IEC 60584-3

Edition 2.0 2007-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Thermocouples –
Part 3: Extension and compensating cables – Tolerances and identification system

Couples thermoélectriques –
Partie 3: Câbles d'extension et de compensation – Tolérances et système d'identification

IEC 60584-3:2007

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THERMOCOUPLES –

Part 3: Extension and compensating cables – Tolerances and identification system

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International Standard IEC 60584-3 has been prepared by subcommittee 65B: Devices and process analysis, of IEC Technical Committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition of IEC 60584-3 issued in 1989. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- Addition of Subclause 5.4 Connectors.
- Addition of Clauses 7 Dimensions and 8 Requirements.

The text of this standard is based on the following documents:

FDIS	Report on voting
65B/642/FDIS	65B/646/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60584 series, under the general title *Thermocouples*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

THERMOCOUPLES –

Part 3: Extension and compensating cables – Tolerances and identification system

1 Scope

This part of IEC 60584 specifies manufacturing tolerances for extension and compensating cables (other than mineral insulated cables) provided directly to users of industrial processes. These tolerances are determined with respect to the e.m.f.-temperature relationship of Part 1 of the standard.

The method for identification of insulated thermocouple extension and compensating cables other than mineral insulated cables is described.

Furthermore, requirements for extension and compensating cables for use in industrial process control are specified.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60584-1:1995, *Thermocouples – Part 1: Reference tables*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
extension and compensating cables
are used for the electrical connection between the open ends of a thermocouple and the reference junction in those installations where the conductors of the thermocouple are not directly connected to the reference junction. The thermoelectric properties of extension and compensating cables shall be close to the properties of the corresponding thermocouple.

3.1.1
extension cables
are manufactured from conductors having the same nominal composition as those of the corresponding thermocouple. They are designated by the letter "X" following the designation of the thermocouple, for example "JX".

3.1.2
compensating cables
are manufactured from conductors having a composition different from the corresponding thermocouple. They are designated by the letter "C" following the designation of the thermocouple, for example "KC". In some cases different tolerances apply for the same thermocouple type over different temperature ranges. These are distinguished by additional letters such as, for example, KCA and KCB.

3.2
tolerance
the tolerance of an extension or compensating cable is the maximum additional deviation in microvolts caused by the introduction of the extension or compensating cable into the measuring circuit.

4 Tolerance values

Table 1 shows the specified tolerance for extension and compensating cables when used at temperatures within the ranges indicated as "Cable temperature range".

Table 1– Tolerance classes for extension and compensating cables

Type	Tolerance class		Cable temperature range	Measuring junction temperature
	1	2		
JX	±85 µV (±1,5 °C)	±140 µV (±2,5 °C)	–25 °C to +200 °C	500 °C
TX	±30 µV (±0,5 °C)	±60 µV (±1,0 °C)	–25 °C to +100 °C	300 °C
EX	±120 µV (±1,5 °C)	±200 µV (±2,5 °C)	–25 °C to +200 °C	500 °C
KX	±60 µV (±1,5 °C)	±100 µV (±2,5 °C)	–25 °C to +200 °C	900 °C
NX	±60 µV (±1,5 °C)	±100 µV (±2,5 °C)	–25 °C to +200 °C	900 °C
KCA		±100 µV (±2,5 °C)	0 °C to +150 °C	900 °C
KCB		±100 µV (±2,5 °C)	0 °C to +100 °C	900 °C
NC		±100 µV (±2,5 °C)	0 °C to +150 °C	900 °C
RCA		±30 µV (±2,5 °C)	0 °C to +100 °C	1 000 °C
RCB		±60 µV (±5,0 °C)	0 °C to +200 °C	1 000 °C
SCA		±30 µV (±2,5 °C)	0 °C to +100 °C	1 000 °C
SCB		±60 µV (±5,0 °C)	0 °C to +200 °C	1 000 °C

NOTE 1 Cable temperature range may be restricted to figures lower than those shown in the table because of temperature limitations imposed by the insulant.

NOTE 2 A cable comprising two copper conductors may be used with Type B thermocouples. The expected maximum additional deviation within the cable temperature range 0 °C to +100 °C is 40 µV. The equivalent in temperature is 3,5 °C when the measuring junction of the thermocouple is at 1 400 °C.

NOTE 3 Tolerances are specified in microvolts. The table also includes, in parentheses, the approximate equivalent tolerances in degrees Celsius. Because thermocouple e.m.f.-temperature relationships are non-linear, the tolerance in degrees Celsius depends on the temperature of the measuring junction of the thermocouple. The figures shown in the table are those appropriate to the measuring junction temperatures in the final column. In most cases the error expressed in degrees Celsius will be larger at lower thermocouple junction temperatures.

5 Colour coding

5.1 Negative conductor

The insulation of the negative conductor shall be WHITE for all thermocouple types.

5.2 Positive conductor

The insulation of the positive conductor shall be as given in Table 2.

5.3 Outer sheath

The outer sheath, if any, shall be coloured as given in Table 2. If for intrinsically safe circuits the outer sheath is coloured BLUE, then the thermocouple type shall be indicated by other means, for instance by printed or coloured tags (colour as given in Table 2).

Table 2 – Colour code for extension and compensating cables

Thermocouple type	Colour of positive conductor and sheath insulation
T	Brown
E	Violet
J	Black
K	Green
N	Pink
B	Grey
R	Orange
S	Orange

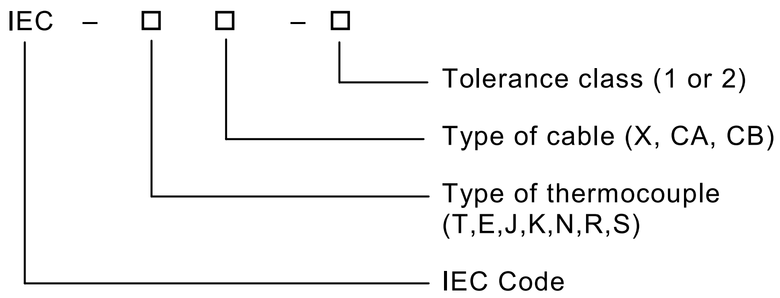
5.4 Connectors

The connectors, if any, used in conjunction with thermocouples and compensating or extension cables, shall be coloured as given in Table 2. The colouring may be a mass colouring or a coloured dot on the connector's surface.

6 Additional identification

6.1 Information applied by the manufacturer shall have the following format:

Example: IEC – K X – 1



6.2 Additional markings for number of pairs, cross-section of conductors, temperature range, manufacturer, etc., may be made if necessary.

7 Dimensions

The dimensions of conductors should be agreed between user and manufacturer taking into account for example tensile strength and flexibility of the cable. Tables 3a and 3b show typical examples of nominal dimensions.

Table 3a – Dimensions of conductors (typical nominal values)

Solid wire diameter and wire diameter of strands mm
0,10
0,12
0,18
0,20
0,30
0,32
0,40
0,45
0,50
0,60
0,63
0,65
0,80
1,00
1,25
1,29
1,38
1,60

Table 3b – Cross-sectional area and construction of stranded conductors

Stranded wire nominal cross-sectional area mm^2	Construction (number of strands * diameter in mm)
0,05	7 * 0,10
0,11	12 * 0,12
0,22	7 * 0,20
	3 * 0,30
0,38	12 * 0,20
0,41	13 * 0,20
0,50	16 * 0,20
	7 * 0,30
0,60	19 * 0,20
0,72	23 * 0,20
0,75	24 * 0,20
	11 * 0,30
1,00	32 * 0,20
	14 * 0,30
	5 * 0,50
	3 * 0,65

Table 3b *(continued)*

Stranded wire nominal cross-sectional area mm²	Construction (number of strands * diameter in mm)
1,20	7 * 0,45 4 * 0,60
1,25	4 * 0,63
1,30	4 * 0,65
1,50	48 * 0,20 21 * 0,30 3 * 0,80
2,00	16 * 0,40 7 * 0,60
2,2	7 * 0,63
2,3	7 * 0,65

8 Requirements

8.1 Materials

8.1.1 Insulating materials

The choice of insulating materials has to be agreed between vendor and user.

8.1.2 Conductor materials

For the cable temperature range the thermal e.m.f. of conductor materials shall comply both with IEC 60584-1 and with the tolerances specified in Clause 4 of this standard.

8.2 Electromagnetic shielding

The cables shall be manufactured by using pairs of twisted conductors or flat parallel conductors. Additional shielding should be used for thermoelectric circuit in order to reduce the susceptibility to electrical noise.

8.3 Capacitance and inductance

The capacitance and inductance - both per metre - (conductors against conductors and conductors against shield - if present) shall be made available.

8.4 Resistance of single conductors and loop resistance

The nominal value of the resistance of single conductors in Ω/m at (20 ± 5) °C shall be declared by the manufacturer and the nominal loop resistance in Ω/m at (20 ± 5) °C shall be made available.

8.5 Insulation resistance

The minimum insulation resistance shall be 5 MΩ·km ($5 \cdot 10^3$ MΩm = $5 \cdot 10^9$ Ωm) for cables with fibrous insulation and 500 MΩ·km ($0{,}5 \cdot 10^6$ MΩm) for all other cables within the scope of this standard.

NOTE The total electrical requirements of the system may take precedence over this specification.

The insulation resistance shall be measured between each conductor and all others and shield combined at (500 ± 50) V DC and a temperature of (20 ± 15) °C and a relative humidity of 45 % to 85 %.

8.6 Dielectric strength

A voltage of 500 V AC shall be applied for 1 min each time at ambient conditions between:

a) each conductor separately and all others connected together,

b) all conductors and the shielding.

No breakdown shall occur during this test.

8.7 Marking

Each coil or drum shall be fitted with a nameplate with the following information, if applicable:

- traceable identification number,
- thermocouple type and tolerance class,
- length in m,
- diameter or cross-sectional area of one conductor in mm or mm^2,
- number of pairs (if multi-pair),
- insulating material.

Some or all of this information may be in code form.