thermokon®
HOME OF SENSOR TECHNOLOGY

Information

- Passive Temperature Sensors -

EN

(Issue date: 07/2020)

1 General

1.1 2-, 3- and 4-wire connection

2-wire circuit
The Resistance Temperature Detector (RTD) is connected via a 2-wire connection cable. The measurement includes also the copper resistance which can be compensated for by a line compensation. Temperature variations changing the cable resistance will not be considered. This type of connection is not recommended for low-ohmic sensor element e.g. PT100, because the copper resistance represents a significant percentage of the nominal resistance.

Typical applications:
- Cables up to 250 mm length
- Standard use of PT1000 RTDs

3- wire circuit
The Resistance Temperature Detector (RTD) is connected via a 3-wire connection cable.
The special 3-wire transducer senses the copper resistance of the connection cable and compensates for it by deducting twice the sensed copper resistance.

Typical applications:
- Cables up to 30 m length
- Transmitter, display, control or process control systems

4-wire circuit
The Resistance Temperature Detector (RTD) is connected via a 4-wire connection cable. Supply and sensing wires are separated. The sensing wires do not carry any current resulting in no voltage drop. The high impedance transducer senses the temperature directly at the RTD.

Typical applications:
- Cables up to 1000 m length
- Transmitter, display, control or process control systems (laboratory calibration technology)

1.2 Selecting the proper temperature sensor

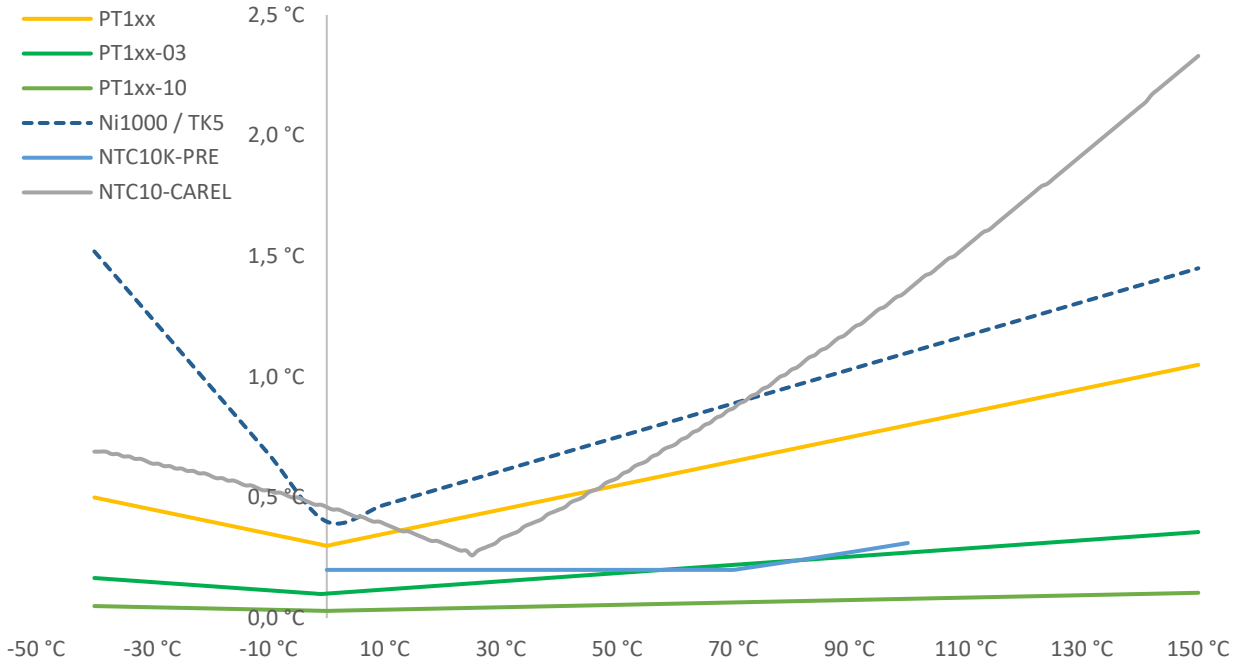
Which sensor element should be used depends on the application. Often sensors are used for measuring temperature in gases, liquids, molten masses or on the surface of solids. Accuracy, response time, temperature range and chemical properties define the correct sensor element.
Primarily Platinum (PT100/PT1000) and Nickel sensors are used in the process industry due to their high stability and repeatability. Both metals have a positive temperature coefficient, i.e. the resistance increases with increasing temperature. In a two-wire circuit the PT1000 has the advantage that the influence of the wire length (copper resistance) is lower by a factor of 10 compared to the PT100.
NTC measuring elements are far less sensitive to copper resistance due to their high nominal resistance. Platinum elements are suitable for temperatures up to +500 °C, NTC resistors can be used typically only up to 160 °C.

	PT100	PT1000	NI1000	NTC	KTY
Temperature measuring range	++	++	+	o	o
Accuracy	++	++	+	o	-
Linearity	++	++	++	-	o
Influence of cable length	-	+	+	++	+
Temperature sensitivity	-	+	+	++	+
Long term stability	++	++	+	o	o
International standards	++	++	+	-	-

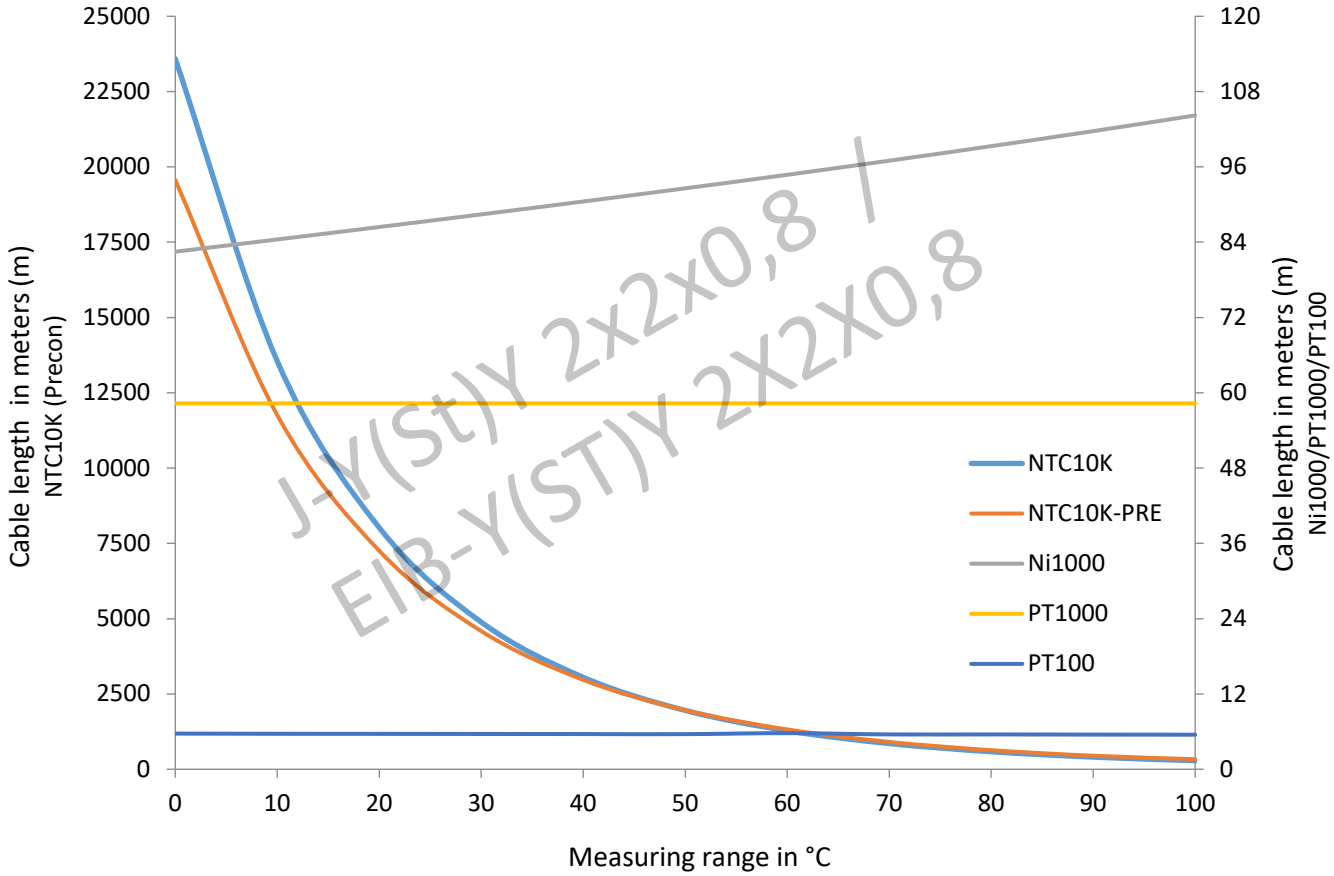
2 Technical data

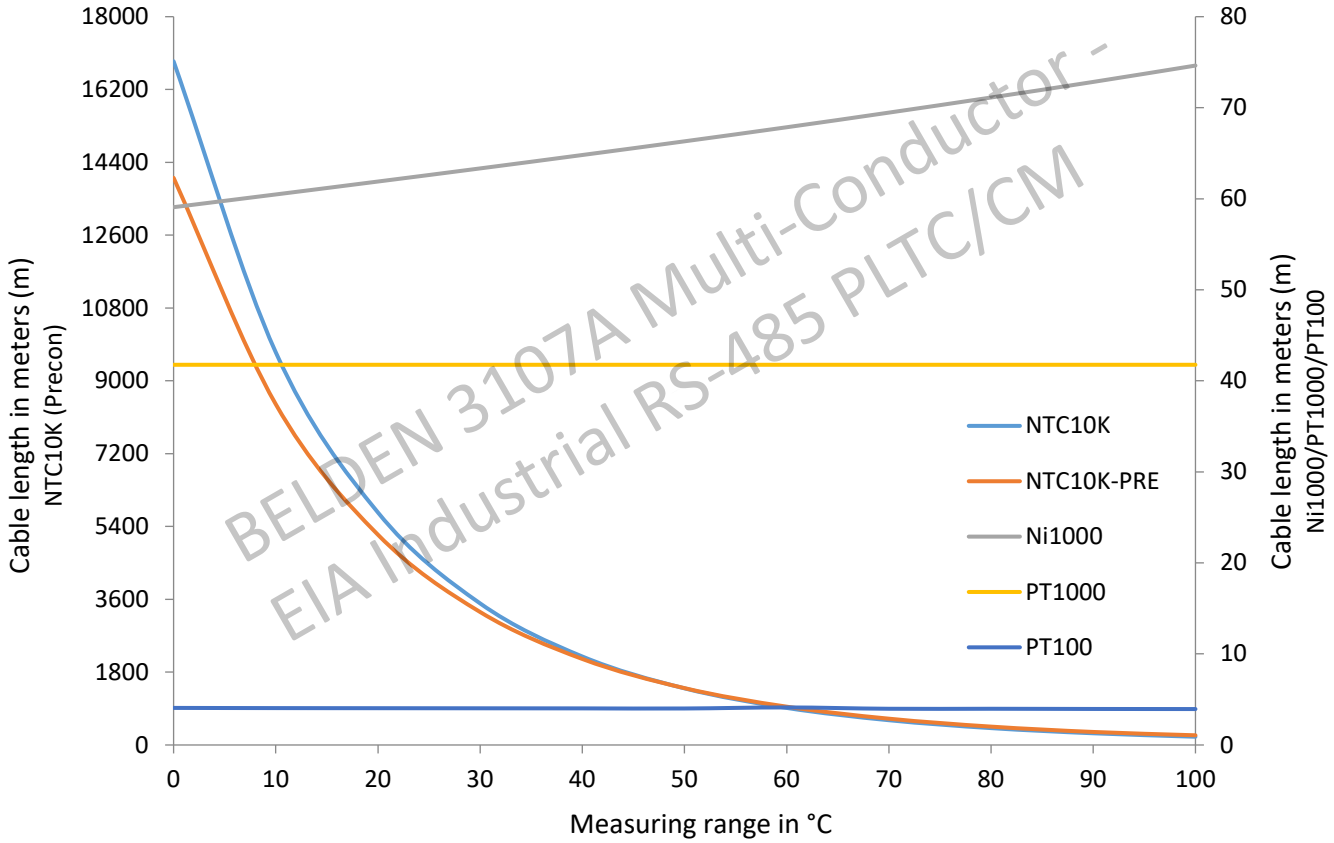
Sensor element	PT100	PT1000	Ni1000	Ni1000 TK5000	NTC 10K	NTC 10K Precon	NTC 10 K Carel
	IEC 751 | EN 60751 Class AA: ±0,1 °C / 0 °C Class B: ±0,3 °C / 0 °C		±0,4 °C / 0 °C,	±0,4 °C / 0 °C	±0,22 °C / 25 °C	±0,2 °C / 25 °C	±0,26 °C / 25 °C
Temp. °C	Ω	Ω	Ω	Ω	kΩ	kΩ	Ω
-50	80,31	803,10	743,00	790,88	667,83	-	-
-40	84,27	842,70	791,00	830,83	335,67	239,8	186.796
-30	88,22	882,20	842,00	871,69	176,68	135,2	110.881
-20	92,16	921,60	893,00	913,48	96,97	78,91	67.683
-10	96,09	960,90	946,00	956,24	55,30	47,54	42.431
0	100,00	1.000,00	1.000,00	1.000,00	32,65	29,49	27.280
10	103,90	1.039,00	1.056,00	1.044,79	19,90	18,79	17.961
20	107,79	1.077,90	1.112,00	1.090,65	12,49	12,26	12.092
25	109,74	1.097,40	1.141,00	1.113,99	10,00	10,00	10.000
30	111,67	1.116,70	1.171,00	1.137,61	8,06	8,19	8.312
40	115,54	1.155,40	1.230,00	1.185,71	5,32	5,59	5.826
50	119,40	1.194,00	1.291,00	1.234,97	3,60	3,89	4.159
60	123,24	1.232,40	1.353,00	1.285,44	2,49	2,76	3.020
70	127,07	1.270,00	1.417,00	1.337,14	1,75	1,99	2.228
80	130,89	1.308,90	1.483,00	1.390,12	1,26	1,46	1.668
90	134,70	1.347,00	1.549,00	1.444,39	0,92	1,08	1.266
100	138,50	1.385,00	1.618,00	1.500,00	0,68	0,82	974
110	142,29	1.422,00	1.688,00	1.556,98	0,51	0,62	758
120	146,06	1.460,60	1.760,00	1.651,36	0,39	0,48	597
130	149,82	1.498,20	1.853,00	1.675,18	0,30	0,38	475
140	153,58	1.535,80	1.909,00	1.736,47	0,23	0,30	382
150	157,31	1.573,10	1.987,00	1.799,26	0,18	0,24	310

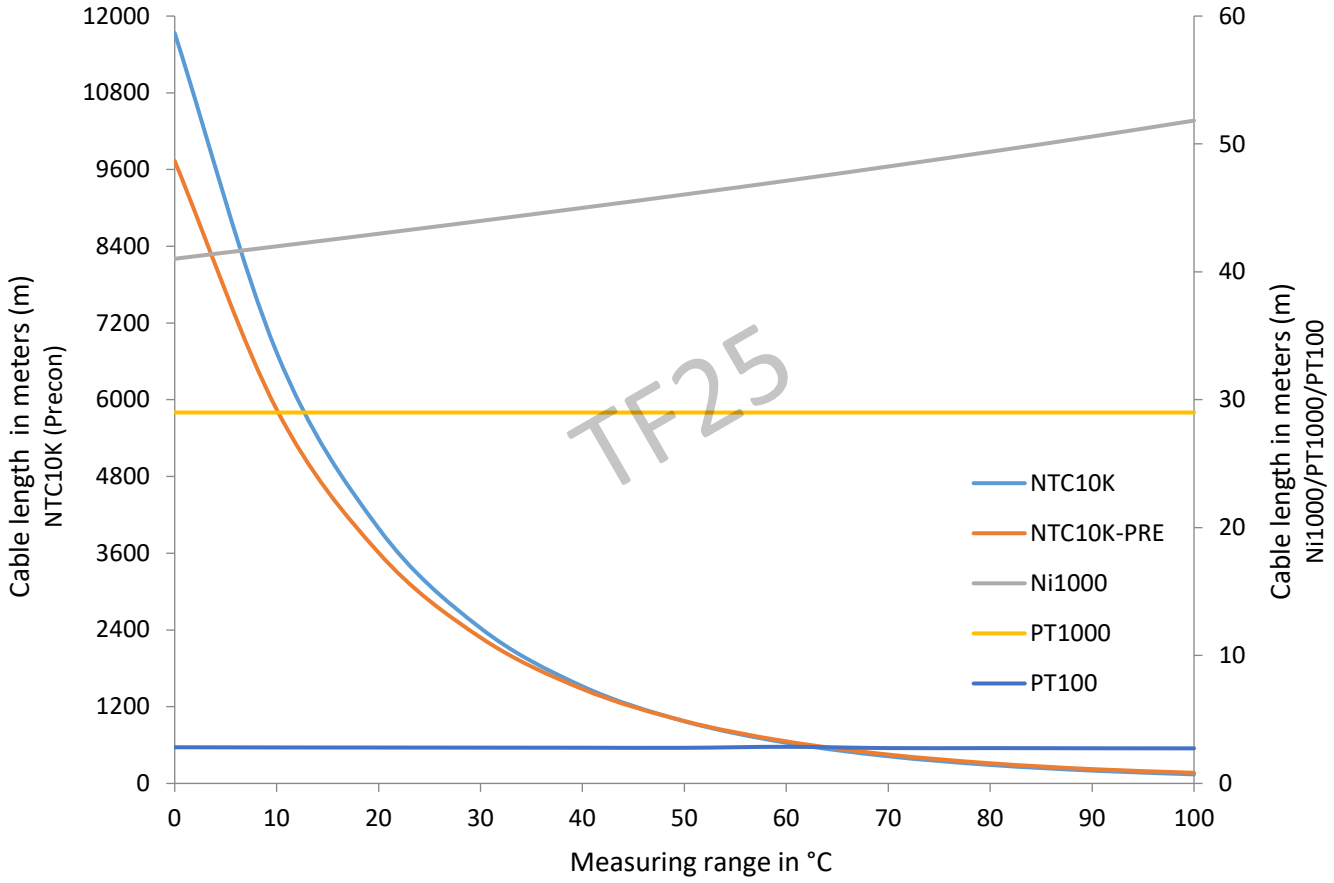
y-scale in °C (y-scale) shows max. error of the measuring elements.

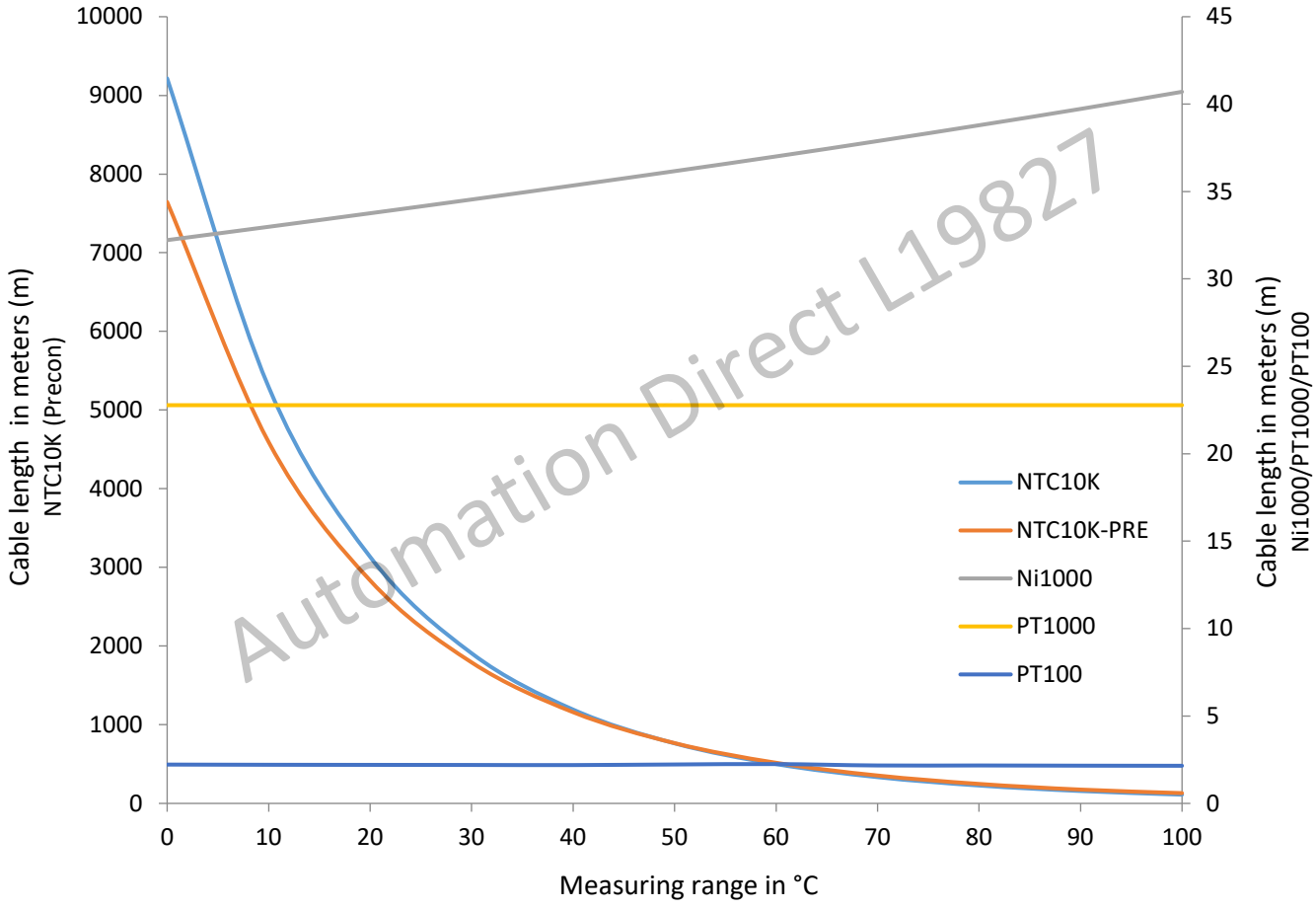


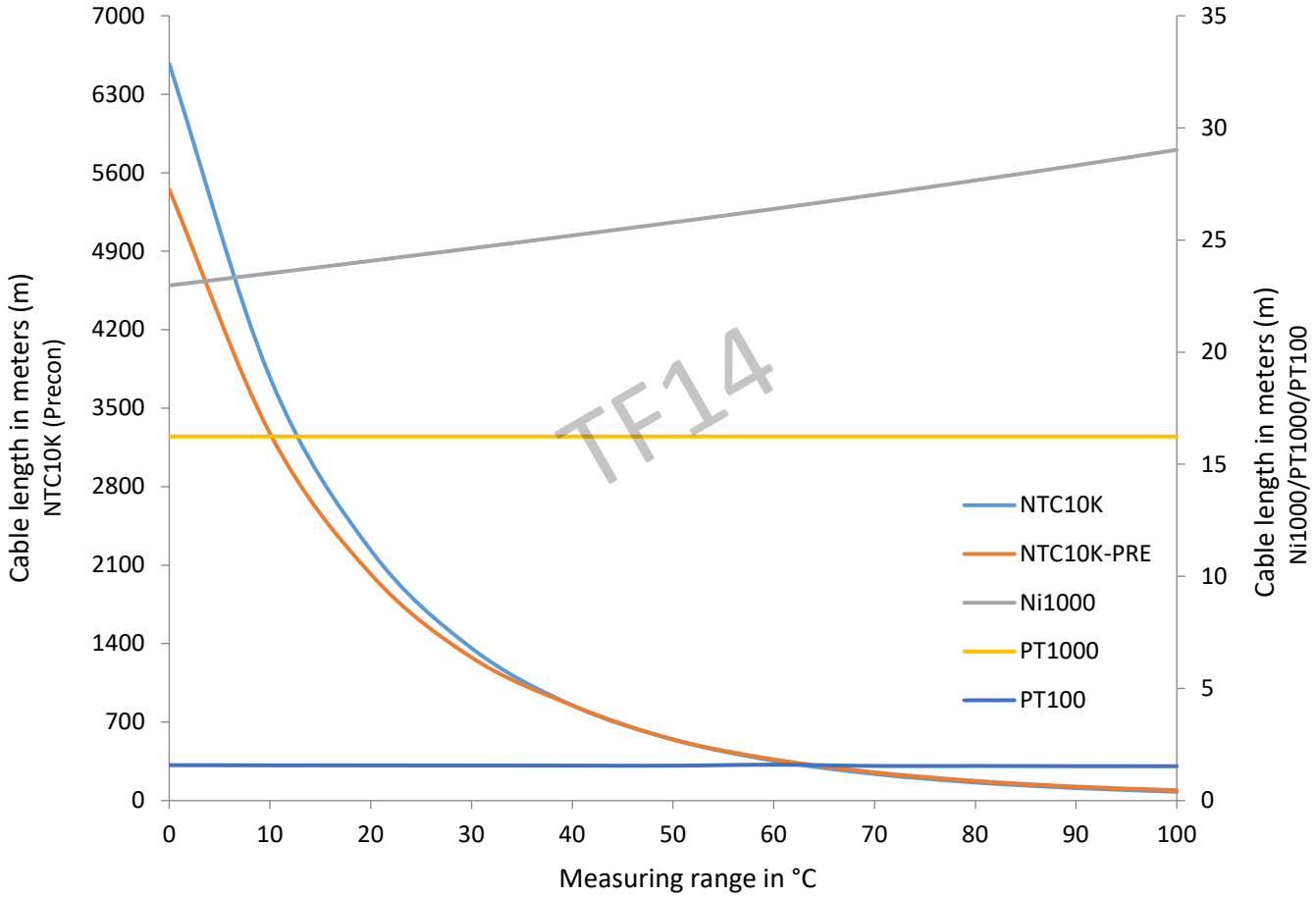
2.1 Cable-depending measuring error of 1 ° C






Cable length in meters (m)
NTC10K (Precon)
Cable length in meters (m)
Ni1000/PT1000/PT100
Measuring range in °C
NTC10K
NTC10K-PRE
Ni1000
PT1000
PT100
TF25


Cable length in meters (m)
NTC10K (Precon)
Cable length in meters (m)
Ni1000/PT1000/PT100
Measuring range in °C
NTC10K
NTC10K-PRE
Ni1000
PT1000
PT100
Automation Direct L19827


7000
6300
5600
4900
4200
3500
2800
2100
1400
700
0
Cable length in meters (m)
NTC10K (Precon)
35
30
25
20
15
10
5
0
Cable length in meters (m)
Ni1000/PT1000/PT100
0
10
20
30
40
50
60
70
80
90
100
Measuring range in °C
TF14
NTC10K
NTC10K-PRE
Ni1000
PT1000
PT100