

Cable products

Thermocouple cables TERC (in acc. with TU 3567-015-76960731-2009)

comply with the international standard IEC584-3, with the national standard GOST 1791-2014 and others including use in hazardous areas, all classes

Doncable LLC – quality management system is certified according to ISO 9001

Thermocouple Cables TERC are designed to connect thermocouples to the secondary transducers (temperature measuring means).

In order to substantially eliminate the influence of the operating mode of the object (e.g., a heating furnace) at the temperature of the free ends of the thermocouple there is need to remove them from the heating space for a considerable distance. This does not necessarily require to apply long thermocouple, it is better to lengthen them with flexible cables. These cables should be thermoelectrically identical to thermoelectrodes of the thermocouples, due to that they are called *thermocouple cables*.

Thermocouple cables TERC are divided into extension and compensation:

1. *Extension cables* – cable conductors are made of the same alloy as the thermocouple. Extension cables, unlike thermocouples, operate in a narrower temperature range. Within the cable designation after the specified type of thermocouple (acc. to GOST 50342-92 or IEC 584-1) is added the symbol «X», for example: «NX» - an extension cable for thermocouple of N type (made of nichrosil-nisil). The «X» symbol is derived from the English term «eXtension cable». At a predetermined temperature range the electrodes (conductors) of these cables develop in tandem with the third electrode (eg, copper or platinum) the same thermal EMF as thermocouple respective electrodes. Therefore, extension cables are called cables with electrode-wise compensation.
2. *Compensation cables* – cable conductors, compared with the extension cables ones are made of less expensive or precious metals. For example, for a thermocouple of K type (chromel-alumel) is used the compensation cable with conductors made of copper (positive) and constantan (negative). The application of compensating cables can also be caused by the need to have a minimum resistance of the circuit. Compensation cables are developing thermal EMF equal to the thermal EMF of the thermocouple, for which they are intended, and therefore they are called total compensation cables.

Within the compensation cables designation after specifying the type of thermocouple (acc. to GOST 50342-92 or IEC 584-1) the symbol «C» is added, and if there are two versions of the cable that provided for thermocouple - the symbol «CA» or «CB». For example, the "CSA" – is the compensation cable according to IEC 584-3 standard for thermocouple of K type (chromel-alumel). «C» symbol is derived from the English term «Compensation cable». Compensation cables, in comparison with extension cables are characterized by a narrower range of operating temperatures and higher values of tolerances.



Technical data

Extension and compensating cables TERC for thermocouples of the types: T, E, J, K, N, R, S, L, A-1, A-2, A-3, M, B on GOST R 50342-92 / IEC584-1

The cables can be made according to two standards:

- international IEC584-3 (for use, for example, with the thermocouples in accordance with IEC584-1 standard)
- national GOST 1791-2014 and oth. (for use with the thermocouples under GOST R 50342-92 and GOST R 8.585-2001)



Conductors of total twist or coupled («x2»):

- multiwired
- multiwired of advanced flexibility «G»
- single wired «ozh»



Shields for couple and a common shield for all couples can be made of:

- AlumoFlex «E»,
- Braid of tinned copper wire «El» and non-tinned wire «Em»,
- Braid of nickel wire «En»

Individual shields for couple can be electrically insulated one of each other, also can be combined – shield made of tinned copper wires is laid upon shield of AlumoFlex.



Cables can be armoured with:

- Zinc-coated steel wires «K»,
- Zinc-coated steel tapes «B»,
- Stainless steel wires «Kn»,
- Stainless steel tapes «Bn»,
- Zinc-coated steel wires «Kp», without outer sheath
- Stainless steel wires «Knр», without outer sheath



Wide service temperature range from -60° up to +400°C (see Table 6)

Minimum cable mounting temperature:

- -30° for HL cables, with materials of «T», «S», «N», «F»
- -15° for other cables.



Climatic performance V, cable placement category «UV» 1-5 (under GOST 15150), other cables - 2-5. Cables are allowed to be used within all macro-climatic areas, including tropics.



«UV» performance cables, resistant to solar radiation.



«V» – under sheath water propagation protection



«M» – sheath resistant to oils, petrol and diesel fuel



Fire resistant cables «FR» maintain performance under fire conditions not less than 180 minutes (PO1 under GOST 31565-2012)

Cables TERC are resistant to:

- Mounting bending (see Table 8)
- Vibration loads up to 2kHz with acceleration of 200m/s²
- Repeated impacts, hardness type IV under GOST 20.57.406-81
- Liner acceleration, hardness type IV under GOST 20.57.406-81
- Acoustic noise, hardness type II under GOST 20.57.406-81
- impacts at freezing under GOST IEC 60811-4-2011
- High air humidity up to 98% at t ≤ 35°C
- Mold fungi effects up to 2 points under GOST 9.048-89



Cables "z" have got extruded filling up to circular cross-section. Cables with one pair of thermocouple can be made flat - "P".

Capacity Cc under GOST IEC 60079-74-2011 not more than:

- 190nF/km between two conductors;
- 300nF/km between one conductor and another one connected to a shield
- Tests under GOST 2990-78 by voltage of 1500V 50Hz within 5 minutes



Shear electrical resistance at t=20°C not less 10M Ohm/km

Cables warranty 2 years

Cables service life at least 25 years since manufacturing

Two standards of TERC cable manufacturing

Cables TERC can be manufactured in one of the two options and comply with the standards:

1. The cables labelled as *KX, KCA, KCB, NX, EX, JX, TX, SCA, SCB, RCA, RCB* are manufactured under the international standard изготавливаются по международному стандарту IEC 584-3 «Thermocouples. Part 3: Extension and compensating cables – Tolerances and identification system» (см. таблицу 2). В The standard establishes the requirements for limited deflection of thermocouple pair thermal EMF, as well as the colour of core insulation and outer sheath of the cable. The cables TERC made under the IEC 584-3 standard makes sense to use with thermocouples manufactured according to international standard.
2. The cable conductors labelled as *XA(KX), XA(KC), XKH(EX), ЖК(JX), XK(LX), МКH(TX), ПП(SCA), ПП(SCB), ПП(RC), ПП(BC), МК(MX)* are made of metals or alloys in accordance with national Russian and intrastate standards: GOST 1791-2014, GOST 492-2006, GOST 859-2014 and others. At the standard GOST 1791-2014 there are established tolerance classes for the thermos-EMF of the wire, which is used for cable conductor, and made of the alloys: chromel K, copel, constantan, TP. A colour of core insulation and outer sheath for the thermocouple cables is not defined by any of the national standards, but in the TERC cables there is in use conductor insulation colours common for Russia (see. Table 3). The cable jacket can be of any colour (by default - black).

Application range

The cables are designed for fixed and mobile laying indoors and outdoors if protected from direct exposure to solar radiation, on shelves, in trays, ducts, channels, tunnels, earth (trenches), in places exposed to stray currents. The cables with "UV" coding can be installed outdoors unprotected from the sun radiation. The cables of "M" performance have got a jacket resistant to engine oil, gasoline and diesel fuel. The cables of "V" performance is protected to the spread of water under the jacket.

Fire-resistant cables «FR» have got the top fire resistance PO1 according to GOST 31565-2012 and are able to operate in a fire conditions at least 180 minutes.

The cables with extruded filling "z" have a circular cross section and prevent the spread of potentially explosive gases under the jacket. These cables fully comply with the technical regulations of the Customs Union TR CU 012/2011 "On safety equipment for use in potentially explosive atmospheres" and GOST IEC 60079-14-2011 «Explosive atmospheres. Part 14: Design, selection and mounting of electrical installations ", and can be used in hazardous zones of all classes.

The operating temperature of cables is shown in Table 6, the temperature depends on the insulation and jacket material. Preferred areas of application of TERC cables taking into account the type of performance and fire hazard class in accordance with GOST 31565-2012 are shown in Table 7.

TERC cable design

The cable conductors are made of metal and alloy or two alloys in accordance with the Table 2 (standard IEC 584-3) or Table 3 (national standards).

The conductors are manufactured stranded (default) or single-wire ("ozh" index). The cables labelled "G" are made with strands of increased flexibility.

The conductor of fire-resistant cables «FR» before the insulation imposition is wound with mica tapes, it provides maximum cable resistance to mechanical stress in case of fire.

The wires in the cable can be manufactured in a twisted pair of thermocouple, in this case, the symbol «x2» is added to the number of pairs in the order code.

Cables can be produced with the combined cross-section of conductors (such as «2x1,5 + 4x1,0» or «1x2x1,5 + 2x2x1,0»).

Digital marking is applied to all the cores of a cable of the same colour.

The cables can have a shield: individual one of each pair and / or the total one of all pairs.

Shields can be made as:

- Aluminium-foiled tape (AlumoFlex) with drain tinned copper wire "E",
- braid made of untinned copper wire «Em»,
- braid made of tinned copper wire «El»,
- braid made of nickel wire «En».

Individual shields of couples can be electrically isolated between each other by a extruded polymer layer as well as can be fabricated as combined type "EEI" - on a top of the AlumiFlex shield a braiding of tinned copper wires is imposed.

The cables can have got an armor as:

- made of zinc-coated steel wires «K», the outer sheath is imposed upon armor;
- made of zinc-coated steel tapes «B», the outer sheath is imposed upon armor;
- made of stainless steel wires «Kn», the outer sheath is imposed upon armor;
- made of stainless steel tapes «Bn», the outer sheath is imposed upon armor;
- tank armor of zinc-coated wire "Kp" is over the inner shell, the outer sheath is not imposed;
- tank armor of stainless steel wire "Knp" is over the inner shell, the outer sheath is not imposed;

Cables with a single thermocouple pair can be made in a flat version "P".

Table 6 shows the materials of insulation and sheath, as well as the corresponding fire safety performance coding.

Table 1 Core nominal cross section and the number of cores or pairs

Core nominal cross section and, mm ²	The number of pairs	The number of cores
0,20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 24, 27, 30, 32, 36, 37, 40	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40
0,35		
0,50		
0,75		
1,0		
1,5		
2,5		
4,0	-	

Material alloy of conductors, colour of core insulation and outer sheath for TERC cables on the standard IEC 584-3: with marking KX, KCA, KCB, NX, EX, JX, TX, SCA, SCB, RCA, RCB

The colour of negative core insulation for TERC cables should be white as of the standard IEC 584-3. The

colour of the positive core insulation should comply with Table 2. The colour of outer sheath should be as the positive core one. Cables are designed for intrinsically safe circuits shall be permitted to make with a sheath of light-blue (blue) colours.

Table 2 The material and colour of the core insulation for TERC cables as of IEC 584-3

Thermocouple type as of IEC 584-1	General coding of the thermocouple	TERC cable coding as of IEC 584-3	Positive core (+)		Negative core (-)	
			Material	Colour	Material	Colour
J	ТЖК	JX	100%Fe	black	44%Ni-remaining Cu	white
T	ТМКН	TX	100%Cu	brown	44%Ni- remaining Cu	
E	ТХКН	EX	90%Ni-10%Cr	violet	44%Ni- remaining Cu	
K	ТХА	KX	90%Ni-10%Cr	green	95%Ni+Al-Mn-Si	
		KCA	100%Fe		43%Ni-2%Mn-2%Fe-remaining Cu	
		KCB	100%Cu		44%Ni- remaining Cu	
N	ТНН	NX	84%Ni-14.2%Cr-Si	pink	95%Ni-4.3%Si	
R	ТПП	RCA	100%Cu	orange	3%Ni-Mn- remaining Cu	
		RCB	100%Cu		3%Ni-Mn- remaining Cu	
S	ТПП	SCA	100%Cu	orange	3%Ni-Mn- remaining Cu	
		SCB	100%Cu		3%Ni-Mn- remaining Cu	

- **Core alloy material, core insulation and outer sheath colour for TERC cables as of the national standards:** marked as XA(KX), XA(KC), XKH(EX), ЖК(JX), XK(LX), МКH(TX), ПП(SCA), ПП(SCB), ПП(RC), ПП(BC), МК(MX)

The core insulation colour for TERC cables, as it's customised in Russia, is designating metal or alloy

applied (see Table 3). In agreement the other colours of insulated cores are allowed.

In Russia, there is no stricken requirement for the colour of the cable jacket, so TERC cables are available by default with black jacket. Provided there is a need for other jacket colour, it should be stipulated at the order code.

Table 3 Material and colour of core insulation for TERC cables as of the national standards

Thermocouple type as of GOST R 50342-92 (GOST R 8.585-2001)	Thermocouple coding	TERC cable coding	Positive core (+)		Negative core (-)	
			Material	Colour	Material	Colour
T	ТМКН	МКН(ТХ)	copper (Cu)	Red or pink	Constantan alloy (CuNi)	brown
E	ТХКН	ХКН(ЕХ)	Chromel K alloy (NiCr)	Violet or black	Constantan alloy (CuNi)	brown
J	ТЖК	ЖК(ЈХ)	железо (Fe)	Light blue or blue	Constantan alloy (CuNi)	brown
K	ТХА	ХА(КХ)	Chromel K alloy (NiCr)	Violet or black	сплав алюмель (Ni)	White or natural
		ХА(КС)	copper (Cu)	Red or pink	Constantan alloy (CuNi)	brown
R	ТПП	ПП(РС)	copper (Cu)	Red or pink	Alloy TP (CuNi)	green
S	ТПП	ПП(SCA)	copper (Cu)	Red or pink	Alloy TP (CuNi)	green
		ПП(SCB)	Alloy KPR (Cu+3,2Si)	White or natural	Alloy KP (Cu+5Ni+3,7Mn)	black
L*	ТХК	ХК(ЛХ)	Chromel K alloy (NiCr)	Violet or black	Copel alloy (CuNi)	Orange or yellow
A-1, A-2, A-3	ТВР	ВР(АС)	copper (Cu)	Red or pink	сплав МН 2,4 (Cu+(2,2-2,6)Ni)	Light blue or blue
M	ТМК	МК(МХ)	copper (Cu)	Red or pink	Copel alloy (CuNi)	Orange or yellow
B	ТПР	ПР(ВС)	copper (Cu)	Red or pink	copper (Cu)	black

* thermocouple of L type as of GOST R 50342-92, not to be mixed with thermocouple of L type as of DIN 43710 (Fe-CuNi)

Tolerance classes and limit deviation limits of thermal EMF (TEMF)

Tolerance class characterises the allowed deviations limit of TEMF. As of standard IEC 584-3 the tolerance classes are defined for thermocouple pair of a cable, while as of GOST 1791-2014 – for the wire, which is used for the core manufacturing paired with the copper sample. For some cables the tolerance class is defined for the wire paired with the platinum sample. Provided there is no specific notes regarding the tolerance class, the TERC cable class is defined by a manufacturer choice – generally it's an alloy with the 2nd tolerance class.

1. Tolerance classes for TERC cables as of standard IEC 584-3: labelled as KX, KCA, KCB, NX, EX, JX, TX, SCA, SCB, RCA, RCB

In the international standard IEC 584-3 the cable tolerance class determines the deviation limit of TEMF measured in mV and degrees Celsius within the certain cable operating temperature range (см. таблицу 4). Since TEMF nonlinearly depends on the temperature, the tolerance value in degrees Celsius is given for a specific operating temperature of a thermocouple junction.

For cables there was established only 2 tolerance classes. Extension cables (with the symbol "X") may be made as of class 1 and 2, and compensation cables (with symbols «C», «CA», «CB») - only as of the 2nd tolerance class.

Table 4 TEMF deviation limits for TERC cables as of standard IEC 584-3

TERC cable type as of IEC 584-3	TEMF deviation limits for a tolerance (in parentheses it's indicated the deviation in degrees Celsius for junction operating temperature from the last column)		Cable operating temperature range, for which the deviation limit is determined, in mV	Junction operating temperature, for which the deviation limit is determined degrees Celsius
	1-го	2-го		
JX	± 85мкВ (±1,5°C)	± 140мкВ (±2,5°C)	-25 ... +200°C	500°C
TX	± 30мкВ (±0,5°C)	± 60мкВ (±1,0°C)	-25 ... +100°C	300°C
EX	± 120мкВ (±1,5°C)	± 200мкВ (±2,5°C)	-25 ... +200°C	500°C
KX	± 60мкВ (±1,5°C)	± 100мкВ (±2,5°C)	-25 ... +200°C	900°C
NX	± 60мкВ (±1,5°C)	± 100мкВ (±2,5°C)	-25 ... +200°C	900°C
KCA	-	± 100мкВ (±2,5°C)	0 ... +150°C	900°C
KCB	-	± 100мкВ (±2,5°C)	0 ... +100°C	900°C
NC	-	± 100мкВ (±2,5°C)	0 ... +150°C	900°C
RCA	-	± 30мкВ (±2,5°C)	0 ... +100°C	1000°C
RCB	-	± 60мкВ (±5,0°C)	0 ... +200°C	1000°C
SCA	-	± 30мкВ (±2,5°C)	0 ... +100°C	1000°C
SCB	-	± 60мкВ (±5,0°C)	0 ... +200°C	1000°C

2. Tolerance classes for TERC cables as of GOST 1791-2004: cables labelled as XA(KX), XK_H(EX), ЖК(JX), XK(LX), МК_H(TX), МК(MX), XA(KC), ПП(SCA), ПП(RC)

GOST 1791-2014 determines 2 tolerance classes for wire, which is used for the thermocouple cable core

manufacturing, alloys: chromel K, copel, constantan, TP (see Table 5). Tolerance class is determined for the wire paired with the copper sample at temperature 100°C (free end at 0°C). TEMF deviation limits are determined mV for each tolerance class.

The wire made of TP alloy has got deviation limit as of ± 0,03 mV.

Table 5 TEMF deviation limits for a wire which is used for TERC cable manufacturing as of Russian (intrastate) standard GOST 1791-2014

Name of wire alloy	Coding of TERC cable, where a wire is used	EMF for a pair with copper sample at temperature 100°C (free end at 0°C), mV	Deviation limit, mV, for tolerance class	
			1-st	2-nd
Chromel K	XA(KX), XK _H (EX), XK(LX), XA(KC)	+2,09	0,05	0,08
Copel	XK(LX), МК(MX)	-4,77	0,06	0,1
Constantan	XK _H (EX), ЖК(JX), МК _H (TX)	-4,10	0,06	0,1
TP	ПП(SCA), ПП(RC)	-0,64	-	-

Table 6 Fire safety performance coding and operating temperature depending on the sheath and the insulation material

Insulation and sheath material	Fire safety performance coding	Insulation and sheath material description	Cable operating temperature, °C
V	(no index)	Insulation and sheath made of PVC plastics	-50°...+70°C *
	ng(A)	Insulation made of PVC plastics, and sheath made of low combustible PVC plastics	-50°...+70°C *
	ng(A)-LS	Insulation and sheath made of PVC plastics with low - smoking and gassing	-50°...+70°C *
	ng(A)-FRLS	Insulation and sheath made of PVC plastics with low - smoking and gassing, flame retardant cable	-50°...+70°C *
Vt	(no index)	Insulation and sheath made of thermostable PVC plastics	-50°...+105°C
P	нг(A)-HF	Insulation and sheath made of halogen free polymer compounds	-50°...+70°C *
	нг(A)-FRHF	Insulation and sheath made of halogen free polymer compounds, flame retardant cable	-50°...+70°C *
T	нг(A)	Insulation and sheath made of low combustible thermoplastic elastomers	-60°...+125°C
	нг(A)-FR	Insulation and sheath made of low combustible thermoplastic elastomers, flame retardant cable	-60°...+125°C
S	нг(A)	Insulation and sheath made of low combustible silicone rubber	-60°...+180°C
F	(no index)	Insulation and sheath made of extruded fluoropolymer	-60°...+200°C
N	(no index)	Insulation and sheath made of thermostable glass threads	-60°...+400°C

as «HL» performance with operating temperature down to minus 60°C

Table 7 Major application range for TERC cable according to performance type and fire safety performance coding as of GOST 31565-2012

Performance type	Fire safety performance coding	Major application range
no index	O1.8.2.5.4	For a single laying in cable structures and production areas. Group laying is permitted only in outdoor electrical installations and production facilities, where it is possible only periodic presence of service personnel, and there is a need to use a passive fire protection.
ng(A)	П16.8.2.5.4	For laying in open cable structures (overpasses, galleries) of external electrical installations.
ng(A)-LS	П16.8.2.2.2	For laying in indoor electrical installations, as well as in buildings and enclosed cable structures.
ng(A)-HF	П16.8.1.2.1	For laying in indoor electrical installations, as well as in buildings with massive presence of people, including the multi-functional high-rise buildings and buildings complexes.
ng(A)-FRLS	П16.7.2.2.2	For laying in fire protection systems, and other systems that must continue to operate in a fire.
ng(A)-FRHF	П16.7.1.2.1	

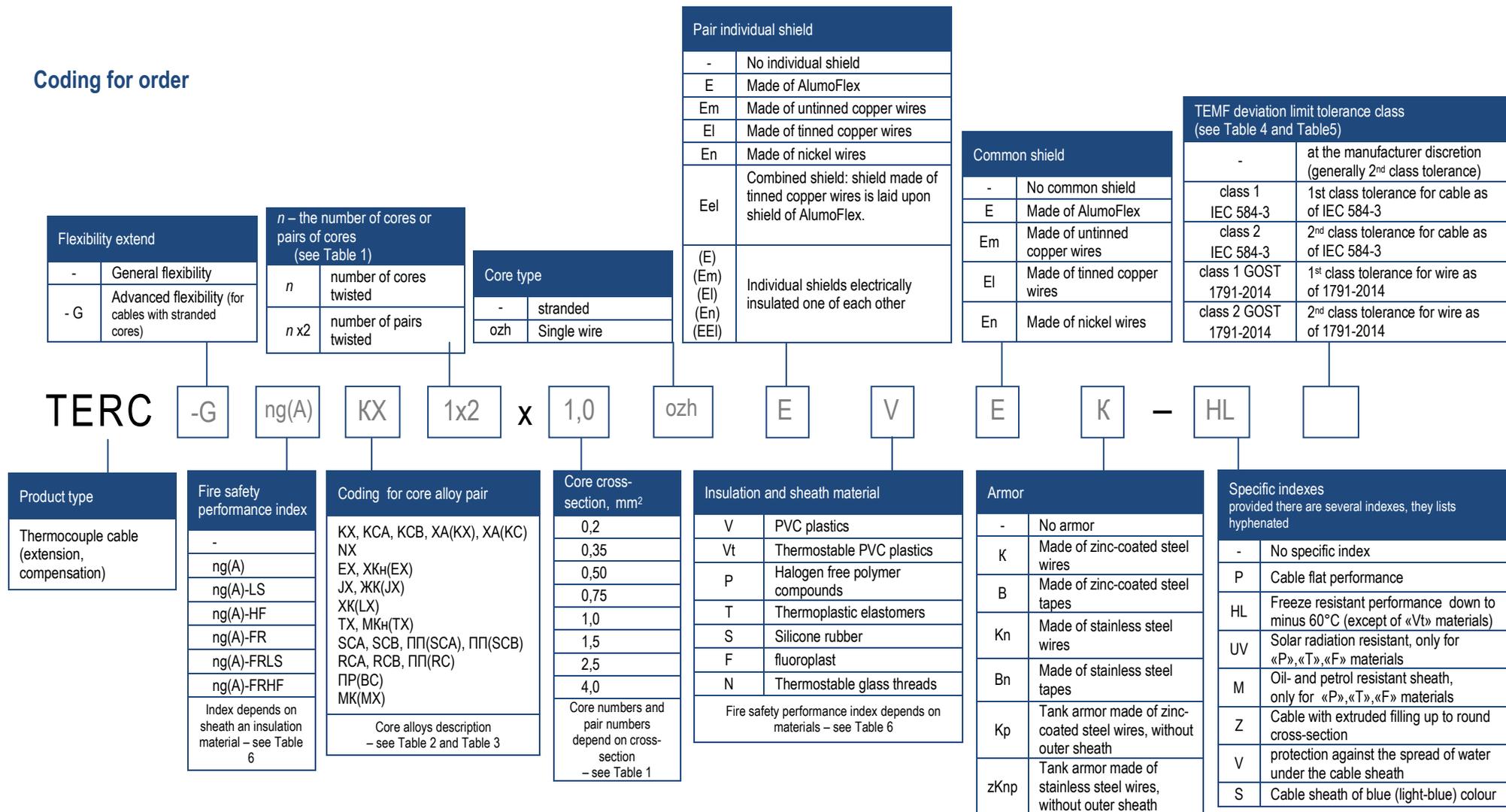
Table 8 Allowed TERC cables bending radius

Cable type		Bending radius (D – cable outer diameter)
General performance (with stranded cores)	without armour and with wire armour	3 D
	with tape armour	5 D
«TERC-G» performance (with conductors of advanced flexibility)	without armour and with wire armour	2,5 D
	with tape armour	5 D
«ozh» performance (with single wire cores)	without armour and with wire armour	5 D
	with tape armour	7,5 D

Table 9 Colours of insulation and jacket for TERC cable

Thermocouple type as of GOST R 50342-92 (GOST R 8.585-2001) and as of IEC 584-1	International standard IEC 584-3	Common in Russia colours (cable jacket colour may be any, by default – black)			
J		ЖК(JX)			
K		ХА(KX)		ХА(KC)	
T		МКн(TX)			
S/R		ПП(SCA) ПП(RC)		ПП(SCB)	
E		ХКн(EX)			
N					
L		ХК(LX)			
A-1, A-2, A-3		ВР(AC)			
M		МК(MX)			
B		ПР(BC)			

Coding for order



Example of cable order coding	Description
TERC ng(A) XK(LX) 4x2x1,0ozh TE-z-v TU 3567-015-76960731-2009	Extension cable for thermocouples of L type according to GOST R 8.585-2001 (thermocouple TCA), with four pairs of single-wire conductors with nominal cross-section of 1.0 mm ² made of Chromel and Copel alloys (GOST 1791-2014), with the insulation and sheath made of thermoplastic elastomers, in general shield made of aluminum foiled film, under the sheath is extruded filling to a round shape, the cable has a water swelling tape, prevents the spread of water under the sheath.
TERC-G ng(A)-HF NX 2x2x0,5 PEIK class 1 IEC 584-3 TU 3567-015-76960731-2009	Extension cable for thermocouples of N type according to IEC 584-1 and GOST R 8.585-2001 (thermocouple TNN), with two pairs of stranded cores of advanced flexibility with nominal cross-section of 0.5 mm ² made of Nichrosil and nilsil alloys, 1 st tolerance class as of standard IEC 584-3, with the insulation and sheath made of halogen-free polymer compounds, in the general shield of tinned copper wires, in the armor of zinc-coated steel wires.

Attention! TERC cable manufacturing period may be from 3 to 6 months - this is due to a wide variety of core alloys, which we do not keep in significant quantities in stocks of the manufacturer.