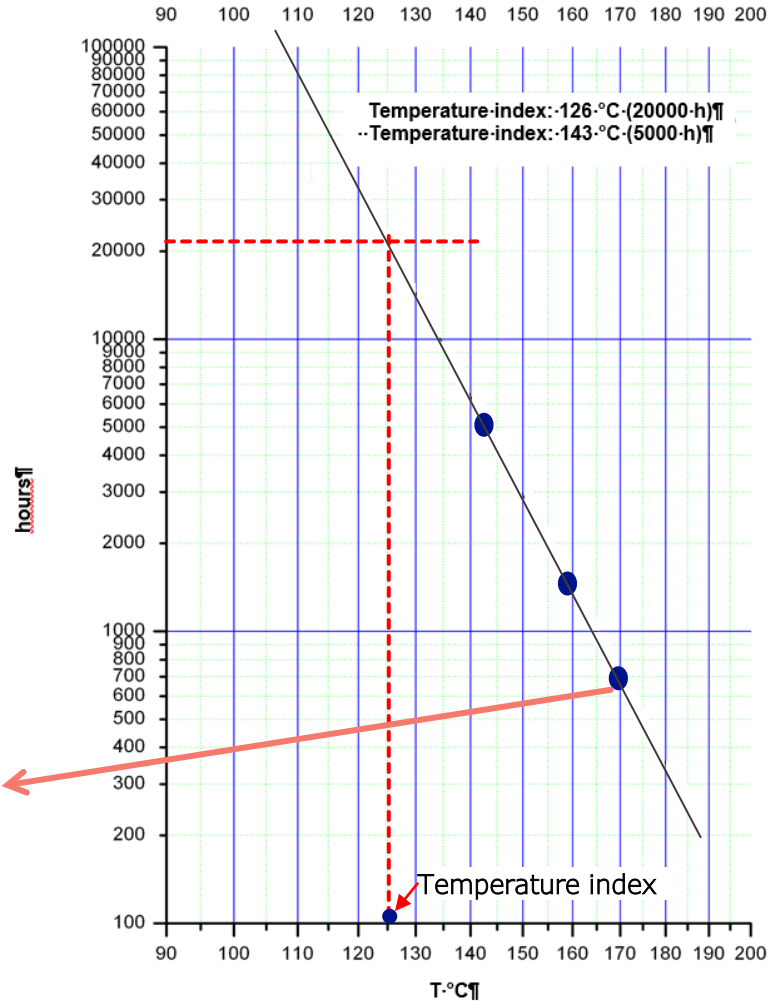


312 hours



336 hours

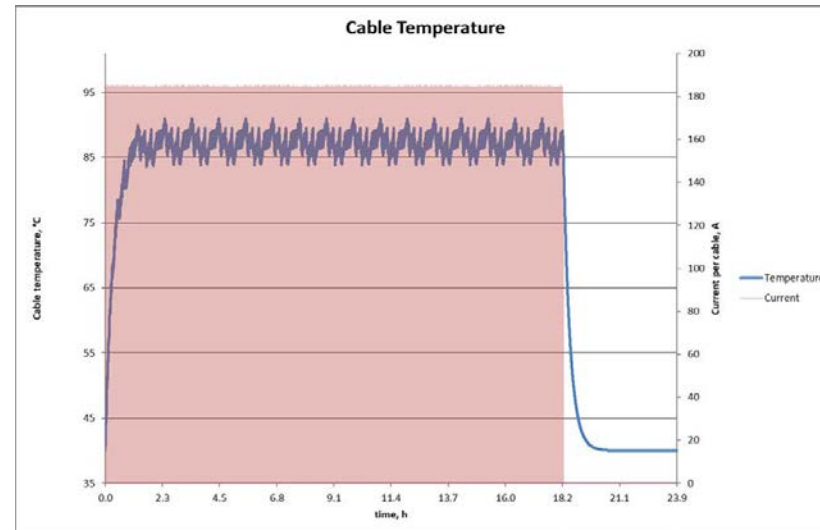
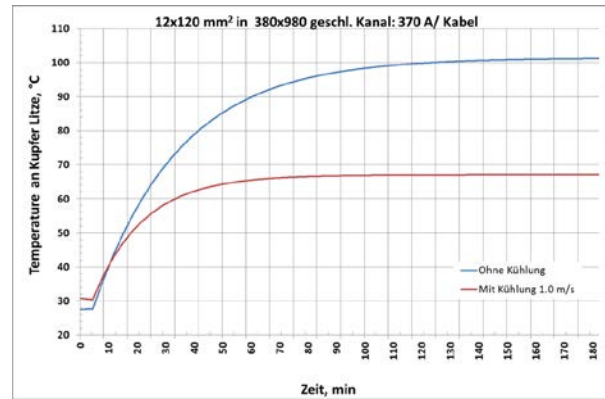
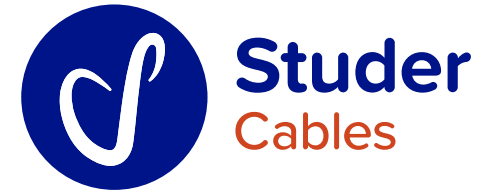
Aging at 180°C



Conductor Temperature, °C	Expected Lifetime, hours	Expected Lifetime, years
105	80'000	13
95	160'000	25
92	196'000	31
90	226'000	35
85	320'000	51

ENGINEERING SERVICE

Life time evaluation, fire safety measurements, type testing, designing hybrid cables



Results	
Expected Lifetime, years	13.0
Average current pro cable, A	98.0
aging rate / 24 hours, h ⁻¹	2.6289E-04
Average cable temperature, °C	77.7
Maximum cable temperature, °C	91.0
current @ °C at given condition, A	155
Expected Lifetime, hours	68'469