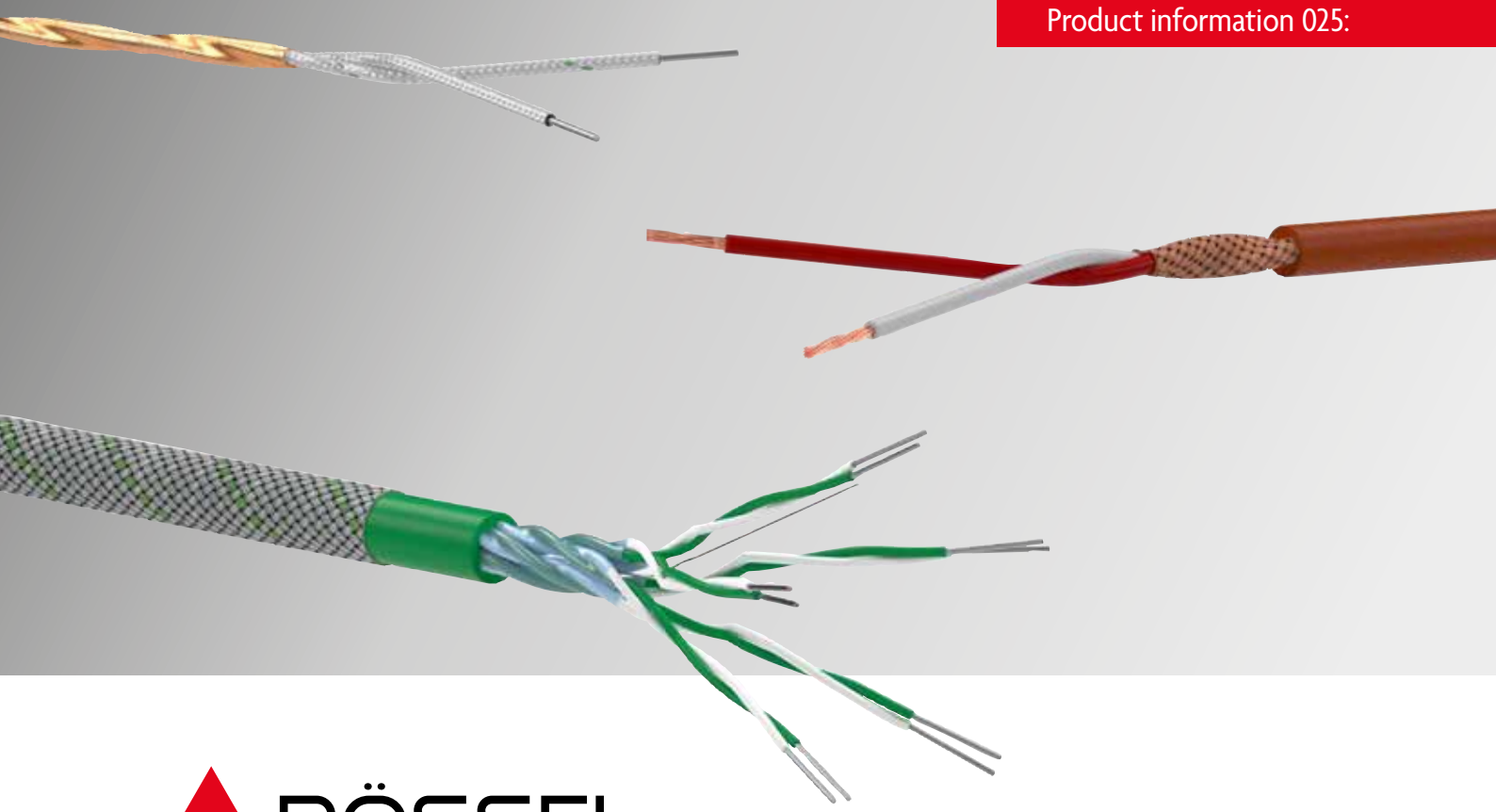

RÖSSEL MESSTECHNIK

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CONNECTION CABLES FOR THERMOCOUPLES

DESIGNED TO MEASURE TEMPERATURES UP TO 2000°C

Connection cables are primarily used to connect thermocouples to a measuring instrument. A distinction is made between extension cables and compensating cables and between solid and stranded conductors within these groups.

Extension cables are connection cables with conductors made of the same materials as the thermocouple. Accordingly, the same limit deviations apply. Extension cables are identified by the letter X after the code letter for the thermocouple. As a result, KX denotes an extension cable/insulated thermowire for the thermocouple type K (NiCr - Ni).

Compensating cables are connection cables with conductors made of materials that only have the same thermoelectric properties as the thermocouple within a limited temperature range. Compensating cables are identified by the letter C after the code letter for the thermocouple. So, KC denotes a compensating cable for the thermocouple type K. A wide range of materials are available to provide insulation for the individual conductors and the outer sheath. The material is selected on the basis of chemical and mechanical resistance to the ambient conditions, temperature range, insulation resistance, flexibility, outer diameter, shielding, etc. In addition, a wide range of cable types as well as extension and compensating cables are also available with more than two inner conductors. Custom versions are available on request at short notice in certain cases.

SPECIAL ADVANTAGES:

- Mechanical stability
- High degree of flexibility
- Chemical stability
- Special cables available on request
- Wide range of types for each individual scenario
- Connection cables are available for all types of thermocouples

Materials, color coding, limit deviations

Insulation material properties

	PVC	Silicone	Rubber	Glass silk E-glass	R-glass	FEP	PTFE	PFA	Kapton	Cerafi	Refrasil
Application temperature	105	200	80	400	600	210	260	260	320	1200	900
Suitability for:											
Steam	good	limited	good	not suitable		excellent	excellent	excellent	limited	not suitable	
Weak alkalis	+	+	+	+	+	+	+	+	+	+	+
Weak acids	+	+	+	+	+	+	+	+	+	+	+
Alcohols	+	+	+	+	+	+	+	+	+	+	+
Petrol	+	-	o	+	+	+	+	+	+	+	+
Benzene	-	-	-	+	+	+	+	+	+	+	+
Mineral oils	+	-	o	+	+	+	+	+	+	+	+

+ = stable o = limited stability - = not stable

Color coding for extension and compensating cables

Pursuant to DIN EN 60584-3

Material	Fe-CuNi	Fe-CuNi	NiCr-Ni	Cu-CuNi	NiCr-CuNi	NiCrSi-NiSi	Pt10%Rh-Pt	Pt13%Rh-Pt	Pt30%Rh-Pt6%Rh
Code letter	L*	J	K	T	E	N	S	R	B
Color	---	Black	Green	Brown	Purple	Pink	Orange	Orange	Gray
Positive pole	(Red)	---	(Red)	(Red)	---	---	(Red)	(Red)	---
Color	---	White	White	White	White	White	White	White	White
Negative pole	(Blue)	---	(Green)	(Brown)	---	---	(White)	(White)	---
Sheath color	---	Black	Green	Brown	Purple	Pink	Orange	Orange	Gray
	(Blue)	---	(Green)	(Brown)	---	---	(White)	(White)	---

Code letters pursuant to DIN EN 60584-1 (DIN 43710) Type L pursuant to DIN 43710 (standard 7/97 retracted) Code colors in brackets pursuant to DIN 43714

Limit deviations for extension and compensating cables

Pursuant to DIN EN 60584-3

Element type Type of wire	Limit deviation DIN EN 60 584-3 Class 1 Class 2		Application temperature range	Measuring temperature
JX (LX)	± 85 µV (± 1.5 °C)	± 140 µV (± 2.5 °C)	-25 to +200 °C	500 °C
TX	± 30 µV (± 0.5 °C)	± 60 µV (± 1.0 °C)	-25 to +100 °C	300 °C
EX	± 120 µV (± 1.5 °C)	± 140 µV (± 2.5 °C)	-25 to +200 °C	500 °C
KX	± 60 µV (± 1.5 °C)	± 100 µV (± 2.5 °C)	-25 to +200 °C	900 °C
NX	± 60 µV (± 1.5 °C)	± 100 µV (± 2.5 °C)	-25 to +200 °C	900 °C
KCA		± 100 µV (± 2.5 °C)	0 to +150 °C	900 °C
KCB		± 100 µV (± 2.5 °C)	0 to +100 °C	900 °C
NC		± 100 µV (± 2.5 °C)	0 to +150 °C	900 °C
RCA/SCA		± 30 µV (± 2.5 °C)	0 to +100 °C	1000 °C
RCB/SCB		± 60 µV (± 5.0 °C)	0 to +200 °C	1000 °C

Due to the non-linear relationship between thermoelectric voltage and temperature, information provided on limit deviation in °C (values in brackets) refer to the measuring temperatures stated in the last column.

Order code structure

Single wire | outer sheath - count number - number of wires | TC type | cable type - cross-section/diameter - wire configuration

The following order code can be used for versions that are not listed on the following pages. However, please note that not all conceivable combinations are available. Please get in touch to receive assistance with configuration. The limit deviation (see page 2) and the version with or without shielding braid must always be specified in plain text.

Example : A thermocable type K, two-wire, 0.22 mm² cross-section, individually and jointly insulated with FEP/PFA/PTFE with shielding braid, limit deviation class 1 (DIN EN 60584-3) is requested.

Example: **T T** - **465** - **2 K X** - **0.22** - **L**

Single wire insulation

C	Cerafi (ceramic fiber)
G	Glass silk
K	Kapton (polyimide)
P	PVC (polyvinyl chloride)
R	Refrasil (quartz fiber)
S	Silicone
T	FEP/PFA/PTFE

Joint outer sheath

C	Cerafi (ceramic fiber)
G	Glass silk
K	Kapton (polyimide)
P	PVC (polyvinyl chloride)
R	Refrasil (quartz fiber)
S	Silicone
T	FEP/PFA/PTFE

Code for cable structure

Number of inner wires

Thermocouple types

J | K | T | E | N | S | R | B	pursuant to DIN EN 60584-3 or
L	= Fe-CuNi (DIN 43710)
AA	= W - W26%Re
AE	= W3%Re - W25%Re
AO	= W5%Re - W26%Re

Cable type

C	Compensating cable
X	Extension cable

Cross-section/ diameter

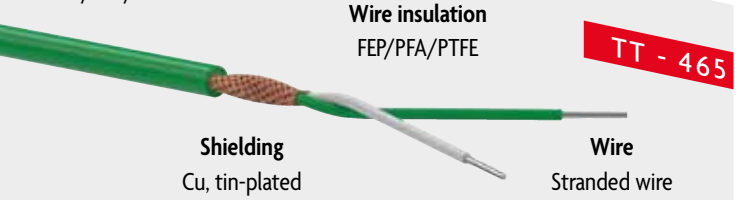
Cross-section in mm² for stranded wires
Diameter in mm for solid wires

Wire structure

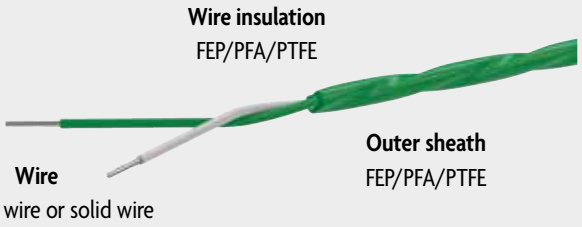
L	Stranded wire
M	Solid wire

Extension cables and compensating cables

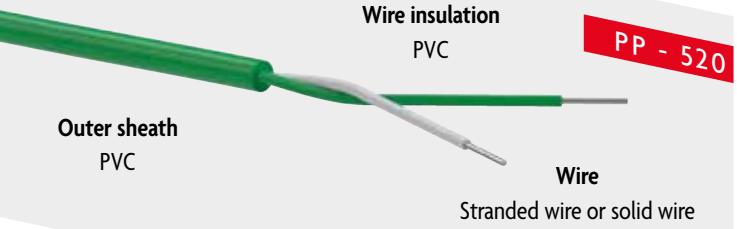
TT - 465



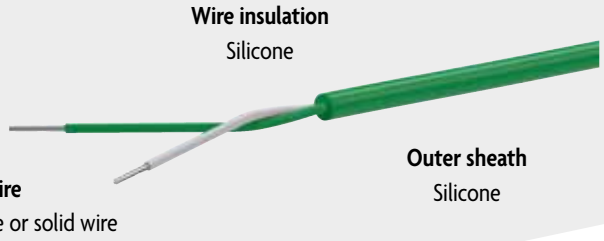
TT - 460



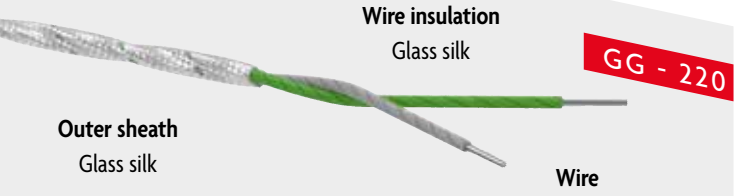
PP - 520



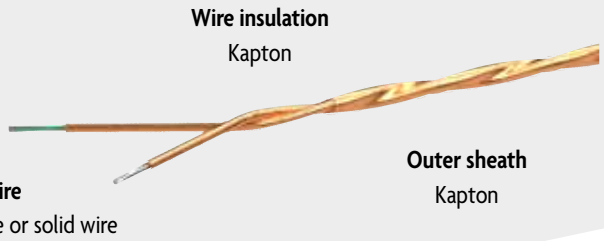
SS - 350



GG - 220

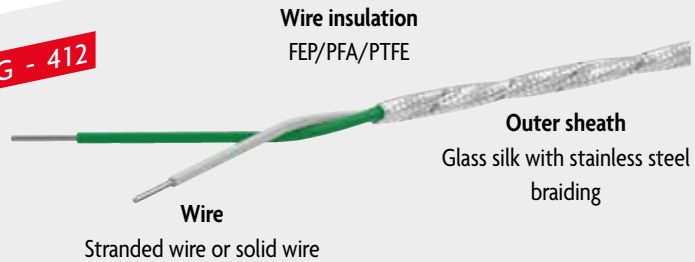


KK - 610

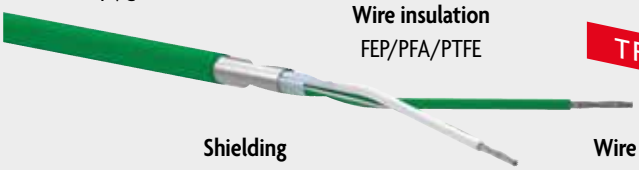


GK - 270

TG - 412



TP - 440



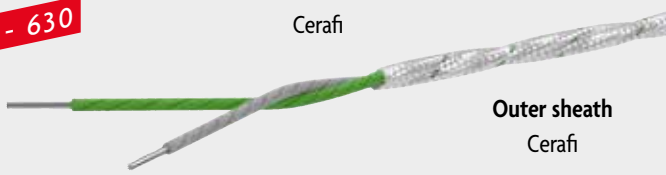
Outer sheath
PVC

Wire insulation
FEP/PFA/PTFE

Shielding
AL foil

Wire
Stranded wire

CC - 630

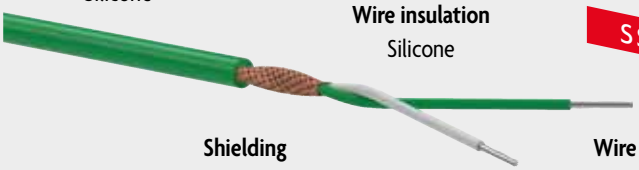


Wire insulation
Cerafi

Outer sheath
Cerafi

Wire
Stranded wire or solid wire

SS - 354



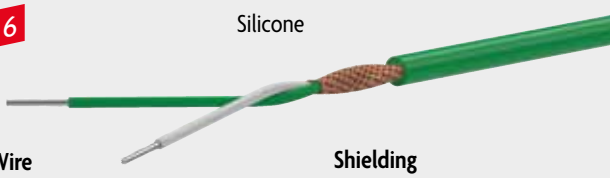
Outer sheath
Silicone

Wire insulation
Silicone

Shielding
Cu, tin-plated

Wire
Stranded wire

PP - 526

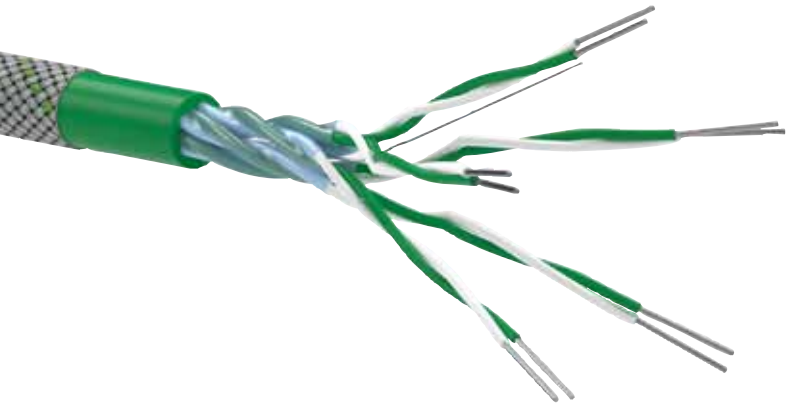


Outer sheath
Silicone

Wire insulation
Silicone

Wire
Stranded wire or solid wire

Shielding
Cu, tin-plated



COMPENSATING CABLES FOR HIGH TEMPERATURE THERMOCOUPLES

Due to the extreme brittleness of the thermowires, no extension cables are available for high temperature thermocouples made from tungsten-rhenium alloys. Compensating cables will always be used instead. The cables we use have a permissible limit deviation of +/- 50 µV (namely +/- 3.5 K based on a measuring temperature of 2000 °C) in the range of 0 to 100 °C ambient temperature.

Application notes

PVC insulated extension and compensating cables

Cables with PVC insulation are suitable for use in dry, damp and wet areas with a medium mechanical load. They may be laid either fixed or flexibly. Tensile stress must be avoided when laid loosely. Forced guidance can be provided, but recurrent bending stress must be avoided. PVC insulated cables must not be used outdoors without UV protection and only if the temperature range is observed.

Temperature range: fixed installation -40 +105 °C
flexible + 5 to + 70 °C
Combustion behavior: fire retardant and self-extinguishing

Adhering to the following bending radii is recommended:
Flexible installation: 12 x outer diameter
Fixed installation: 4 x outer diameter

Silicone insulated extension and compensating cables

Use of cables with silicone insulation is recommended when high ambient temperatures or the impact of strong temperature fluctuations cause the cable insulation to become brittle or fragile within a short period of time. They are suitable for use in dry, damp and wet areas with a low mechanical load. They may be laid either fixed or flexibly. Tensile stress must be avoided when laid loosely. Silicone insulated cables are highly flexible and resistant to many low concentrate acids and alkalis. However, resistance against fuels and mineral oils is low. Silicone insulated cables are halogen-free as per IEC 754-1.

Temperature range: fixed installation -50 +200 °C
flexible -25 +180 °C
temporary +250 °C

Combustion behavior: flame-retardant and self-extinguishing; no development of corrosive combustion gas

Minimum bending radius: 12 x outer diameter

FEP | PTFE | PFA insulated extension and compensating cables

Cables with FEP/PTFE/PVC insulation are suitable for use in dry, damp and wet areas with high ambient temperatures and a high mechanical load. FEP/PTFE/PVC insulated cables can be installed outside without any issues. They may be installed either fixed or flexibly.

FEP insulation

Temperature range: fixed installation -100 to +205 °C
flexible -100 to +205 °C

PFA and PTFE insulation

Temperature range: fixed installation -190 to +260 °C
flexible -100 to +260 °C

Combustion behavior: flame-retardant and self-extinguishing

Adhering to the following bending radii is recommended:
Flexible installation: 10 x outer diameter
Fixed installation: 4 x outer diameter

Glass silk insulated extension and compensating cables

Cables with glass silk insulation are suitable for use in dry environments at high temperatures. They may be installed either fixed or flexibly. Kinks must be avoided during installation under all circumstances.

Temperature range: fixed installation -25 to +400 °C
flexible -25 to +180 °C
temporarily up to + 600 °C

Combustion behavior: non-flammable, no development of corrosive combustion gases

Adhering to the following bending radii is recommended (temp. < 180 °C):
The cable should not be bent after being exposed to temperatures > 200 °C.

Flexible installation: 10 x outer diameter
Fixed installation: 4 x outer diameter

Mineral fiber insulated extension and compensating cables

Mineral fiber insulation cables have the same possible uses and application notes as glass silk insulated cables, however for significantly higher temperatures:

REFRASIL up to 900 °C
CERAFI up to 1200 °C

Combustion behavior: non-flammable,
no development of corrosive combustion gases

Adhering to the following bending radii is recommended (temp. < 180 °C):
The cable should not be bent after being exposed to temperatures > 200 °C.

Flexible installation: 10 x outer diameter
Fixed installation: 4 x outer diameter

Kapton insulated extension and compensating cables

The polyimide material kapton has similar properties to FEP/PFA/PTFE in terms of chemical resistance. However, in contrast to FEP/PFA/PTFE, Kapton can be made into thin yet highly tear-resistant films. As a result, it offers virtually no flow properties, but high elasticity and stretchability. Similar to glass fiber insulated cables, it is primarily used in dry environments at high temperatures. Kapton provides excellent electrical and mechanical properties. Fixed installation is preferable. Loose installation should only be permitted in exceptional cases. Tensile stress is not permitted. The cable is not suitable for continuous movements. Kinks must be avoided during installation under all circumstances.

Temperature range: fixed installation -40 to +320 °C
flexible -25 to +220 °C
temporarily + 380 °C

Adhering to the following bending radii is recommended:
Flexible installation: 10 x outer diameter
Fixed installation: 6 x outer diameter

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Furnace construction expert

Henry Hall (M.A.)
Managing director

Carsten Tillmann
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