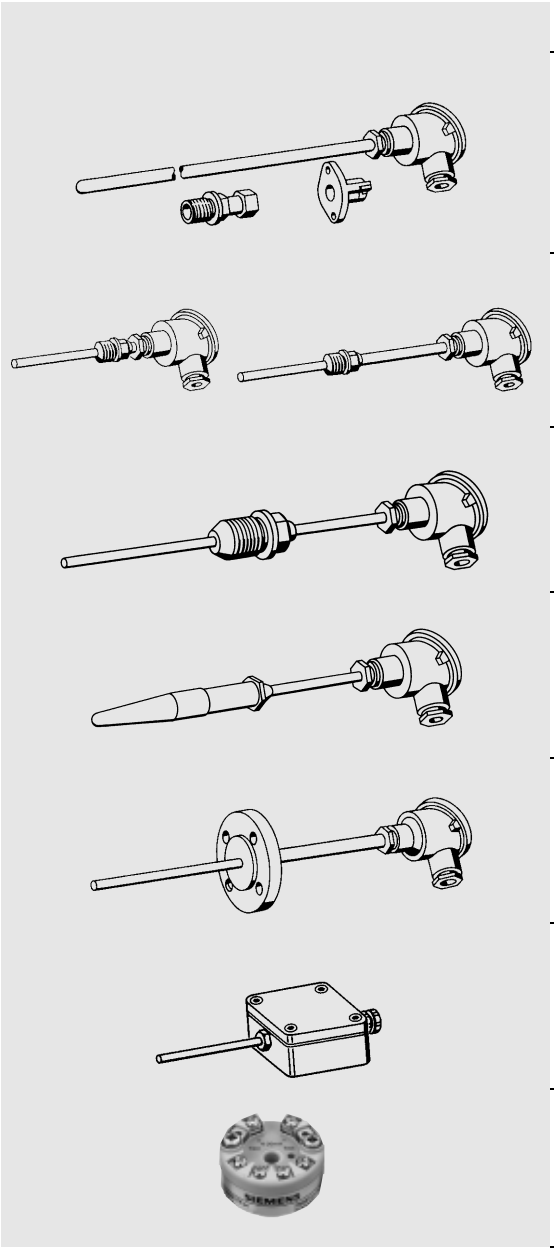
SIEMENS

Resistance thermometers

Supersedes:
Catalog MP 19, Section 1 · 1992

Summary

Summary



Device	Largest measuring range	Page
Flue gas resistance thermometers	-50 to 600 °C	1/9
Low-pressure screw-in resistance thermometers		
Without neck tube	-50 to 400 °C	1/10
With neck tube	-50 to 600 °C	1/11
High-pressure screw-in resistance thermometers	-50 to 600 °C	1/12
High-pressure welding-type resistance thermometers	0 to 550 °C	1/13
Flange-type resistance thermometers	-50 to 600 °C	1/14
Resistance thermometers for damp rooms	-30 to +60 °C	1/16
Temperature transmitters for installation in connection head of resistance thermometer		1/20

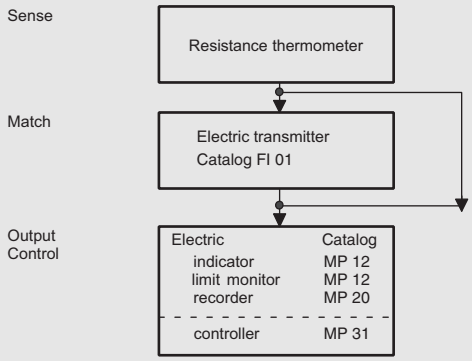


Fig. 1/1 Instrument combination for measuring and controlling temperature, with resistance thermometer as sensor

Design and mode of operation

A resistance thermometer comprises

- the measuring resistor (metal; platinum, Pt or nickel, Ni) and
- the mounting and connection parts required in each case.

The resistance changes with temperature according to a certain, reproducible series of calibration data. The changes in resistance are transmitted as changes in voltage to indicators, recorders or controllers directly via copper wires or via transmitters. The type of measuring circuit depends on the instrument to be connected and the required measuring range.

Measuring resistors are suitable for temperatures from	made of platinum -200 to +850 °C	made of nickel -60 to +150 °C, briefly up to 180 °C.

The measuring resistors are balanced at 0 °C to 100 Ω ± 0.1 Ω. The basic calibration data of the resistors (i.e. the dependence of the resistance on temperature) and the permissible deviations are defined in DIN EN 60 751 (IEC 751).

Calibration data for platinum measuring resistors (to DIN EN 60 751)

°C	Ω	°C	Ω
–200	18.52	240	190.47
–180	27.10	260	197.71
–160	35.34	280	204.90
–140	43.88	300	212.05
–120	52.11	320	219.15
–100	60.26	340	226.21
– 80	68.33	360	233.21
– 60	76.33	380	240.18
– 40	84.27	400	247.09
– 30	88.22	420	253.96
– 20	92.16	440	260.78
– 10	96.09	460	267.56
0	100.00	480	274.29
10	103.90	500	280.98
20	107.79	520	287.62
30	111.67	540	294.21
40	115.54	560	300.75
50	119.40	580	307.25
60	123.24	600	313.71
80	130.90	620	320.12
100	138.51	640	326.48
120	146.07	660	332.79
140	153.58	700	345.28
160	161.05	750	360.64
180	168.48	800	375.70
200	175.86	850	390.48
220	183.19		

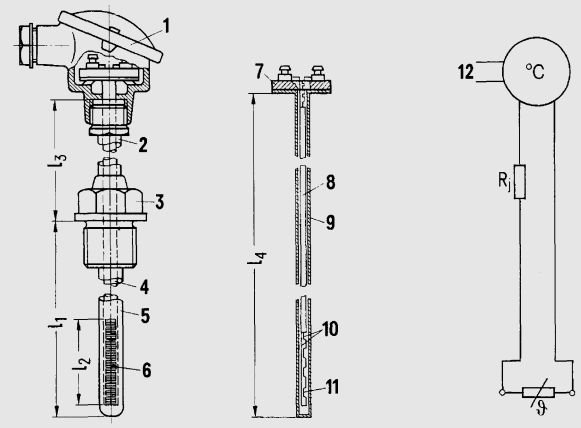
Measuring resistors of class B are supplied. A range of resistors of class A or 1/3 to 1/10 class B is available on request.

Error limits to DIN EN 60 751 (IEC 751)

The resistance thermometers are divided into two classes according to their error limits:

Class	Error limits in °C
A	$0.15 + 0.002 \lvert t \rvert$ [1]
B	$0.3 + 0.005 \lvert t \rvert$

[1] $\lvert t \rvert$ is the numerical value of the temperature in °C without consideration of the sign



a Cross-section of resistance thermometer
l_1 Mounting length
l_2 Sensor length
l_3 Neck length
l_4 Measuring insert length
R_j Balancing resistor

b Cross-section of measuring insert
1 Connection head
2 Extension neck
3 Threaded socket
4 Measuring insert
5 Protective tube
6 Temperature sensor

c Circuit diagram
7 Terminal block
8 Insulating rod
9 Insert tube
10 Internal conductor
11 Measuring resistor
12 Current source

Fig. 1/2 Components and circuitry of a resistance thermometer

In the standard version, the measuring resistors are embedded in ceramic. In the case of special vibration resistance requirements, the Pt measuring resistors are double-wound and fused into glass.

Single and double resistance thermometers are available.

Technical description

To protect the measuring resistor for industrial measurements and to enable easy replacement, it is fixed in a measuring insert (Fig. 1/2) which in turn is fitted in a protective tube. The measuring insert is spring-mounted in the connection head of the protective tube using two screws. The internal conductor in the measuring insert connects the measuring resistor to the terminals on the terminal block.

Measuring ranges for Pt 100 resistance thermometers (to DIN 43 701)

°C	°C	°C	°C
–220 to + 50	0 to 40	0 to 200	50 to 150
–100 to + 50	0 to 60	0 to 300	100 to 200
– 30 to + 60	0 to 100	0 to 400	200 to 400
– 30 to +150	0 to 120	0 to 500	300 to 600
– 20 to + 20	0 to 150	0 to 600	400 to 800

Depending on the measuring range and the accuracy required, the thermometers are connected in two-wire, three-wire or four-wire systems to the output devices.
The measuring inserts are therefore available with two, three or four internal conductors. If the resistance of the internal conductor is negligibly small, measuring inserts with only two internal conductors can be used for the three-wire and four-wire systems.
Exact balancing of the internal conductor under operating conditions is only possible with three conductors. If the resistance of the internal conductor is greater than 0.2 Ω, its magnitude is indicated on the mounting flange of the measuring insert.
The thermometer is heated up by the thermometer current compared to the material to be measured. The heating-up error thus produced increases with the square of the thermometer current and linearly with the resistance of the measuring resistor. Apart from the magnitude of the thermometer current, the error depends on the design of the thermometer and on the heat transfer between the protective tube and the medium. A high measuring power is required for output instruments operating according to the deflection method. To keep the heating-up error within permissible limits, the thermometer current should not be greater than 10 mA in this case.
When measuring the temperature of gases with very small flow velocities, a considerably greater heating-up error occurs than in measurements with very fast gases or liquids. The heating-up error is negligibly small with high flow velocities.
Suitable protective fittings are used for installation in pipelines, tanks etc. depending on the mechanical or chemical requirements.
The materials for the protective tubes or combinations of different protective tube materials must be carefully selected in order to meet the requirements due to static pressure, flow and temperature. Furthermore, the indication response should be as fast as possible.
The type of installation of the protective tubes depends on the application. The protective tubes are screwed into the pipelines in the case of operating pressures up to approx. 90 bar. Tapered protective tubes which can be welded in are available for higher pressures. Thermometers for measuring furnace temperatures are fixed using flanges.
Owing to the different operating conditions, no guarantee can be given for protective fittings. The manufacturer is responsible for damages and measuring errors caused by wrong installation in compliance with the General Terms of Delivery if the instruments have been installed by the manufacturer and if the specifications for the operating conditions furnished by the customer were correct and sufficiently detailed.

Installation examples and materials of protective tubes

Measuring point and maximum operating temperature		Protective tube material	No.
A. Steam power plants			
Water and steam lines (screw-in and welding-type thermometers)	300 °C 400 °C 540 °C 570 °C	Bronze Sn Bz 6 (only for water) St 35.8 13 CrMo 44 10 CrMo 9 10	2.1020 1.0305 1.7335 1.7380
Flue gas	550 °C	St 35.8, enamelled	1.0305
Pulverized coal/air mixture line	100 °C	St 35.8 (with baffle rod)	1.0305
Water treatment	30 °C	X 6 CrNiTi 18 10 or X 6 CrNiMoTi 17 122	1.4541 1.4571
B. Paper mills			
In paper pulp (cylindrical paper mills, hand-made paper, refiner)	60 °C	X 6 CrNiMoTi 17 122	1.4571
C. Cellulose manufacture		For all tanks with internal lining: only flange-type thermometers	
1. Sulphite pulp			
Boiling acid in vat, peetz tank and acid tower	150 °C	X 6 CrNiMoTi 17 122	1.4571
Hypochlorite tower, alkali tower	40 °C	X 6 CrNiMoTi 17 122	1.4571
Sulphite lye evaporation, heat exchanger, preheater and lye collecting tank	140 °C	X 6 CrNiMoTi 17 122	1.4571
2. Sulphate pulp			
Vat, lye heater	In vat 180 °C		
Waste lye tank, etc.	otherwise 80 °C	X 6 CrNiTi 18 10 or X 6 CrNiMoTi 17 122	1.4541 1.4571
Cellulose multiple-stage bleaching (moist chloric gases present)	40 °C	Hastelloy C (59 Ni; 16 Mo; 15,5 Cr; 5,5 Fe; 3,8 W) or X 6 CrNiMoTi 17 122 with Ti protective sleeve	1.4571
Sulphate lye evaporation, heat exchanger, preheater and lye collecting tank	140 °C	X 6 CrNiMoTi 17 122	1.4571
D. Dye works			
Jigger, automatic yarn skein dying machine	110 °C	X 6 CrNiMoTi 17 122	1.4571
E. Food industry			
1. Breweries			
Brewing water	80 °C	Bronze Sn Bz 6 or X 6 CrNiTi 18 10	2.1020 1.4541
Mash, hot wort	100 °C	Bronze or X 6 CrNiTi 18 10	 1.4541
Cold wort	4 °C	X 6 CrNiTi 18 10	1.4541
2. Sugar factories			
Salt removal in sugar juice	100 °C	X 6 CrNiTi 18 10	1.4541
3. Cereals production			
Salt removal in whey	20 °C	X 6 CrNiTi 18 10	1.4541
4. Malt houses			
Steeping water	100 °C	Bronze Sn Bz 6	2.1020
5. Yeast production			
Yeast cooling	4 °C	X 6 CrNiTi 18 10	1.4541
Yeast fermentation	33 °C	X 6 CrNiMoTi 17 122	1.4571
F. Chemical and petrochemical industries			
Corrosion-resistant steel, material Nos. 1.4541 and 1.4571, can be used for many applications. The numerous substances to be measured in these industrial branches render it sometimes difficult to recommend suitable protective tube materials. If required, please contact our representatives in these cases.			

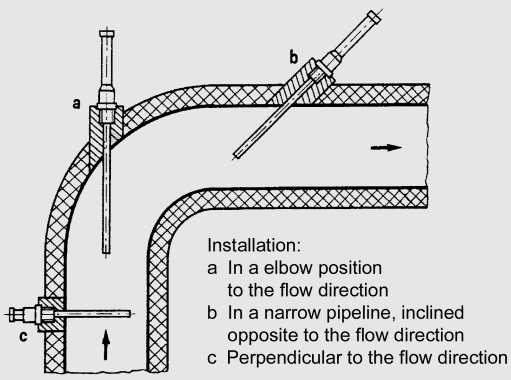


Fig. 1/3 Protective tubes in a pipeline

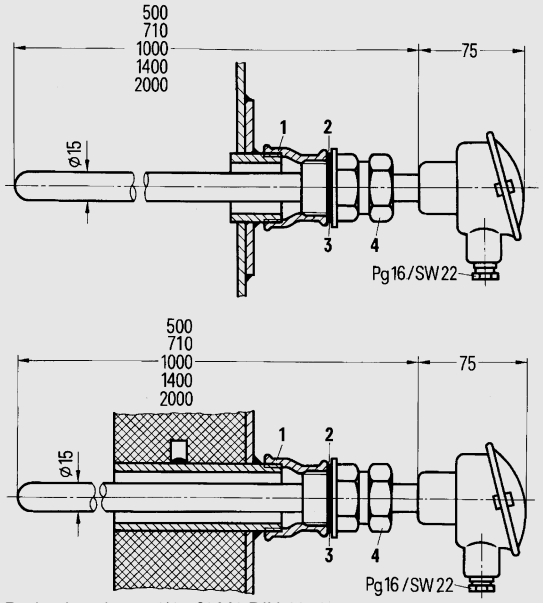


Fig. 1/4 Flue gas resistance thermometer, fitted in a sheet-metal duct (top) and a flue gas duct (bottom)

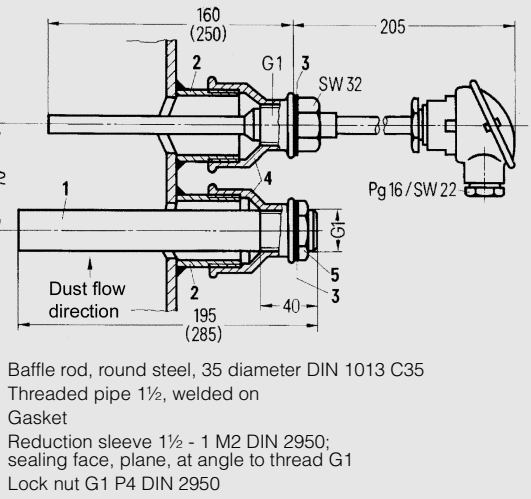


Fig. 1/5 Screw-in resistance thermometer in a pulverized coal line, with baffle rod

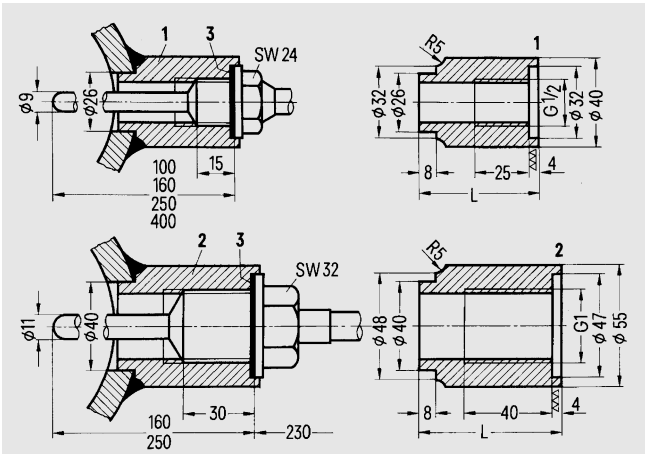
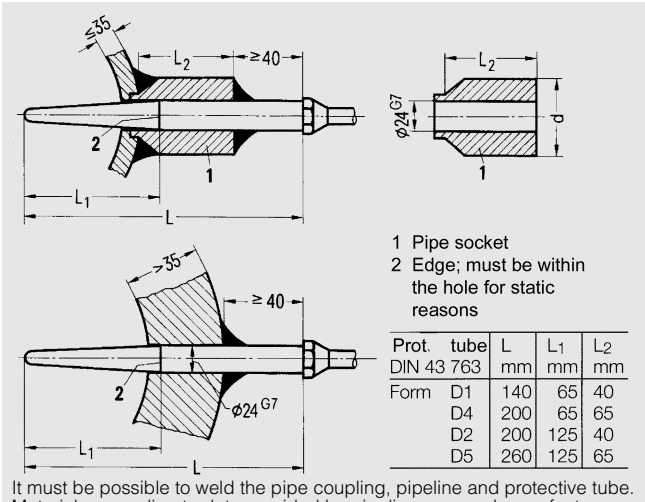


Fig. 1/6 Screw-in protective tubes, mounted;
at top for low-pressure, with screw socket G½;
at bottom for high-pressure, with screw socket G1

It must be possible to weld the pipe coupling and pipeline. Material according to data provided by pipeline or vessel manufacturer.

Thread	G½				G1	
Mounting length in mm	100	160	250	400	160	250
Nominal diameter	L in mm					
50	80	-	-	–	–	–
65	70	-	-	–	–	–
80	65	125	-	–	100	–
100	55	115	205	–	100	–
125	45	100	190	–	100	–
150	45	90	180	–	65	–
175	–	75	165	–	65	–
200	–	65	155	–	65	125
250	–	45	130	–	65	100
300	–	–	105	–	65	100
350	–	–	80	–	65	65
400	–	–	55	205	65	65
500	–	–	45	155	65	65
600	–	–	–	105	65	65
700	–	–	–	55	65	65



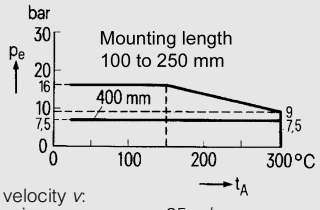
Prot. tube DIN 43 763		L mm	L_1 mm	L_2 mm
Form	D1	140	65	40
	D4	200	65	65
	D2	200	125	40
	D5	260	125	65

Fig. 1/7 Welding-type protective tubes, mounted;
top: wall thickness ≤ 35 mm; mounting using welded coupling;
bottom: wall thickness > 35 mm

Loading capacity to DIN 43 763

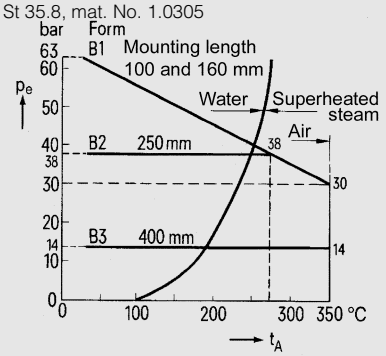
Protective tubes form B for low-pressure screw-in resistance thermometers and thermocouples

Material: Bronze



Permissible flow velocity *v*:
for air 25 m/s
for water 3 m/s 2 m/s
with mounting length ≤ 250 mm 400 mm
Permissible tightening torque for screw socket:
33 Nm

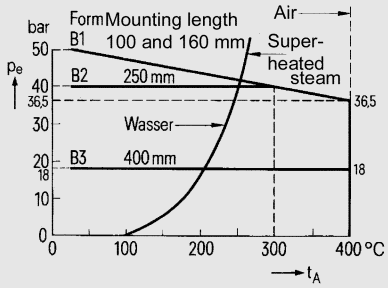
St 35.8, mat. No. 1.0305



for air and superheated steam 25 m/s
for water 3 m/s

50 Nm

X 6 CrNiTi 18 10, mat. No. 1.4541, and
X 6 CrNiMoTi 17 122, mat. No. 1.4571

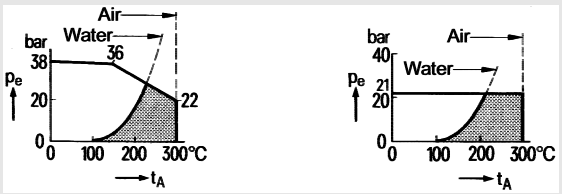


for air and superheated steam 25 m/s
for water 3 m/s

50 Nm

Fig. 1/8 Loading capacity of the protective tubes, form B, for low-pressure screw-in resistance thermometers and thermocouples

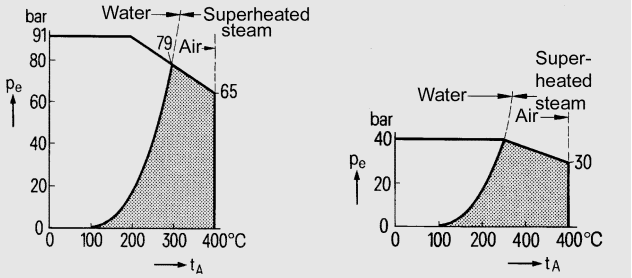
Protective tubes form C for high-pressure screw-in resistance thermometers and thermocouples



Form C1, mount. length 160 mm Form C2, mount. length 250 mm
Permissible tightening torque for screw socket: 65 Nm

Mount. length	Temperature	Measured medium: Water	Measured medium: Air
		Max. permissible flow velocity: 5 m/s	Max. permissible flow velocity: 40 m/s
mm	°C	Permissible pressure in bar	
160	20	0 to 38	38
	150	3.9 to 36	36
	200	14 to 31	31
	300	–	22
250	20	0 to 21	21
	150	3.9 to 21	21
	200	14 to 21	21
	300	–	21

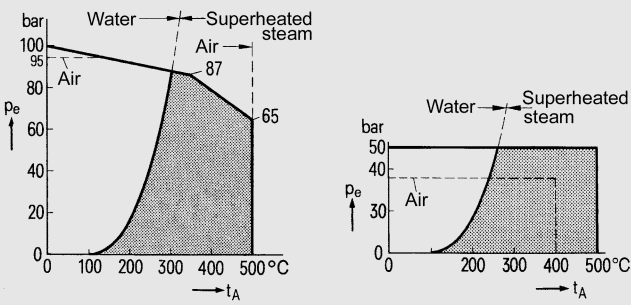
Fig. 1/9 Loading capacity of the protective tubes, form C, bronze



Form C1, mount. length 160 mm Form C2, mount. length 250 mm
Permissible tightening torque for screw socket: 100 Nm

Mount. length	Temperature	Measured medium: Water	Measured medium: Superh. steam	Measured medium: Air
		Max. permissible flow velocity: 5 m/s	Max. permissible flow velocity: 40 m/s	Max. permissible flow velocity: 40 m/s
mm	°C	Permissible pressure in bar		
160	20	0 to 91	–	91
	200	14 to 91	14	91
	250	39 to 84	39	84
	294	79	79	79
	400	–	65	65
250	20	0 to 40	–	40
	200	14 to 40	14	40
	250	39 to 40	39	40
	251	–	40	40
	400	–	30	30

Fig. 1/10 Loading capacity of the protective tubes, form C, St 35.8, mat. No. 1.0305



Form C1, mount. length 160 mm Form C2, mount. length 250 mm
Permissible tightening torque for screw socket: 100 Nm

Mount. length	Temperature	Measured medium: Water	Measured medium: Superh. steam	Measured medium: Air
		Max. permissible flow velocity: 5 m/s	Max. permissible flow velocity: 40 m/s	Max. permissible flow velocity: 40 m/s
mm	°C	Permissible pressure in bar		
160	20	0 to 100	–	95
	200	14 to 93	14	93
	250	39 to 91	39	91
	300	86 to 89	86	89
	302	89	89	89
	350	–	87	87
	500	–	65	65
250	20	0 to 50	–	35
	200	14 to 50	14	35
	250	39 to 50	39	35
	264	50	50	35
	500	–	50	–

Fig. 1/11 Loading capacity of the protective tubes, form C, 13 CrMo 44, mat. No. 1.7335, or X 6 CrNiMoTi 17 122, mat. No. 1.4571

Protective tubes form D for high-pressure welding-type resistance thermometers and thermocouples

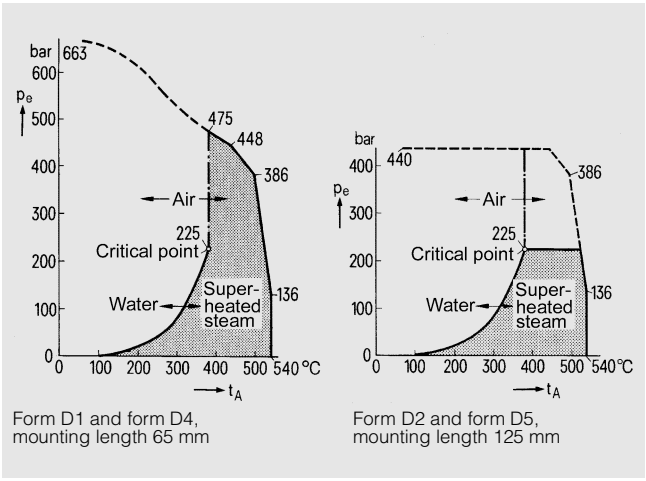
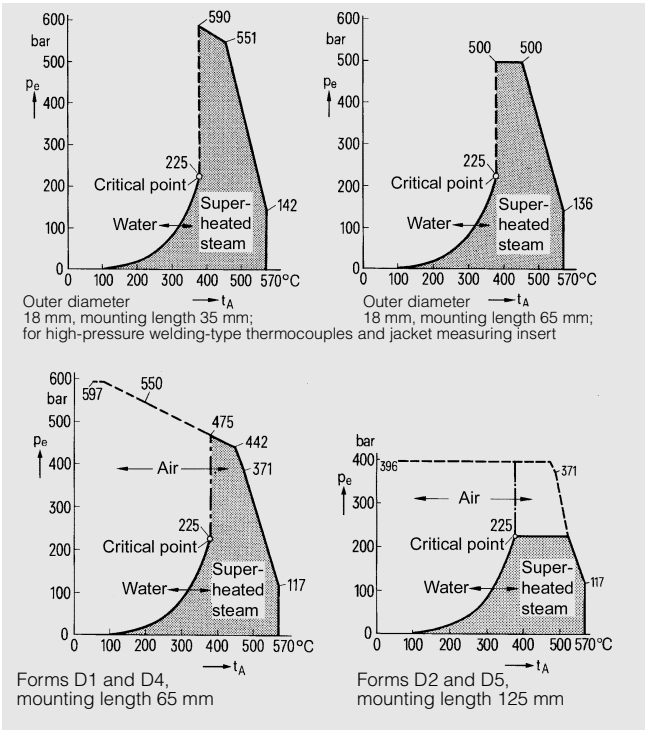


Fig. 1/12 Loading capacity of protective tubes, form D, made of 13 CrMo 44, mat. No. 1.7335

Temperature	Protective tube material 13 CrMo 44, mat. No. 1.7335			
	Form D1 and form D4, mounting length 65 mm		Form D2 and form D5, mounting length 125 mm	
	Permissible pressure in bar			
°C	Super. steam	Air	Super. steam	Air
20	–	663	–	440
200	14	619	14	440
250	39	575	39	440
300	86	539	86	440
350	167	486	167	440
375	225	475	225	440
375	475	475	225	440
435	448	448	225	440
443	439	439	225	440
490	386	386	225	386
500	343	343	225	343
510	270	270	225	270
516	240	240	225	225
520	210	210	210	210
530	170	170	170	170
540	136	136	136	136

Max. permissible flow velocity for air and superheated steam: 60 m/s

Permissible water pressure with flow velocities up to 5 m/s: 450 bar



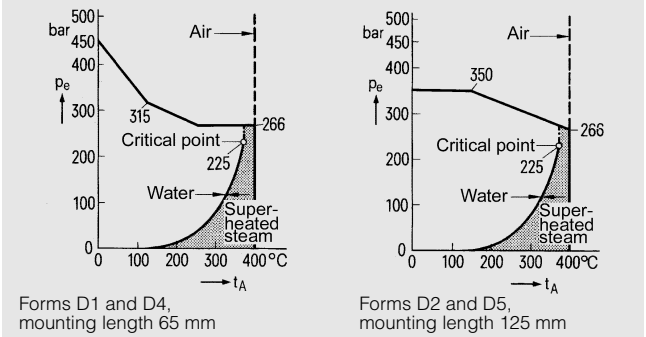
Temperature	Protective tube material 10 CrMo 9 10, mat. No. 1.7380					
	Forms D1 and D4, mounting length 65 mm		Forms D2 and D5, mounting length 125 mm		Outer diam. 18 mm, mounting length 35 mm	65 mm
	Permissible pressure in bar					
°C	Superh. steam	Air	Superh. steam	Air	Superh. steam	Superh. steam
20	–	597	–	396		
200	14	550	14	396	14	14
250	39	528	39	396	39	39
300	86	507	86	396	86	86
350	167	485	167	396	167	167
375	225	475	225	396	225	225
375	475	475	225	396	590	500
450	442	442	225	396	551	500
470	399	399	225	396		
480	371	371	225	371	444	
490	337	337	225	337		
500	301	301	225	301	355	
510	265	265	225	265		
520	230	230	225	230	285	271
522	225	225	225	225		
530	203	203	203	203		232
540	177	177	177	177	215	201
550	153	153	153	153	184	171
560	132	132	132	132	159	155
570	117	177	117	117	142	136

Max. permissible flow velocity for air and superheated steam: 60 m/s

Permissible water pressure with flow velocities up to 5 m/s: 450 bar

The outer diameter of the protective tubes to DIN 43 763, forms D1, D2, D4 and D5 is 24 mm.

Fig. 1/13 Loading capacity of protective tubes, form D or similar (top), made of 10 CrMo 9 10, mat. No. 1.7380

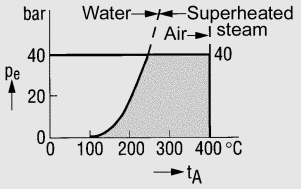


Temperature	Protect. tube material X 6 CrNiMoTi 17 122, mat. No. 1.4571;			
	Form D1 and form D4, mounting length 65 mm		Form D2 and form D5, mounting length 125 mm	
	Max. permissible flow velocity of			
	Water, superheated steam or air 60 m/s		Water, superheated steam 30 m/s	Air 60 m/s
	Permissible pressure in bar			
°C	Superheated steam	Air	Superheated steam	Air
20	–	450	–	350
200	10	275	10	335
250	27	266	27	320
300	75	266	75	300
350	150	266	150	280
400	225	266	225	266

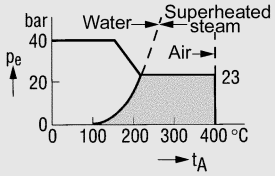
Fig. 1/14 Loading capacity of protective tubes, form D, made of X 6 CrNiMoTi 17 122, mat. No. 1.4571

Loading capacity to DIN 43 763

Protective tubes of form F



Form F1, mounting length 225 mm, and
form F2, mounting length 285 mm

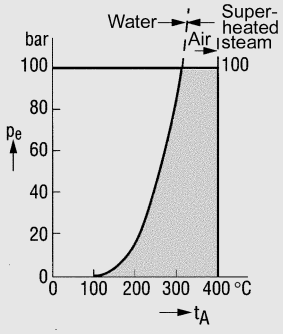


Form F3, mounting length 345 mm

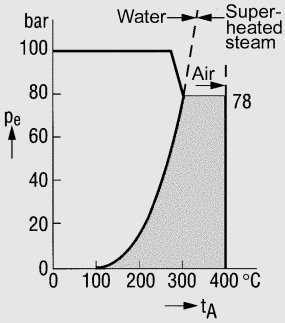
Mount. length	Flange nominal pressure	Measured medium: Water	Sup. steam	Air			
		Max. permissible flow velocity in m/s: 5	40	10	20	30	40
mm		Permissible pressure in bar					
225	40	As shown in the diagrams	As shown in the diagrams	40	40	40	40
	100			100	100	68	42
285	40			40	40	40	25
	100			75	65	45	25
345	40			40	40	30	18
	100			58	45	30	18

Fig. 1/15 Loading capacity of the protective tubes, form F, X 6 CrNiMoTi 17 122, mat. No. 1.4571, or X 6 CrNiTi 18 10, mat. No. 1.4541

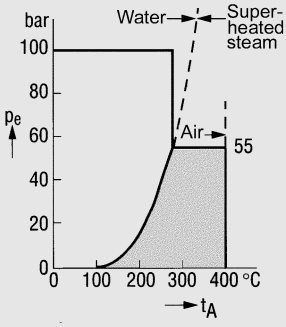
Protective tubes of form G



Form G1, mounting length 160 mm



Form G2, mounting length 220 mm



Form G3, mounting length 280 mm

Mount. length	Measured medium: Water	Superh. steam	Air			
	Max. permissible flow velocity in m/s: 5	40	10	20	30	40
mm	Permissible pressure in bar					
160	As shown in the diagrams	As shown in the diagrams	100	100	100	100
220			100	100	98	58
280			100	100	58	38

Fig. 1/16 Loading capacity of the protective tubes, form G, X6 CrNiMoTi 17 122, mat. No. 1.4571, or X 6 CrNiTi 18 10, mat. No. 1.4541

Application

The sensor is suitable for a temperature range from -50 to 600 °C.
The sensor is also available with a built-in temperature transmitter.

Design

Design	According to DIN 43 764: thermometer without mount
Protective tube	
Form	A, DIN 43 763; cylindrical, 15 mm diameter, wall thickness 3 mm, seamless
Material	St 35.8, mat. No. 1.0305, enamelled
Loading capacity	1 bar above atmospheric, to DIN 43 763
Measuring insert	Replaceable, with measuring insert tube (8 mm diameter) made of stainless steel; terminal block with clamping springs

Please order mounting flange or threaded sleeve separately.

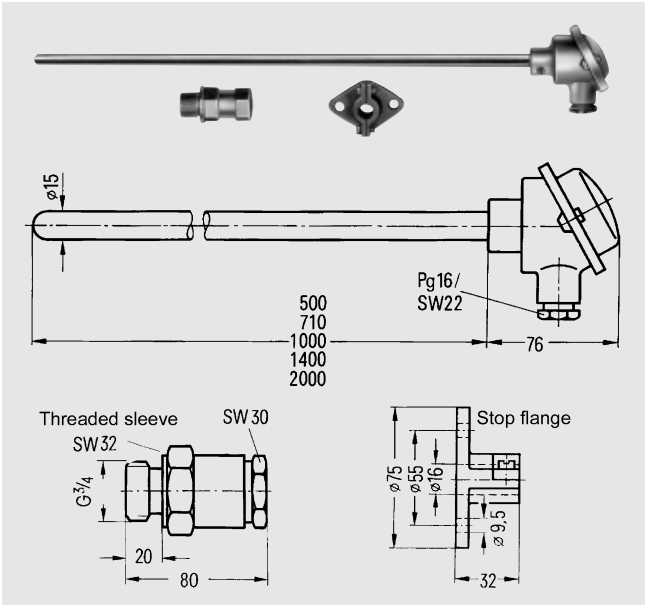


Fig. 1/17 Flue gas resistance thermometer with connection head

Ordering data

Flue gas resistance thermometer

Mounting length	kg	Measuring resistor (winding) embedded in ceramic 1 Pt measuring resistor, three-wire system
mm		Order No.
500	0.9	**7MC1000-1BA2**
710	1.1	**7MC1000-2BA2**
1000	1.5	**7MC1000-3BA2**
1400	1.9	**7MC1000-4BA2**
2000	2.7	**7MC1000-5BA2**
Connection head, form B, made of cast light alloy, with 1 cable bushing and		↑
• Screw cover		**1**
• Standard hinged cover		**4**
• High hinged cover		**6**
Accessories		
Mounting flange, adjustable, to DIN 43 734; material: GTW 35, mat. No. 0.8035, for 15 mm protective tube diameter	0.3	**7MC2998-5CA**
Gas-tight threaded sleeve Material: 9 SMnPb 28, mat. No. 1.0718, for 15 mm protective tube diameter, G¾ internal thread with gasket	0.4	**7MC2998-5DA**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

Low-pressure screw-in resistance thermometers
with connection head, without neck tube

7MC1006

Application

The sensor is suitable for a temperature range from -50 to 400 °C.
The sensor is also available with a built-in temperature transmitter.

Design

Design	According to DIN 43 765: screw-in thermometer
Protective tube	
Form	B, DIN 43 763; cylindrical, 9 mm diameter, wall thickness 1 mm
Loading capacity	To DIN 43 763; cf. page 1/6
Screw socket	G½; suitable is gasket 21 x 26, similar to form C or D, DIN 7603
Measuring insert	Replaceable, with measuring insert tube (6 mm diameter) made of stainless steel; terminal block with clamping springs

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 25 s $t_{0.9}$ = 75 s
In air with flow velocity	v = 1 m/s	$t_{0.5}$ = 2 min $t_{0.9}$ = 6.3 min
Explosion protection		Type of protection EEx ia IIC T6, zone 1, available soon

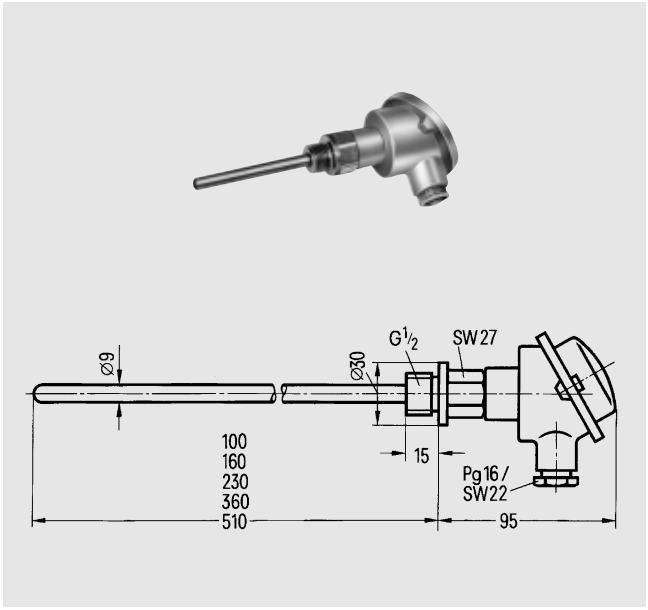


Fig. 1/18 Low-pressure screw-in resistance thermometer with connection head, without neck tube

Ordering data

Low-pressure screw-in resistance thermometer

Measuring resistor	Protective tube to DIN 43 763, form	Mounting length mm	kg	Measuring insert not explosion protected Protective tube and screw socket X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.	Measuring insert explosion protected [1] Protective tube and screw socket X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.
1 Pt measuring resistor, embedded in ceramic, three-wire system	–	100	0.6	**7MC1006-1DA1** ■	**7MC1006-1DE1** ■
	B1	160	0.7	**7MC1006-2DA1** ■	**7MC1006-2DE1** ■
	B2	230	0.8	**7MC1006-3DA1** ■	**7MC1006-3DE1** ■
	B3	360	0.9	**7MC1006-4DA1** ■	**7MC1006-4DE1** ■
	–	510	1.0	**7MC1006-5DA1** ■	**7MC1006-5DE1** ■
2 Pt measuring resistors, embedded in ceramic, two-wire system	–	100	0.6	**7MC1006-1DB1** ■	**7MC1006-1DF1** ■
	B1	160	0.71	**7MC1006-2DB1** ■	**7MC1006-2DF1** ■
	B2	230	0.81	**7MC1006-3DB1** ■	**7MC1006-3DF1** ■
	B3	360	0.91	**7MC1006-4DB1** ■	**7MC1006-4DF1** ■
	–	510	1.01	**7MC1006-5DB1** ■	**7MC1006-5DF1** ■
Connection head form B, made of cast light alloy, with 1 cable bushing and screw cover				▲	▲
standard hinged cover				**1**	**1**
high hinged cover				**4**	**4**
				6	**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

[1]) Available soon

Application

The sensor is suitable for a temperature range from -50 to 600 °C.
The sensor is also available with a built-in temperature transmitter.

Design

Design	According to DIN 43 765: screw-in thermometer
Protective tube	
Form	B, DIN 43 763; cylindrical, 9 mm diameter, wall thickness 1 mm,
Loading capacity	To DIN 43 763; cf. page 1/6
Screw socket	G½; suitable is gasket 21 x 26, similar to form C or D, DIN 7603
Measuring insert	Replaceable, with measuring insert tube (6 mm diameter) made of stainless steel; terminal block with clamping springs

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 25 s $t_{0.9}$ = 75 s
In air with flow velocity	v = 1 m/s	$t_{0.5}$ = 2 min $t_{0.9}$ = 6.3 min
Explosion protection		Type of protection EEx ia IIC T6. zone 1, available soon

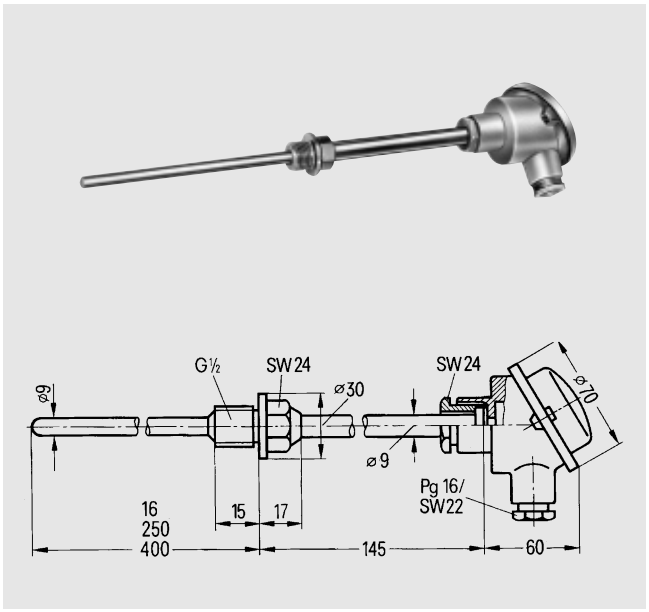


Fig. 1/19 Low-pressure screw-in resistance thermometer with neck tube

Ordering data

Low-pressure screw-in resistance thermometer

Measuring resistor	Protective tube to DIN 43 763, form	Mounting length mm	kg	Measuring insert not explosion protected Protective tube and screw socket X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.	Measuring insert explosion protected [1] Protective tube and screw socket X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.
1 Pt measuring resistor, embedded in ceramic, three-wire system	B1 B2 B3	160 250 400	0,8 0,9 1,0	**7MC1007-5DA1** **7MC1007-6DA1** **7MC1007-7DA1**	**7MC1007-5DE1** **7MC1007-6DE1** **7MC1007-7DE1**
2 Pt measuring resistors, embedded in ceramic, two-wire system	B1 B2 B3	160 250 400	0,9 1,0 1,1	**7MC1007-5DB1** **7MC1007-6DB1** **7MC1007-7DB1**	**7MC1007-5DF1** **7MC1007-6DF1** **7MC1007-7DF1**
Connection head form B, made of cast light alloy, with 1 cable bushing and screw cover				↑ **1** **4** **6**	↑ **1** **4** **6**
				standard hinged cover high hinged cover	

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

[1]) Available soon

High-pressure screw-in resistance thermometers
with connection head and neck tube

7MC1008

Application

The sensor is suitable for a temperature range from -50 to 600 °C.

The sensor is also available with a built-in temperature transmitter.

Design

Design	According to DIN 43 766: screw-in thermometer
Protective tube	
Form	C, DIN 43 763; cylindrical, 11 mm diameter, wall thickness 2 mm
Loading capacity	To DIN 43 763; cf. page 1/6
Screw socket	G1; suitable is gasket 33 x 39, similar to form C or D, DIN 7603
Measuring insert	Replaceable, with measuring insert tube (6 mm diameter) made of stainless steel; terminal block with clamping springs

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 32 s $t_{0.9}$ = 96 s
In air with flow velocity	v = 1 m/s	$t_{0.5}$ = 2.2 min $t_{0.9}$ = 6.8 min

Ordering data

High-pressure screw-in resistance thermometer

Measuring resistor	Protective tube to DIN 43 763, form	Mounting length	kg	Protective tube and screw socket X 6 CrNiMoTi 17 122, mat. No. 1.4571
		mm		Order No.
1 Pt measuring resistor, embedded in ceramic, three-wire system	C1	160	0.83	**7MC1008-6DA1**
	C2	250	0.93	**7MC1008-7DA1**
2 Pt measuring resistors, embedded in ceramic, two-wire system	C1	160	0.86	**7MC1008-6DB1**
	C2	250	0.94	**7MC1008-7DB1**
Connection head form B, made of cast light alloy, with 1 cable bushing and				
• Screw cover				**1**
• Standard hinged cover				**4**
• High hinged cover				**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

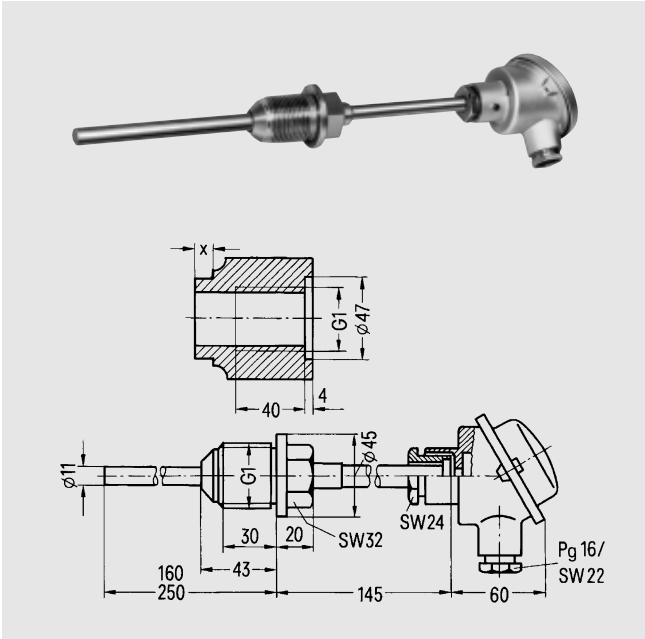


Fig. 1/20 High-pressure screw-in resistance thermometer with neck tube

High-pressure welding-type resistance thermometers
with connection head and neck tube

7MC1010

Application

The sensor is suitable for a temperature range from 0 to 540, or 550 °C.

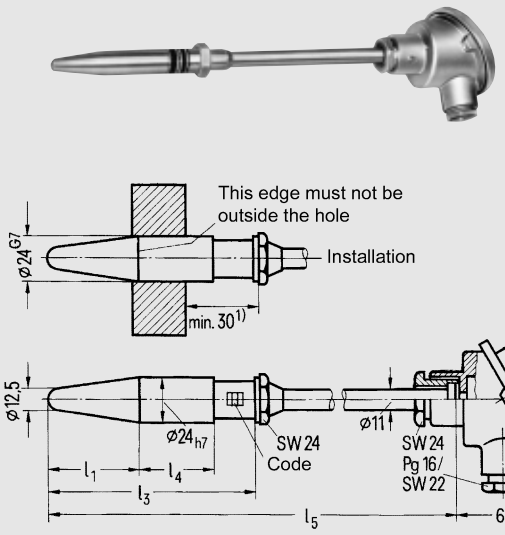
The sensor is also available with a built-in temperature transmitter.

Design

Design	According to DIN 43 767: screw-in thermometer
Protective tube	
Form	D, DIN 43 763; tapered, for welding in; with female thread M18 x 1.5 for neck tube
Loading capacity	To DIN 43 763; cf. page 1/7
Neck tube	Stainless steel, unscrewable
Measuring insert	Replaceable, with measuring insert tube made of stainless steel; terminal block with clamping springs

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 25 s $t_{0.9}$ = 80 s
Explosion protection		Type of protection EEx ia IIC T6, zone 1, available soon



1) Select distance at least large enough to prevent damage to the thread during welding.

Fig. 1/21 High-pressure welding-type resistance thermometer with connection head and neck tube

Ordering data

High-pressure screw-in resistance thermometer

Measuring resistor	Protective tube to DIN 43 763, form	Mounting length l_1 mm	Protective tube length l_3 mm	Length l_4 mm	Total length without connection head l_5 mm	kg	Measuring insert not explosion protected Temperature up to 540° C Protective tube 13 CrMo 44, mat. No. 1.7335 Order No.	not explosion protected up to 550° C Protective tube X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.	explosion protected 1) up to 550° C Protective tube X 6 CrNiMoTi 17 122, mat. No. 1.4571 Order No.
							7MC1010-	**7MC1010-**	**7MC1010-**
1 Pt measuring resistor, embedded in ceramic, three-wire system	D 1	65	140	50	305	0.78	**1GA2** ■	**1FA2** ■	**1FE2** ■
					365	0.82	**2GA2** ■	**2FA2** ■	**2FE2** ■
					395	0.85	**3GA2** ■	**3FA2** ■	**3FE2** ■
	D 4		200	110	365	0.95	**4GA2** ■	**4FA2** ■	**4FE2** ■
					395	0.98	**5GA2** ■	**5FA2** ■	**5FE2** ■
	D 2	125	200	50	365	0.95	**6GA2** ■	**6FA2** ■	**6FE2** ■
					395	0.98	**7GA2** ■	**7FA2** ■	**7FE2** ■
	D 5		260	110	395	1.15	**8GA2** ■	**8FA2** ■	**8FE2** ■
2 Pt measuring resistors, embedded in ceramic, two-wire system	D 1	65	140	50	305	0.79	**1GB2** ■	**1FB2** ■	**1FF2** ■
					365	0.83	**2GB2** ■	**2FB2** ■	**2FF2** ■
					395	0.86	**3GB2** ■	**3FB2** ■	**3FF2** ■
	D 4		200	110	365	0.86	**4GB2** ■	**4FB2** ■	**4FF2** ■
					395	1.00	**5GB2** ■	**5FB2** ■	**5FF2** ■
	D 2	125	200	50	365	0.96	**6GB2** ■	**6FB2** ■	**6FF2** ■
					395	1.00	**7GB2** ■	**7FB2** ■	**7FF2** ■
	D 5		260	110	395	1.20	**8GB2** ■	**8FB2** ■	**8FF2** ■
Connection head form B, made of cast light alloy, with 1 cable bushing and							▲	▲	▲
					screw cover		**1**	**1**	**1**
					standard hinged cover		**4**	**4**	**4**
					high hinged cover		**6**	**6**	**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts: measuring inserts on page 1/17, connection heads on page 1/19.

1) Available soon.

Flange-type resistance thermometers
with connection head

7MC1017

Application

The sensor can be installed in tanks and pipelines; it is suitable for a temperature range from -50 to 600 °C.

The sensor is also available with a built-in temperature transmitter.

Design

Protective tube	
Form	Cylindrical, 11 mm diameter, wall thickness 2 mm
Material	X 6 CrNiMoTi 17 122, mat. No. 1.4571
Flange	Nominal diameter DN 25, nominal pressure PN 40
Measuring insert	Replaceable, with measuring insert tube (6 mm diameter) made of stainless steel; terminal block with clamping springs

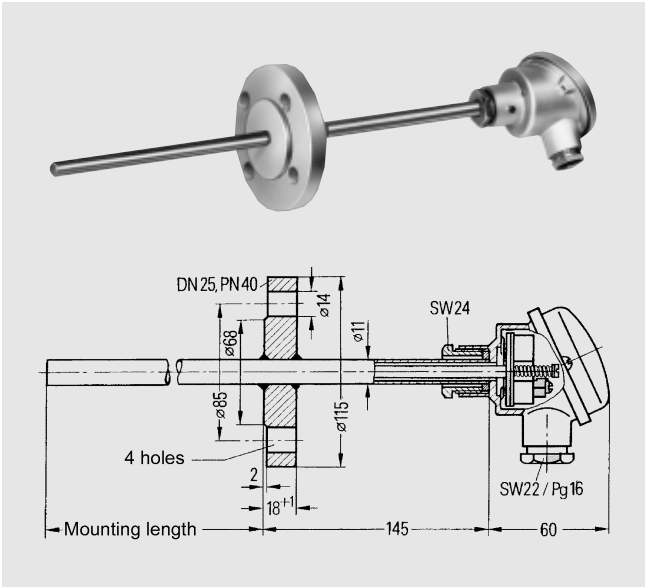


Fig. 1/22 Flange-type resistance thermometer with connection head

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 32 s $t_{0.9}$ = 96 s
In air with flow velocity v = 1 m/s		$t_{0.5}$ = 2.2 min $t_{0.9}$ = 6.8 min
Explosion protection		Type of protection EEx ia IIC T6, zone 1, available soon

Ordering data

Flange-type resistance thermometer

Measuring resistor	Mounting length	kg	Measuring insert not explosion protected	Measuring insert explosion protected [1]
	mm		Order No.	Order No.
1 Pt measuring resistor, embedded in ceramic, three-wire system	160	1.5	**7MC1017-1FA1**	**7MC1017-1FE1**
	250	1.5	**7MC1017-2FA1**	**7MC1017-2FE1**
2 Pt measuring resistors, embedded in ceramic, two-wire system	160	1.6	**7MC1017-1FB1**	**7MC1017-1FF1**
	250	1.6	**7MC1017-2FB1**	**7MC1017-2FF1**
Connection head form B, made of cast light alloy, with 1 cable bushing and				
• Screw cover			**1**	**1**
• Standard hinged cover			**4**	**4**
• High hinged cover			**6**	**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

[1]) Available soon.

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Application

The sensor can be installed in tanks and pipelines; it is suitable for a temperature range from -50 to 600 °C.

The sensor is also available with a built-in temperature transmitter.

Design

Protective tube	
Form	F, DIN 43 763; cylindrical, 12 mm diameter, wall thickness 2.5 mm, tapered towards tip; tip cylindrical over length of 47 mm, 9 mm diameter, wall thickness 1.5 mm
Material	X 6 CrNiMoTi 17 122, mat. No. 1.4571
Loading capacity	To DIN 43 763; cf. page 1/8
Flange	Nominal diameter DN 25, nominal pressure PN 40
Measuring insert	Replaceable, with measuring insert tube (6 mm diameter) made of stainless steel; terminal block with clamping springs

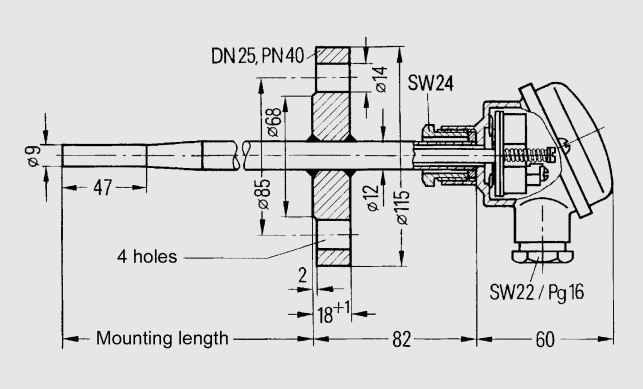


Fig. 1/23 Flange-type resistance thermometer with reduced response time; with connection head

Technical data

Response times to VDI/VDE 3 522		
In water with flow velocity	v = 0.4 m/s	$t_{0.5}$ = 22 s $t_{0.9}$ = 66 s
In air with flow velocity	v = 1 m/s	$t_{0.5}$ = 2.1 min $t_{0.9}$ = 6.5 min
Explosion protection		Type of protection EEx ia IIC T6, zone 1, available soon

Ordering data

Flange-type resistance thermometer

Measuring resistor	Mounting length	kg	Measuring insert not explosion protected	Measuring insert explosion protected [1]
	mm		Order No.	Order No.
1 Pt measuring resistor, embedded in ceramic, three-wire system	225	1,5	**7MC1041-1AA0**	**7MC1041-1EA0**
	285	1,5	**7MC1041-2AA0**	**7MC1041-2EA0**
	345	1,5	**7MC1041-3AA0**	**7MC1041-3EA0**
2 Pt measuring resistors, embedded in ceramic, two-wire system	225	1,6	**7MC1041-1AB0**	**7MC1041-1EB0**
	285	1,6	**7MC1041-2AB0**	**7MC1041-2EB0**
	345	1,6	**7MC1041-3AB0**	**7MC1041-3EB0**
Connection head form B, made of cast light alloy, with 1 cable bushing and				
• Screw cover			**1**	**1**
• Standard hinged cover			**4**	**4**
• High hinged cover			**6**	**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Individual parts:
measuring inserts on page 1/17, connection heads on page 1/19.

[1]) Available soon.

7MC1027

Application

The sensor is suitable for a temperature range from -30 to +60 °C.

Design

Protective tube	Made of stainless steel
Connection head	Made of cast light alloy, with cable bushing; made of plastic on request
Measuring insert	1 or 2 Pt measuring resistors to DIN IEC 751, connection in three-wire or four-wire system, class B
Degree of protection	IP 65 to VDE 0470-1

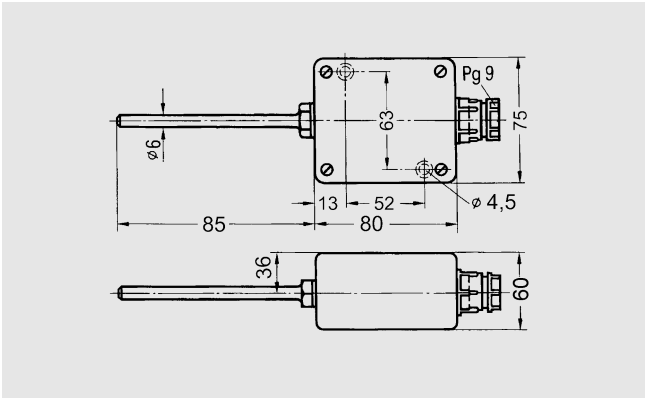


Fig. 1/24 Resistance thermometer for moist rooms

Ordering data

Designation	kg	Order No.
Resistance thermometer for damp rooms		
With 1 Pt measuring resistor	0.1	**7MC1027-1AA**
With 2 Pt measuring resistors	0.1	**7MC1027-1AB**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Measuring inserts for flue gas, low-pressure, high-pressure and flange-type resistance thermometers

Design to DIN 43 762

Components

Measuring insert with resistor, insert tube with retaining plate, terminal block with clamping springs and 2 or 3 internal conductors of Cu-Ni sheathed wire for each Pt 100 measuring resistor.

The resistance of the internal conductors is stated on the measuring insert if it is greater than 0.2 Ω

The measuring inserts have a filling of Al_2O_3 powder which surrounds the measuring resistor and the internal conductors and results in a high vibration resistance (for temperatures up to 600 °C). The winding is embedded in a ceramic body.

If the vibrations at the measuring location are greater than normal, the special vibration-proof measuring inserts should be used (for temperatures up to 450 °C). The measuring resistor is embedded in an homogeneous, fused glass body.

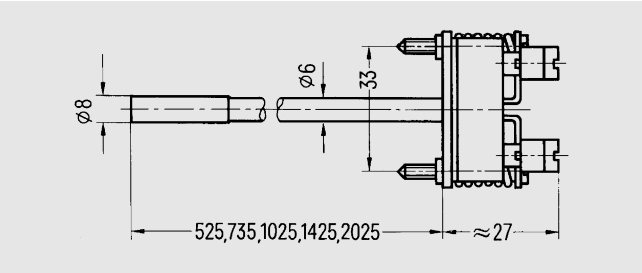


Fig. 1/25 Measuring insert for flue gas resistance thermometers

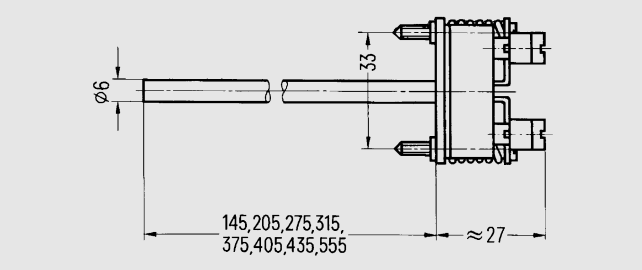


Fig. 1/26 Measuring insert for low-pressure, high-pressure and flange-type resistance thermometers

Ordering data

Measuring insert for flue gas resistance thermometer 7MC1000 (not explosion protected), for temperatures up to 600 °C, insert tube made of stainless steel

Measuring insert length	Mounting length of resistance thermometer	kg	Measuring resistor; winding embedded in ceramic 1 Pt measuring resistor, three-wire system
mm	mm		Order No.
525	500	0.22	**7MC1900-1EA**
735	710	0.27	**7MC1900-2EA**
1025	1000	0.32	**7MC1900-3EA**
1425	1400	0.42	**7MC1900-4EA**
2025	2000	0.62	**7MC1900-5EA**

Measuring insert for low-pressure, high-pressure and flange-type resistance thermometers (not explosion protected)
Insert tube made of stainless steel

Measuring insert length	Screw-in thermometer without neck tube, 7MC1006	Screw-in thermometer with neck tube, 7MC1007 and 7MC1008	Welding-type thermometer 7MC1010	Flange-type thermometer		kg	Measuring resistor; winding embedded in ceramic (max. 600 °C)	
				7MC1017	7MC1041		1 Pt measuring resistor,	2 Pt measuring resistors,
	Mounting length	Mounting length	Total length without connection head	Mounting length			three-wire system	two-wire system
mm	mm	mm	mm	mm	mm		Order No.	Order No.
145	100	–	–	–	–	0.15	**7MC1910-1JA**	**7MC1910-1JB**
205	160	–	–	–	–	0.16	**7MC1910-2JA**	**7MC1910-2JB**
275	230	–	–	–	–	0.17	**7MC1910-3JA**	**7MC1910-3JB**
315	–	160	305	160	225	0.18	**7MC1910-4JA**	**7MC1910-4JB**
375	–	–	365	–	285	0.19	**7MC1910-5JA**	**7MC1910-5JB**
405	360	250	395	250	–	0.20	**7MC1910-6JA**	**7MC1910-6JB**
435	–	–	–	–	345		**7MC1910-8JA**	**7MC1910-8JB**
555	510	400	–	–	–	0.21	**7MC1910-7JA**	**7MC1910-7JB**

Further measuring inserts on request.

Explosion protected measuring insert

Application

An explosion protected measuring insert is suitable for installation in a protective fitting and for connection to a certified intrinsically-safe circuit of category "ia" or "ib".

The measuring insert may only be used if the protective fitting has the degree of protection IP 20 according to DIN 40 050.

Design

The measuring resistor is fitted in a 60-mm long stainless steel sleeve with an outer diameter of 6 mm. The sleeve and the sheath of the supply cable are welded. The sheath of the supply cable is also made of stainless steel, and its outer diameter is 5 mm.

The conductors are made of special copper and are embedded in highly compacted magnesium oxide powder. The connection points between the measuring resistor and the conductors are additionally isolated. The conductors are potted in the terminal base.

The rating plate is located underneath the retaining plate.

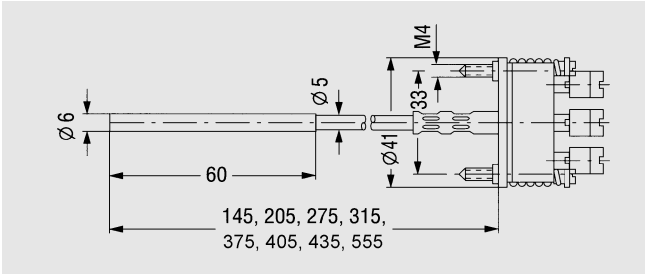


Fig. 1/27 Explosion protected measuring insert for resistance thermometers

Technical data

Measuring temperature	-200 to +450 °C The temperature depends on the maximum measuring current which can flow in the connected measuring circuit if an error occurs.
Resistance of internal conductor	Per measuring circuit, i.e. for both conductors of the two-wire system:
Outer diameter of sleeve 6 mm	0.17 Ω/m measuring insert
Insulation resistance of measuring insert	> 1000 MΩ at room temperature
Explosion protection	Type of protection EEx ia IIC T6, zone 1, available soon

Ordering data

Explosion protected measuring insert for low-pressure, high-pressure and flange-type resistance thermometers
Insert tube made of stainless steel

Measuring insert length	Screw-in thermometer without neck tube, 7MC1006	Screw-in thermometer with neck tube 7MC1007	Welding-type thermometer 7MC1010	Flange-type thermometer 7MC1017	7MC1041	kg	Measuring resistor; winding embedded in ceramic (max. 450 °C)	
			Total length without connection head				1 Pt measuring resistor, three-wire system	2 Pt measuring resistors, two-wire system
	Mounting length	Mounting length		Mounting length	Mounting length		Outer diameter of sleeve 6 mm	6 mm
mm	mm	mm	mm	mm	mm		Order No. [1])	Order No. [1])
145	100	–	–	–	–	0.15	**7MC1913-1AA22**	**7MC1913-1AB12**
205	160	–	–	–	–	0.16	**7MC1913-2AA22**	**7MC1913-2AB12**
275	230	–	–	–	–	0.17	**7MC1913-3AA22**	**7MC1913-3AB12**
315	–	160	305	160	225	0.18	**7MC1913-4AA22**	**7MC1913-4AB12**
375	–	–	365	–	285	0.19	**7MC1913-5AA22**	**7MC1913-5AB12**
405	360	250	395	250	–	0.20	**7MC1913-6AA22**	**7MC1913-6AB12**
435	–	–	–	–	345	0.20	**7MC1913-7AA22**	**7MC1913-7AB12**
555	510	400	–	–	–	0.21	**7MC1913-8AA22**	**7MC1913-8AB12**

Further measuring inserts on request.

[1]) Available soon.

Welding-type protective tubes

Ordering data

Welding-type protective tube for high-pressure resistance thermometers to DIN 43 767, without neck tube, without connection head;
tapered shank with cylindrical welding stub, for measuring insert tube with 6 mm OD;
female thread M18 x 1.5 (including steel screw plug); see page 1/7 for loading capacity

Protective tube to DIN 43 763, form	Mounting length	Protective tube length	kg	Up to 540 °C	Up to 550 °C[1])
				Protective tube made of 13 CrMo 44, mat. No. 1.7335	Protective tube made of X 6 CrNiMoTi 17 122, mat. No. 1.4571
	mm	mm		Order No.	Order No.
D 1	65	140	0.3	**7MC1905-1GA**	**7MC1905-1DA**
D 4	65	200	0.5	**7MC1905-2GA**	**7MC1905-2DA**
D 2	125	200	0.5	**7MC1905-3GA**	**7MC1905-3DA**
D 5	125	260	0.6	**7MC1905-4GA**	**7MC1905-4DA**

Neck tubes

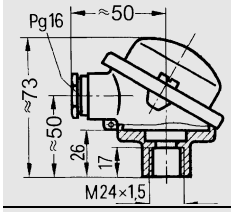
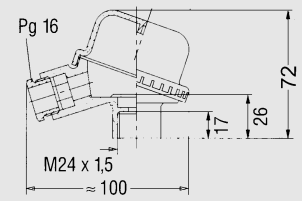
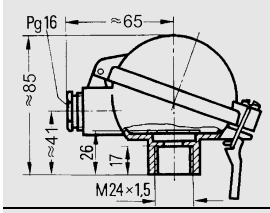
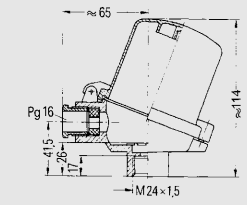
Ordering data

Neck tube for high-pressure welding-type resistance thermometers
made of stainless steel, mat. No. 1.4571, with thread at both ends, for measuring insert tube with 6 mm OD

Neck tube length	Total length of resistance thermometer, without connection head	Protective tube length	kg	Order No.
	mm	mm		
135	395	260	0.14	**7MC1906-1AA**
165	305/365	140/200	0.15	**7MC1906-2AA**
195	395	200	0.18	**7MC1906-3AA**
225	365	140	0.20	**7MC1906-4AA**
255	395	140	0.22	**7MC1906-5AA**

Connection heads for low and high-pressure resistance thermometers, flue gas and flange-type resistance thermometers

Ordering data

	Designation	kg	Order No.
	**Connection head, form B** Degree of protection IP 54, DIN 40 050 Made of cast light alloy, with screw cover and with 1 cable bushing	0.14	**7MC1907-1BA**
	**Connection head, form B** Degree of protection IP 54, DIN VDE 0470-1 Made of plastic, with screw cover and with 1 cable bushing	0.46	**7MC1907-1BK**
	**Connection head, form B** Degree of protection IP 54, DIN VDE 0470-1 Made of cast light alloy, with standard hinged cover and with 1 cable bushing	0.15	**7MC1907-1BF**
	**Connection head, form B** Degree of protection IP 54, DIN VDE 0470-1 Made of cast light alloy, with high hinged cover and with 1 cable bushing	0.2	**7MC1907-1BL**

Connection heads with a drilled hole of 15.5 mm diameter instead of the female thread M24 x 1.5 on request.

1) No loading diagram to DIN 43 763.

Temperature transmitters

Summary

The following temperature transmitters are available for installation in the connection head:

SITRANS TK

Programmable two-wire temperature transmitter (4 to 20 mA), electrical isolation for resistance thermometers and thermocouples.

SITRANS TK-H

Two-wire temperature transmitter with HART communication (4 to 20 mA), electrical isolation for resistance thermometers and thermocouples.

SITRANS T3K PA

Temperature transmitter with PROFIBUS-PA connection, electrical isolation for resistance thermometers and thermocouples.

SITRANS TK/TK-H can be fitted instead of the terminal block or in the high hinged cover.

SITRANS T3K PA can only be fitted in the high hinged cover of the connection head.

Detailed information on the transmitters can be found in Catalog FI 01, Section 2.

Fig. 1/28 SITRANS T3K PA (left) and SITRANS TK/TK-H (right) temperature transmitters

Ordering data

To order the sensor with a built-in temperature transmitter, add **"-Z"** to the Order No. of the sensor, and supplement by the following Order code:

Transmitter to be fitted	Order code
SITRANS TK, without Ex	**K10**
SITRANS TK, EEx n for zone 2	**K11**
SITRANS TK, EEx ia IIC	**K12**
SITRANS TK-H, without Ex	**K20**
SITRANS TK-H, EEx n for zone 2	**K21**
SITRANS TK-H, EEx ia IIC	**K22**
SITRANS T3K PA, without Ex	**K30**
SITRANS T3K PA, EEx ia IIC	**K31**
Customer-specific setting of the built-in transmitter (specify settings in plain text)	**Y11**

SIEMENS

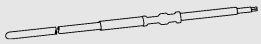
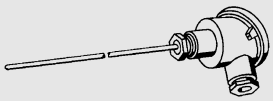
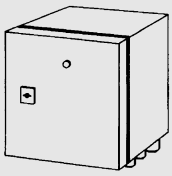
Thermocouples

2

Supersedes:
Catalog MP 19, Section 2 · 1992

Summary

Summary

	Device	Largest measuring range	Page
	**Straight thermocouples**	0 to 1250 °C	2/7
	**Jacket thermocouple with extension lead**	0 to 1100 °C	2/10
	**Jacket thermocouple with connection head, form B**	0 to 1100 °C	2/11
	**Jacket thermocouple with socket**	0 to 1100 °C	2/12
	**Cold junction** with built-in power supply unit	Reference temperature 0 or 20 °C	2/14
	**Cold junction thermostat** For max. 6 or 12 measuring points For max. 12 or 24 measuring points	Reference temperature 50, 60 or 70 °C 50, 60 or 70 °C	 2/15 2/16
	**Temperature transmitters** for installation in connection head of thermocouple		Section 1, page 1/20

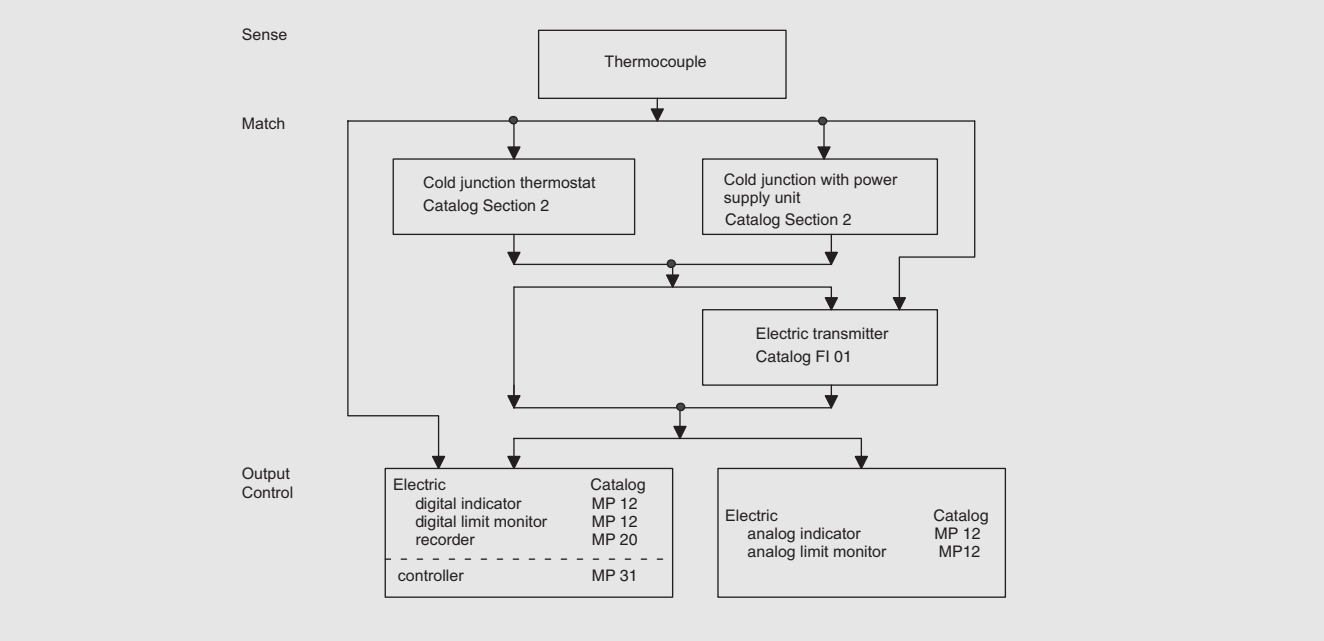


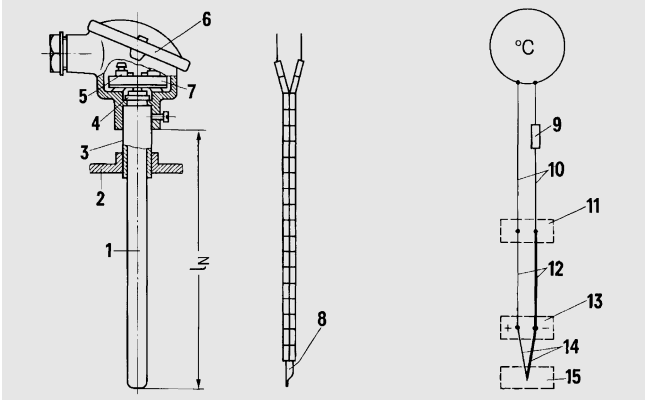
Fig. 2/1 Instrument combination for measuring and controlling temperature, with thermocouple as sensor

Design and mode of operation

A thermocouple comprises

- the thermocouple element (sensor) and
- the mounting and connection parts required in each case.

The thermocouple element is formed by two conductors of dissimilar metals or metal alloys which are soldered or welded together at one end, the measuring junction (Fig. 2/2).



a Cross-section of thermocouple
l_N Nominal length
1 Ceramic protective tube
2 Locating flange
3 Support tube
4 Retaining ring
5 Terminal

b Thermocouple element with insulating beads
6 Connection head
7 Terminal block
8 Temperature sensor
9 Balancing resistor
10 Lead

c Circuit diagram
11 Cold junction
12 Extension lead
13 Connection point
14 Thermocouple element with positive and negative legs
15 Measuring junction

Fig. 2/2 Thermocouple

If the measuring junction is exposed to a temperature different from that at the free ends of the thermocouple element, a voltage (the thermoelectric voltage, Seebeck effect) is produced at these free ends. The magnitude of the thermoelectric voltage depends on the difference in temperature between the measuring junction and the free ends, and on the combination of materials in the thermocouple element. Since a thermocouple element always measures a temperature difference, the free ends of the thermocouple must be connected to a reference junction (cold conjunction) and held constant at a known temperature.

The calibration data and the permissible deviations for commonly used thermocouples are defined in DIN EN 60 584, Part 1, (page 2/4). The thermocouples Cu-CuNi and Fe-CuNi to DIN 43 710 are used for replacement purposes. For more accurate measurements, thermocouples are available with half the DIN tolerance or with a test certificate. The tolerances only apply to the condition upon delivery.

During operation at high temperatures, the tolerances of the thermocouples may change due to absorption of foreign matter, oxidation or evaporation of alloy components.

The thermocouple elements are extended from the connection point to a point whose temperature is as constant as possible (the cold junction) by means of extension leads.

The extension leads have the same color code as the associated thermocouple elements; the positive pole is marked in red. Correct polarity must be ensured since otherwise large errors will occur. Up to 200 °C, the same calibration data and tolerances apply to the extension leads as to the corresponding thermocouple elements.

The influence of temperature changes at the cold junction can be balanced by means of a compensating circuit, e.g. a compensating box. The reference temperature is 0 °C or 20 °C.

It is also possible to keep the cold junctions at a constant temperature of 50, 60 or 70 °C using a thermostat (for several measuring junctions).

The connections from the cold junction to the measuring or process instrument are made using copper leads. With energy-consuming instruments such as indicators or multipoint recorders, the complete measuring circuit (thermocouple, extension lead and copper lead) must be balanced in the operating condition using a resistor. SITRANS T transmitters and KOMPENSOGRAPH servo recorders for connection to thermocouples have a built-in compensating circuit for balancing the effect of the ambient temperature on the cold junction. Lead balancing is not necessary in this case because of the high input impedance.

Technical description

The thermocouple element can be protected against mechanical stress and chemical attack by a ceramic or metal protective tube which may be mounted using flanges, screwed glands or by welding into the pipeline or tank. The thermocouple element terminates in the connection head.

Installation examples with specification of the recommended thermocouple elements and protective tube materials are listed on pages 2/5 and 2/6.

Owing to the different operating conditions, no guarantee can be given for protective fittings. The manufacturer is responsible for damages and measuring errors caused by wrong installation in compliance with the General Terms of Delivery if the instruments have been installed by the manufacturer and if the specifications for the operating conditions furnished by the customer were correct and sufficiently detailed.

Thermocouples are very compatible since it is almost always possible to adapt them in shape and size to the particular problem. The temperature-responsive part is almost point-shaped. Thermocouples are therefore particularly suitable for measuring rapidly changing temperatures.

Measuring ranges for thermocouples to DIN 43 701

Thermocouple element	Cu-CuNi	Fe-CuNi	NiCr-Ni	PtRh-Pt
	°C	°C	°C	°C
Measuring range	0 to 300 0 to 400 0 to 600	0 to 250 0 to 400 0 to 600 0 to 800 0 to 900 300 to 600	0 to 600 0 to 900 0 to 1000 0 to 1200 0 to 1300 300 to 600 600 to 900 300 to 1000	0 to 1200 0 to 1400 0 to 1600 600 to 1600

Thermocouple designations to DIN 43 710 and DIN IEC EN 60 584 (IEC 584) Aug. 10.96

DIN 43 710, release 12.85		DIN EN 60 584	
Cu-CuNi	Type U	Cu/Cu Ni	Type T
Fe-CuNi	L	Fe/Cu Ni	J
		Ni Cr/Ni	K
		Ni Cr Si-NiSi	N
		Pt 10 % Rh/Pt	S
		Pt 13 % Rh/Pt	R
		Pt 30 % Rh/Pt 6 % Rh	B

Calibration data for thermoelectric voltages and error limits

to DIN EN 60 514-1 (issue 10.96) and
DIN 43 710 (issue 12.85), reference temperature: 0 °C

Thermocouple element	Cu/Cu Ni		Cu-CuNi		Fe/Cu Ni		Fe-Cu Ni		Ni Cr/Ni		Pt 10 % Rh/Pt		Pt 13 % Rh/Pt		Pt 30 % Rh/ Pt 6% Rh	
Type	T, DIN EN 60 514-1		U, DIN 43 710		J, DIN EN 60 514-1		L, DIN 43 710		K, DIN EN 60 514-1		S, DIN EN 60 514-1		R, DIN EN 60 514-1		B, DIN EN 60 514-1	
Color	brown		brown		black		blue		green		orange		orange		gray	
Temperature	Thermoelectric voltage															
°C	Calib. data mV	Error limit, class 2[1])	Calib. data mV	Error limit	Calib. data mV	Error limit, class 2[1])	Calib. data mV	Error limit	Calib. data mV	Error limit, class 2[1])	Calib. data mV	Error limit, class 2[1])	Calib. data mV	Error limit, class 2[1])	Calib. data mV	Error limit, class 2[1])
- 200	- 5.603	(±0.015	- 5.70		- 7.890	(± 0.015	- 8.15		- 5.841							
- 100	- 3.379	· | *t* |)	- 3.40		- 4.633	· | *t* |)	- 4.75		- 3.554							
- 40	- 1.475		- 1.50		- 1.961		- 2.03		- 1.527							
0	0	± 1 °C	0	-	0		0	-	0		0		0		0	
100	+ 4.279	or	4.25	± 3 °C	5.269		5.37	± 3 °C	4.096		0.646		0.647		0.033	
200	+ 9.288	±0.0075	9.20	± 3 °C	10.779		10.95	± 3 °C	8.138		1.441		1.469		0.178	
300	+14.862	· | *t* |	14.90	± 3 °C	16.327	± 2.5 °C	16.56	± 3 °C	12.209		2.323		2.401		0.431	
350	+17.819		17.92	± 3 °C	19.090	or	19.36	± 3 °C	14.293	± 2.5 °C	2.786		2.896		0.596	
400	+20.872		21.00	± 3 °C	21.848	±0.0075	22.10	± 3 °C	16.397	or	3.259		3.408		0.787	
500			27.41	± 0.75 %	27.393	· | *t* |	27.85	± 0.75 %	20.644	±0.0075	4.233		4.471		1.242	
600			34.31	± 0.75 %	37.102		33.67	± 0.75 %	24.905	· | *t* |	5.239		5.583		1.792	
700					39.132		39.72	± 0.75 %	29.129		6.275	± 1.5 °C	6.743	± 1.5 °C	2.431	
750					42.281		42.92	± 0.75 %	31.213		6.806	or	7.340	or	2.782	
800					45.494		46.22	± 0.75 %	33.275		7.345	±0.0025	7.950	±0.0025	3.154	
900					51.877		53.14	± 0.75 %	37.326		8.449	· | *t* |	9.205	· | *t* |	3.957	
1000					57.953				41.276		9.587		10.506		4.834	± 1.5 °C
1100					63.792				45.119		10.757		11.850		5.786	or
1200					69.553				48.838		11.951		13.228		6.786	±0.0025
1300									52.410		13.159		14.629		7.848	· | *t* |
1400											14.373		16.040		8.956	
1500											15.582		17.451		10.099	
1600											16.777		18.849		11.263	
1700											17.947		20.222		12.433	
1800															13.591	

The stepped line indicates reference points for the continuous operation limit of the thermocouples in pure air. For example, a Fe-CuNi thermocouple (3 mm leg diameter to DIN 43 732) can only be used continuously with caution for temperatures above 700 °C.

The application limit also depends on the wire cross-section, particularly for base-metal thermocouples. Further details are available in DIN 43 712 and DIN 43 732.

However, the continuous operating limits cannot be specified exactly since many factors which cannot be exactly defined affect the thermoelectric voltage. The calibration data and the error limits are therefore only guaranteed for the thermocouple wires and elements in the condition upon delivery.

The specified thermoelectric voltages decrease as follows with reference temperatures of 20, 50, 60 and 70 °C (thermostat):

Reference temperature	Reduction in thermoelectric voltage with thermocouple element:							
	Type T mV	Type U mV	Type J mV	Type L mV	Type K mV	Type S mV	Type R mV	Type B mV
20 °C	0.789	0.80	1.019	1.05	0.798	0.113	0.111	-0.003
50 °C	2.035	2.05	2.585	2.65	2.022	0.299	0.296	0.002
60 °C	2.467	2.48	3.115	3.19	2.436	0.365	0.363	0.006
70 °C	2.908	2.91	3.649	3.73	2.850	0.432	0.431	0.011

1) The larger value applies; *t* is the actual temperature.

Installation examples

with specification of appropriate thermocouples and prot. tubes

Measuring point and max. operating temperature		Thermocouple element	Protective tube
A. Iron and steel works			
1. Blast furnace			
Hot blast	1000 °C	Ni Cr/Ni	Open protective tube X 10 CrAl 24, mat. No. 1.4762, bare soldering point, cemented;
Crude gas	300 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
2. Air preheater			
Dome	1200 °C	Pt 10 % Rh/Pt	Outside: X 15 CrNiSi 24 19, mat. No. 1.4841 Inside: KER 710
Exhaust gas	300 °C	Ni Cr/Ni	St 35.8, mat. No. 1.0305, seamless, enamelled
3. Open-hearth furnace			
Exhaust gas ducts	600 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Checkers	1350 °C	Pt 10 % Rh/Pt	Outside: silicon carbide Inside: KER 710
Melt (for short periods)	1600 °C	Pt 10 % Rh/Pt	Immersion-type thermocouple of special design
4. Soaking pit			
Furnace chamber	1350 °C	Pt 10 % Rh/Pt	Outside: silicon carbide Inside: KER 710
Exhaust gas before or behind recuperator	1000 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished; installation with gas-tight screw socket
Combustion air behind recuperator	700 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished; installation with gas-tight screw socket
5. Pusher, rotating hearth furnace, and other types of rolling mill furnace			
Preheating zone	800 °C	Pt 10 % Rh/Pt or Ni Cr/Ni	Outside: silicon carbide Inside: KER 710 Outside: silicon carbide Inside: KER 610
Heating zone	1250 °C	Pt 10 % Rh/Pt	As above
Soaking zone	1350 °C	Pt 10 % Rh/P	Outside: silicon carbide Inside: KER 710
Exhaust gas before air recuperator	900 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished; installation with gas-tight screw socket
Exhaust gas before and behind gas recuperator	700 °C	Ni Cr/Ni	As above or KER 610
Preheated air behind recuperator	700 °C	Ni Cr/Ni	As above
6. Annealing furnace, roller-hearth furnace			
Furnace chamber	800 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Exhaust gas duct	600 °C	Ni Cr/Ni	As above

Measuring point and max. operating temperature		Thermocouple element	Protective tube
7. Bell-type anneal. furn.			
Directly heated furnace	950 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Stack for tin plates	600 to 900 °C	Ni Cr/Ni	Special design, bare thermocouple with thermal contact plate
Stack for motorcar body sheet	700 to 920 °C	Ni Cr/Ni	As above
Protective gas	650 °C	Ni Cr/Ni	Bare thermocouple
8. Sinter belts			
(sucking boxes)	400 °C	Fe/Cu Ni	(jacket thermocouple) X 10 CrAl 24, mat. No. 1.4762
for temperature maximum computing circuit	400, 500 °C	Fe/Cu Ni	As above, with double thermocouple element
9. Tinning plants			
Palm nut oil, pickling vat, tin bath	650 °C	Ni Cr/Ni	St 35.8, mat. No. 1.0305, seamless, enamelled
10. Zinc coating plants			
Zinc bath	480 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, seamless
11. Heat treatment plants			
11.1 In gases			
Tempering furnaces	550 °C	Ni Cr/Ni	St 35.8, mat. No. 1.0305, seamless
Annealing in oxidizing gases containing sulphur and carbon	1050 °C	Pt 10 % Rh/Pt (Ni Cr/Ni)	Outside: X 10 CrAl 24, mat. No. 1.4762, dished Inside: KER 710
	1200 °C	Pt 10 % Rh/Pt	Outside: X 10 CrAl 24, mat. No. 1.4762, dished Inside: KER 710
Annealing in reducing gases containing sulphur	1200 °C	Pt 10 % Rh/Pt	As above
Annealing in nitrogen-containing gases poor in oxygen, also nitriding furnaces with ammonia	1200 °C	Pt 10 % Rh/Pt	Outside: X 15 CrNiSi 24 19, mat. No. 1.4841, dished; Inside: KER 710
11.2 In hardening shop baths (protective tubes bored from the solid are recommended)			
Salt and nitre	550 °C	Ni Cr/Ni	Soft iron, mat. No. 1.1003
Cyanogen	950 °C	Ni Cr/Ni	Soft iron or X 15 CrNiSi 24 19, mat. No. 1.4841,
Baths containing chloride	1050 °C	Pt 10 % Rh/Pt	Outside: X 10 CrAl 24, mat. No. 1.4762 Inside: KER 710
Lead baths	1200 °C	Pt 10 % Rh/Pt	Outside: chromium nickel alloy NiCr 60 15, mat. No. 2.4867 Inside: KER 710; bored from the solid
Barium chloride baths	1300 °C	Pt 10 % Rh/Pt	Outside: chromium nickel alloy NiCr 60 15, mat. No. 2.4867 Inside: KER 710;

Technical description

Installation examples

with specification of appropriate thermocouples and prot. tubes

Measuring point and max. operating temperature		Thermocouple element	Protective tube
B. Metallurgical plants (only limited life time in molten metals)			
Copper melts	1250 °C	Pt 10 % Rh/Pt	Outside: X 10 CrSi 29, mat. No. 1.4772, bored from the solid Inside: KER 710
Exhaust of copper melting furnaces	1300 °C	Pt 10 % Rh/Pt	Outside: silicon carbide Inside: KER 710
Brass melts	900 °C	Ni Cr/Ni	X 10 CrAl 29, mat. No. 1.4772, bored from the solid
Aluminium melts	700 °C	Ni Cr/Ni	Pearlite iron GG 22, bored from the solid
Die-casting, magnesium	700 °C	Ni Cr/Ni	Soft iron, mat. No. 1.1003, bored from the solid
Bearing metal, lead and tin melting houses	600 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, seamless, enamelled
Lead foundries	700 °C	Fe/Cu Ni	Chromium nickel alloy NiCr 60 15, mat. No. 2.4867, bored from the solid
Zinc foundries	480 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, seamless
	600 °C	Fe/Cu Ni	Silicon carbide
Exhaust gases of zinc melting furnaces	1300°C	Pt 10 % Rh/Pt	Outside: silicon carbide Inside: KER 710
C. Ceramic industry			
Ring kiln for standard bricks	800 °C to 1100 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Ring kiln for clinkers, retort furnace, tunnel furnace, glazing kiln	1200 °C to 1300 °C	Pt 10 % Rh/Pt	Outside and inside: KER 710
D. Glass industry			
1. Glass trough furnace			
Checkers of the regenerative chambers, above	1300 °C	Pt 10 % Rh/Pt	Outside: KER 530 Inside: KER 710
Checkers of the regenerative chambers, below	600 °C	Ni Cr/Ni	Thermocouple porcelain
Lateral walls, roof, bottom (in drilled channels down to 50 mm below the bath)	1550 °C 1400 °C	Pt 30 % Rh/ Pt 6 % Rh	Outside and inside: KER 710
Leer	800 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Annealing furnace	1200 °C	Pt 10 % Rh/Pt	KER 710
2. Pot furnace	1500 °C	Pt 30 % Rh/ Pt 6 % Rh	Outside and inside: KER 710
3. Gas generators			
Crude gas	750 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762, dished
Rotary grate (grate head)	180 to 200 °C short-term 500 °C to 1000 °C	Fe/Cu Ni	Special design on request (to be manufactured on site according to specifications)
E. Cement industry			
Rotary kilns			
Secondary air at cooler	900 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762
Hot chamber	900 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762
Drying chamber	400 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, or similar, enamelled
F. Cellulose factories			
Sulphur combustion furnaces, pyrite burner	Up to 1500 °C	Pt 30 % Rh/ Pt 6 % Rh	Outside: silicon carbide Inside: KER 710
Behind waste heat boiler	600 °C	Ni Cr/Ni	X 10 CrAl 24, mat. No. 1.4762,
G. Steam power parts			
Water and steam lines (screw-in and welding-type thermocouples)			
Screw-in thermocouple	300 °C	Fe/Cu Ni	Sn Bz 6 bronze, to DIN 1726 (only for air or water)
Screw-in thermocouple	400 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305
Screw-in thermocouple	500 °C	Fe/Cu Ni	13 CrMo 44, mat. No. 1.7335
Welding-type thermocouple	540 °C	Fe/Cu Ni	13 CrMo 44, mat. No. 1.7335
Welding-type thermocouple	570 °C	Ni Cr/Ni	10 CrMo 9 10, mat. No. 1.7380
	750 °C	Fe/Cu Ni (Ni Cr/Ni)	X 8 CrMoNb 16 16, mat. No. 1.4981
Flue gas	1000 °C	Pt 10 % Rh/Pt (Ni Cr/Ni)	Megapyr, Cr Al 20 5, mat. No. 1.4767 or outside: X 10 CrAl 24, mat. No. 1.4762, Inside: KER 710
	600 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, enamelled
Pulverized coal/air mixture line	100 °C	Fe/Cu Ni	St 35.8, mat. No. 1.0305, (with baffle rod)

Loading capacity of protective tubes: see pages 1/6 to 1/8

7MC2000

Application

The thermocouple together with a metal protective tube is suitable for temperatures from 0 to 1250 °C.

The sensor is also available with a built-in temperature transmitter.

Design

Thermocouple elements	Ni Cr/Ni
Number	1 or 2
Leg diameter	2 to 3 mm
Insulation of legs	Insulating beads
Protective tube	Metal
Connection head	Form A, DIN 43 729; made of cast light alloy, with one cable bushing

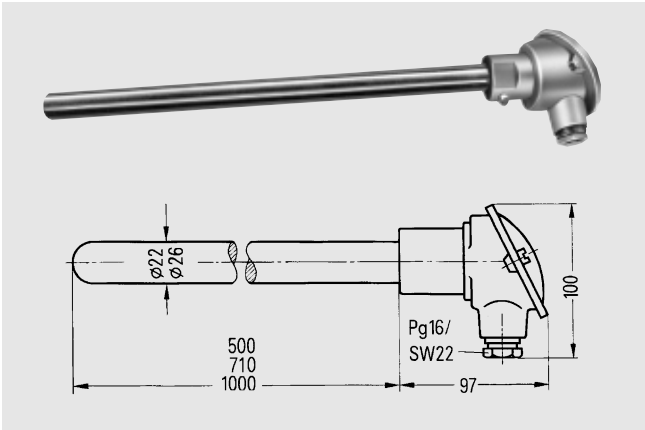


Fig. 2/3 Straight thermocouple

Ordering data

Protective tube; temperature range, material and dimensions	Thermocouples Number	Leg diameter in mm	kg	Nominal length in mm 500 Order No.	710 Order No.	1000 Order No.
Straight thermocouple with Ni Cr/Ni element (type K), for temperatures up to 1250 °C; with metal protective tube						
Up to 1000 °C; X 10 CrAl 24, mat. No. 1.4762, 22 mm diam. x 2 mm	1	2	1.1 to 2.9	**7MC2000-1DC0** ■	**7MC2000-2DC0** ■	**7MC2000-3DC0** ■
	2		1.1 to 3.2	**7MC2000-1DD0** ■	**7MC2000-2DD0** ■	**7MC2000-3DD0** ■
Up to 1200 °C; X 10 CrAl 24, mat. No. 1.4762, 26 mm diam. x 4 mm	1	3	1.3 to 2.2	**7MC2000-1EC0** ■	**7MC2000-2EC0** ■	**7MC2000-3EC0** ■
	2		1.4 to 2.4	**7MC2000-1ED0** ■	**7MC2000-2ED0** ■	**7MC2000-3ED0** ■
Up to 1200 °C; X 15 CrNi Si 24 19, mat. No. 1.4841, 22 mm diam. x 2 mm	1	2	1.7 to 2.9	**7MC2000-1FC0** ■	**7MC2000-2FC0** ■	**7MC2000-3FC0** ■
	2		1.9 to 3.1	**7MC2000-1FD0** ■	**7MC2000-2FD0** ■	**7MC2000-3FD0** ■
Up to 1250 °C; CrAl 205 (Megapyr) mat. No. 1.4767, 22 mm diam. x 1.3 mm	1	3	1 to 2.9	**7MC2000-1HC0** ■	**7MC2000-2HC0** ■	**7MC2000-3HC0** ■
	2		1.1 to 3.2	**7MC2000-1HD0** ■	**7MC2000-2HD0** ■	**7MC2000-3HD0** ■
Connection head, form A, made of cast light alloy, with 1 cable washing and screw cover				↑ **1**	↑ **1**	↑ **1**
high hinged cover				**6**	**6**	**6**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Installation of a transmitter is only possible here in the versions with a high hinged cover (7MC2000-■■■■ 6).

Metal protective tubes, thermocouple elements for straight thermocouples

Metal protective tubes for straight thermocouples to DIN 43 733

Ordering data

Protective tube or inner tube material	kg	Nominal length in mm		
		500	710	1000
		Protective tube length in mm		
		520	730	1020
		Order No.	Order No.	Order No.
Metal protective tube				
X 10 CrAl 24, mat. No. 1.4762, 22 mm diameter x 2 mm, dished	0.55 to 1.10	**7MC2900-1DA**	**7MC2900-2DA**	**7MC2900-3DA**
X 10 CrAl 24, mat. No. 1.4762, 26 mm diameter x 4 mm, dished	1.25 to 2.20	**7MC2900-1EC**	**7MC2900-2EC**	**7MC2900-3EC**
X 15 CrNiSi 25 20, mat. No. 1.4841, 22 mm diameter x 2 mm, dished	1.05	**–**	**–**	**7MC2900-3FA**
CrAl 205 (Megapyr), mat. No. 1.4767, 22 mm diameter x 1.3 mm	0.55 to 1.10	**7MC2900-1HA**	**7MC2900-2HA**	**7MC2900-3HA**

Thermocouple elements for straight thermocouples to DIN 43 733

Ordering data

Thermocouple element	kg	Nominal length *L1* and thermocouple element length *L2* in mm					
		L1	*L2*	*L1*	*L2*	*L1*	*L2*
		500	540	710	750	1000	1040
		Order No.		Order No.		Order No.	
Base-metal thermocouple element with insulating beads, wire diameters 3 mm							
Ni Cr/Ni, up to 1000 °C (max. 1300 °C)	0.55 to 2.10	**7MC2903-1CA**		**7MC2903-2CA**		**7MC2903-3CA**	

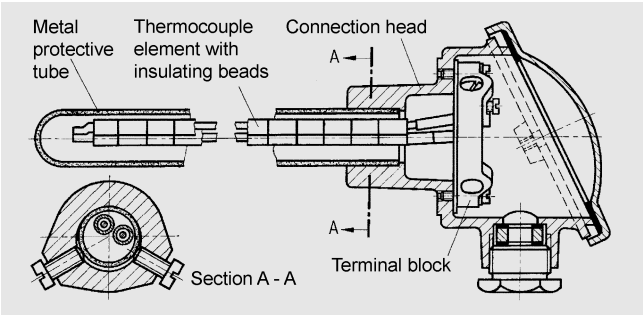


Fig. 2/4 Straight thermocouple with base-metal element Ni Cr/Ni with metal protective tube

Connection heads

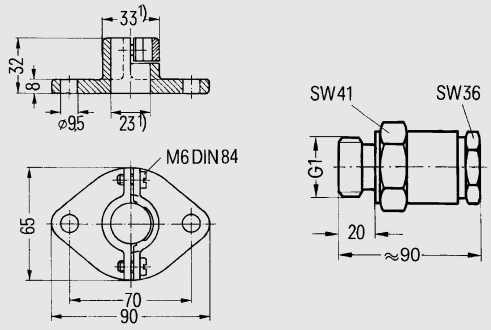
Ordering data

Connection head, form A (without terminal block and terminals)				For protective tube diameter (bore = protective tube diameter + 0.5 mm)	
Material	Seal	Number of cable bushings	kg	22 mm	26 mm
				Order No.	Order No.
Cast light alloy	Screw cover	1	0.35	**7MC2905-1AA**	**7MC2905-1BA**
Light alloy	High hinged cover	1		**7MC2905-4AA**	**7MC2905-4BA**

Mounting accessories

Ordering data

Designation	kg	Order No.
Terminal block without terminals for base-metal thermocouple elements	0.06	**7MC2998-1AA**
Terminal for base-metal thermocouple elements	0.01	**7MC2998-1BA**
Set of gaskets (100 off) for the connection head cover		**7MC2998-1CA**
Set of washers (100 off) for the terminal block		**7MC2998-1CB**
Mounting flange, adjustable; made of GTW		
For protective tube outer diameter 22 mm	0.35	**7MC2998-2CB**
For protective tube outer diameter 26 mm	0.32	**7MC2998-2CC**
Threaded sleeve, gas-tight up to 1 bar, adjustable, mat. No. 1.0718, with gasket		
For protective tube outer diameter 22 mm, **G1**	0.40	**7MC2998-2DB**
For protective tube outer diameter 26 mm, **G1**	0.40	**7MC2998-2DC**



1) For protective tube diameter 22 mm

Fig. 2/5 Mounting flange to DIN 43 734 (left) and threaded sleeve (right) for installing straight thermocouples

Jacket thermocouples with extension lead

7MC2027

Application

The sensor is suitable for a temperature range from 0 to 700, 1000 or 1100 °C; a temperature of 80 to 260 °C is permissible for the extension lead.

Design

Thermocouple element	Ni Cr/Ni, type K, one off
Jacket	
Form	Outer diameter 0.5, 1.0, 1.5 or 3 mm
Minimum bending radius	5 x outer diameter
Material	Inconel; NiCr 15 Fe, mat. No. 2.4816

Extension lead

Type	Max. temperature	Conductor material	Insulation	
			Single	Common
L2SS	180 °C	Ni Cr/Ni	Silicon	Silicon
L2KK	80 °C	Ni Cr/Ni	PVC	PVC
L2TGD	260 °C	Ni Cr/Ni	PTFE	Glass-filament and external stainless steel braiding

Number of conductors	2
Conductor cross-section	0.22 mm^2
Length	3 m

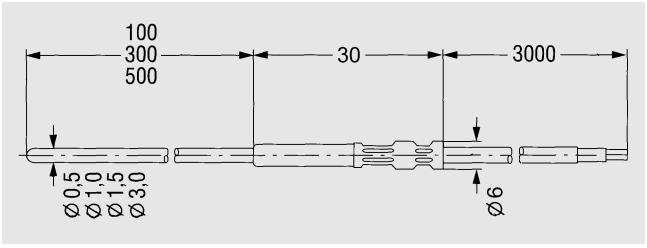


Fig. 2/6 Jacket thermocouple with extension lead

Ordering data

Jacket thermocouple with extension lead

Max. temperature of medium °C	Jacket outer diameter mm	Extension lead Type	Nominal length mm	kg	Order No.
700	0.5	L2KK	300		**7MC2027-2BA10**
1000	1.0	L2SS	100		**7MC2027-1AA20**
			300		**7MC2027-2AA20**
			500		**7MC2027-3AA20**
		L2KK	100		**7MC2027-1BA20**
			300		**7MC2027-2BA20**
			500		**7MC2027-3BA20**
1100	1.5	L2SS	100		**7MC2027-1AA30**
			300		**7MC2027-2AA30**
			500		**7MC2027-3AA30**
		L2KK	100		**7MC2027-1BA30**
			300		**7MC2027-2BA30**
			500		**7MC2027-3BA30**
	3.0	L2SS	100		**7MC2027-1AA40**
			300		**7MC2027-2AA40**
			500		**7MC2027-3AA40**
		L2KK	100		**7MC2027-1BA40**
			300		**7MC2027-2BA40**
			500		**7MC2027-3BA40**
		L2TGD	100		**7MC2027-1CA40**
			300		**7MC2027-2CA40**
			500		**7MC2027-3CA40**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

Jacket thermocouple with connection head, form B

Application

The sensor is suitable for a temperature range from 0 to 800 or 1100 °C.
The sensor is also available with a built-in temperature transmitter.

Design

Thermocouple element	Fe/Cu Ni, Fe-CuNi or Ni Cr/Ni	
Jacket		
Material	X 6 CrNiTi 18 10, mat. No. 1.4541	Inconel
Temperature	Up to 800 °C	Up to 1100 °C
	Measuring junction insulated from base of jacket	
Connection head	Form B to DIN 43 729	
Material	Cast light alloy	
Temperature	–30 to +100 °C is permissible	
	Cable bushing for cables up to 15 mm diameter; terminal block without clamping springs	

Technical data

Thermocouple element	Jacket		Number of thermocouple elements	Thermocouple wire diameter	Resistance (for double conductor)
	Outer diameter	Wall thickness			
	mm	mm		mm	Ω/m
Fe/Cu Ni (type J) fund Fe-CuNi (type L)	3.0	0.42	1	0.54	2.7
		0.42	2	0.48	3.5
	6.0	0.55	1	1.07	0.66
		0.89	2	0.81	1.14
Ni Cr/Ni (type K)	3.0	0.42	1	0.54	4.3
		0.42	2	0.48	5.5
	6.0	0.55	1	1.07	1.12
		0.89	2	0.81	1.94

Insulation resistance between conductors and jacket	≥ 1000 MΩ/m at 20 °C
Minimum bending radius	5 x outer diameter of jacket
Leak resistance of measuring junction	Tested at 40 bar

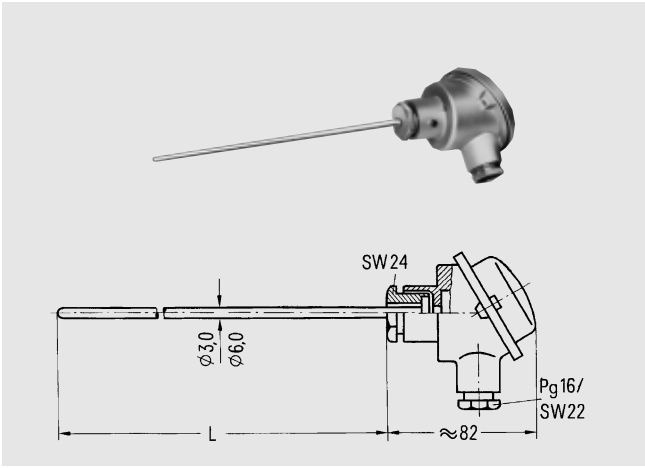


Fig. 2/7 Jacket thermocouple with connection head, form B, made of cast light alloy

Ordering data

Jacket thermocouple with connection head, form B

Thermocouple element		Jacket outer diameter	Temperature up to 800 °C	Temperature up to 1100 °C
Type	Number		Jacket made of X 6 CrNiTi 18 10, mat. No. 1.4541	Jacket made of Inconel
		mm	Order No.	Order No.
Fe/Cu Ni Type J	1	3.0	**7MC2021-2CE-Z**	–
		6.0	**7MC2021-4CE-Z**	–
	2	3.0	**7MC2021-2CF-Z**	–
		6.0	**7MC2021-4CF-Z**	–
Fe/Cu Ni Type L	1	3.0	**7MC2021-2CA-Z**	–
		6.0	**7MC2021-4CA-Z**	–
	2	3.0	**7MC2021-2CB-Z**	–
		6.0	**7MC2021-4CB-Z**	–
Ni Cr/Ni Type K	1	3.0	–	**7MC2021-2LC-Z**
		6.0	–	**7MC2021-4LC-Z**
	2	3.0	–	**7MC2021-2LD-Z**
		6.0	–	**7MC2021-4LD-Z**
Length *L*	0.25 m		Order code	**A01**
	1 m			**A02**
	5 m			**A03**
	10 m			**A04**

Other versions (mounting length, protective tube material etc.) on request: please add Order code **"Y01"**, and specify plain text.

See page 1/20 for ordering a temperature transmitter fitted in the connection head.

Example for ordering:

The following is required:
Jacket thermocouple,
jacket made of X 6 CrNiTi 18 10,
outer diameter 3.0 mm,
with 1 Fe/Cu Ni element, type J,
nominal length 5 m

Order as follows:

1 jacket thermocouple	**7MC2021-2CE-Z**
	A03

Jacket thermocouple with standard plug

7MC2028

Application

The sensor is suitable for a temperature range from 0 to 800, 1000 or 1100 °C; a maximum temperature of 130 °C is permissible for the plug connection.

Design

Thermocouple element	Ni Cr/Ni	
Jacket		
Material	X 6 CrNiTi 18 10, mat. No. 1.4541	Inconel, NiCr 15 Fe, mat. No. 2.4816
Temperature	Up to 800 °C	Up to 1100 °C
Socket OST		
Housing	Made of polyamide	
Contact	Made of temperature-resistant material	
Plug		
OST	On page 2/13; incorrect connection impossible	

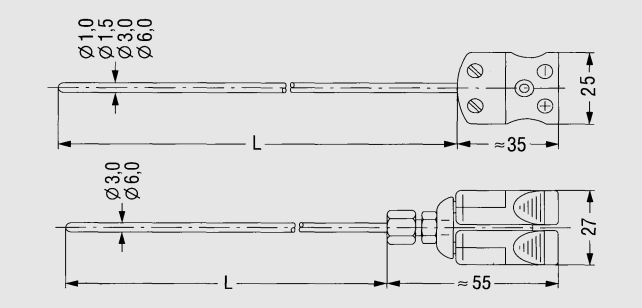


Fig. 2/8 Jacket thermocouple with socket; at top with one thermocouple, at bottom with two thermocouples; dimensions

Ordering data

Jacket thermocouple with socket
(order plug separately according to page 2/13)

Thermocouple element Type	Number	Jacket material No.	Jacket outer diameter mm	Temperature of medium °C	g/m	Length *L* 0.3 m Order No.	Length *L* 0.5 m Order No.
Ni Cr/Ni type K	1	1.4541	3.0	800	41	**7MC2028-1AC31**	**7MC2028-2AC31**
		2.4816	1.0	1000	4	**1AC12**	**2AC12**
			1.5	1100	10	**1AC22**	**2AC22**
			3.0	1100	41	**1AC32**	**2AC32**
			6.0	1100	164	**1AC42**	**2AC42**
	2	1.4541	3.0	800	41	**1AD31**	**2AD31**
			6.0	800	166	**1AD41**	**2AD41**
		2.4816	3.0	1100	41	**1AD32**	**2AC32**
			6.0	1100	166	**1AD42**	**2AD42**

Other versions (mounting length, protective tube material etc.) on request: please supplement Order No. by **"-Z"**, add Order code **"Y01"**, and specify plain text.

Extension leads for jacket thermocouples with plug

7MC2921

Ordering data

Extension lead for jacket thermocouple with socket (7MC2028); twisted cores

Outer diameter	4 mm		4 mm		6 mm		6 mm	
Isolation	PVC		Silicone-silicone		PVC		Silicone-silicone	
Temperature range	-20 to +80 °C		-40 to +180 °C		-20 to +80 °C		-40 to +180 °C	
Number of conductors and cross-section	2 x 0.22 mm²		2 x 0.22 mm²		4 x 0.22 mm²		4 x 0.22 mm²	
For thermocouple element	Ω/m	Order No.	Ω/m	Order No.	Ω/m	Order No.	Ω/m	Order No.
Ni Cr/Ni Color code: green	1.50	**7MC2921-1AC-Z**	0.25	**7MC2921-2AC-Z**	1.50	**7MC2921-3AC-Z**	0.25	**7MC2921-4AC-Z**

Length of extension lead		Order code
	0.25 m	**A01**
	1 m	**A02**
	5 m	**A03**
	10 m	**A04**

Other versions (mounting length, protective tube material etc.) on request: please add Order code **"Y01"**, and specify plain text.

Ordering data

						kg	Order No.
Screw nipple for soldering jacket thermocouples							
With M8 x 1 thread, for jacket outer diameter up to 3.0 mm						0.01	**7MC2922-1EA**
With G¼ thread, for all jacket outer diameters listed in the catalog						0.02	**7MC2922-1FB**
The screw nipple has a centering hole and must be drilled according to the outer diameter of the jacket thermocouple. The thermocouple must be protected from excessive heat when soldering (e.g. by blowing with air).							
Compression joint, gas-tight					Jacket outer diameter		
Temperature	Pressure	Release	Material	Thread			
Up to 350 °C	Pressure-tight up to 80 bar	Subsequent release and movement **not** possible	X6 CrNi Mo Ti 17–122, mat. No. 1.4571; tapered ring like compression joint	M8 x 1 G¼	1.5 mm 3.0 mm 6.0 mm	0.03 0.03 0.04	**7MC2922-3AA** **7MC2922-3BA** **7MC2922-3DB**
Coupling socket of jacket thermocouple 7MC2028 (one per element); for Ni Cr/Ni thermocouple element, type K						0.05	**7MC2922-4BB**
Coupling plug matching the jacket thermocouple 7MC2028 with socket; one plug is required per element; for Ni Cr/Ni thermocouple element, type K						0.05	**7MC2922-4BD**

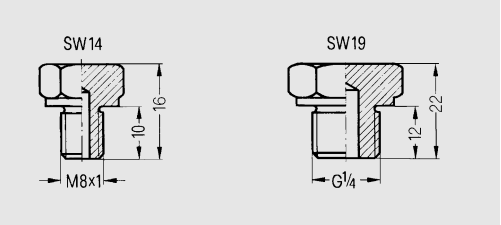
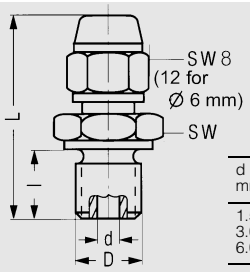


Fig. 2/9 Screw nipple with M8 x 1 thread (left) or G¼ (right)



d mm	D	l mm	L mm	SW
1.5	M8x1	8	32	12
3.0	M8x1	8	32	12
6.0	G¼	10	48	19

d) Jacket outer diameter of thermocouple

Fig. 2/10 Compression joint with M8 x 1 or G¼ thread

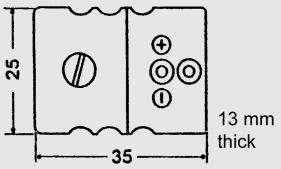


Fig. 2/11 Coupling socket

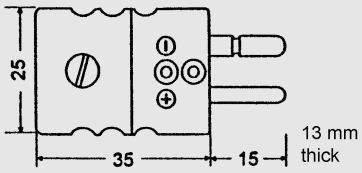


Fig. 2/12 Coupling plug

Cold junction (with built-in power supply unit)

M72166

Application

The cold junction is suitable for a thermocouple element of type J, K, L, R, S, T or U. A correction circuit is fitted which compensates the influence of changes in the cold junction temperature.

The device can be mounted on a rail.

Note: positioning of the cold junction in the vicinity of the measuring point saves expensive extension leads.

Design

The cold junction has a terminal housing made of plastic which is suitable for mounting on a standard rail DIN EN 50 022-35 x 7.5.

The sensor for the cold junction temperature is positioned directly on the terminals for the extension lead.
The device is matched to the type of thermocouple using built-in function plugs and adjusted according to the reference temperature.

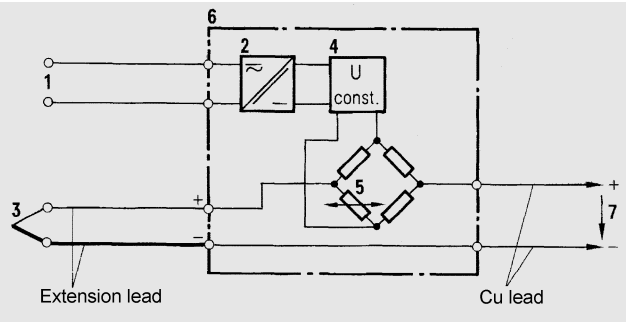
The built-in power supply unit provides the cold junction with power.

Mode of operation

The stabilized power supply feeds a bridge containing a precision temperature sensor. The resistance of the temperature sensor changes with the temperature of the terminals, and thus also the diagonal voltage of the bridge. The bridge is designed according to the characteristic of the respective thermocouple.

Technical data

Signal input	For thermocouples to DIN IEC 584 and DIN 43 710	
Reference temperature	0 °C or 20 °C	
Error limits	0.5 K	
Temperature error	0.1 K/10 K change	
Power supply	AC 47 to 63 Hz, 220 V, 110 V or 24 V, -25 %, +33 %	DC 24 V, -25 %,+33 %
Power consumption	Approx. 0.1 VA	0.1 W
Residual ripple	–	< 10 %
Permissible ambient temp.	-10 to +65 °C	
Permissible storage temp.	-30 to +80 °C	
Degree of protection	DIN 40 050	
Housing	IP 40	
Terminals	IP 20	
Weight	Approx. 0.1 kg	



1 Power supply
2 Power supply unit
3 Measuring point
4 Stabilizer
5 Temperature sensor
6 Cold junction
7 Corrected output voltage

Fig. 2/13 Function diagram of cold junction

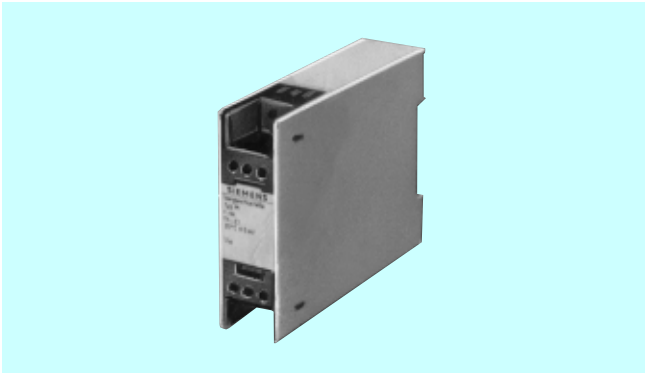
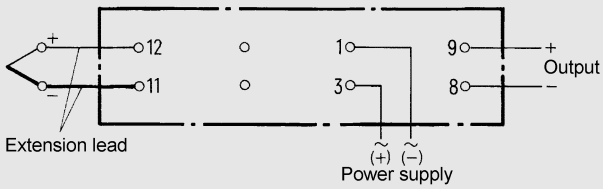


Fig. 2/14 Cold junction with built-in power supply unit



Terminal connections; max. conductor cross-section 2.5 mm^2, stranded max. 1.5 mm^2

Fig. 2/15 Connection diagram of cold junction

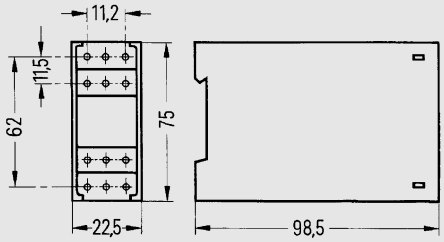


Fig. 2/16 Cold conjunction, dimensions

Ordering data

Designation		Order No.
Cold junction with built-in power supply unit, for rail mounting		**M72166-**
Power supply	AC 220 V	**B 1**
	AC 110 V	**B 2**
	AC 24 V	**B 3**
	DC 24 V	**B 4**
Connection to thermocouple		
Fe-CuNi	Type L	**1**
Fe/Cu Ni	Type J	**2**
Ni Cr/Ni	Type K	**3**
Pt 10 % Rh/Pt	Type S	**4**
Pt 13 % Rh/Pt	Type R	**5**
Cu-CuNi	Type U	**6**
Cu/Cu Ni	Type T	**7**
Reference temperature	0 °C	**00**
	20 °C	**20**

Caution! Compensation of changes in the cold junction temperature should not be carried out for Pt 30 % Rh/Pt 6 % Rh thermocouple elements. The extension leads should be routed to a position where a temperature between –10 and +60 °C exists.

Cold junction thermostat (for 6 or 12 measuring points)

7MC2933

Application

The device is used to keep the cold junction temperature constant when measuring temperature using thermocouples.

Design

The cold junction thermostat consists of an aluminium block in which 6 or 12 reference elements are fitted, a controller, a heater and a power supply unit.

The aluminium block, controller, heater and power supply unit are arranged in two blocks potted in synthetic resin. In this manner, uniform temperature distribution and protection against external effects are ensured. The cast blocks are fitted to the base plate using metal brackets, thus ensuring high resistance to vibration.

The device has a red lamp visible on the outside of the door to permit checking of the temperature in the aluminium block (thermostat). It is also possible to fit

- a Pt 100 resistance thermometer or
- an electronic monitoring unit with relay output whose NC contact opens if there is a fault.

The cold junction thermostat has a sheet-steel housing.

Mode of operation

The temperature of the aluminium block is held constant at a reference temperature of 50, 60 or 70 °C by an electronic two-step controller with low hysteresis.

With a constant cold junction temperature, the difference between the voltage of the measuring element and that of the reference element is a measure of the temperature at the measuring point. The thermocouples are electrically isolated from one another and from the power supply.

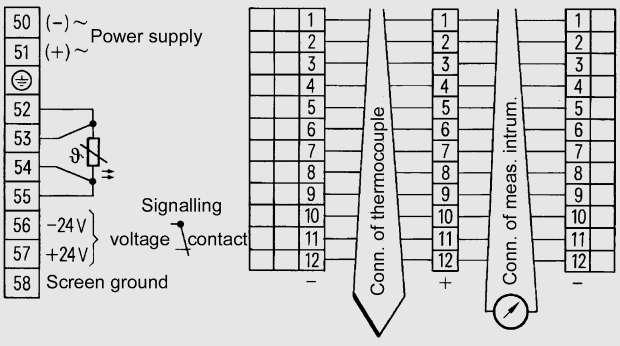


Fig. 2/17 Cold junction thermostat 7MC2933, connection diagram

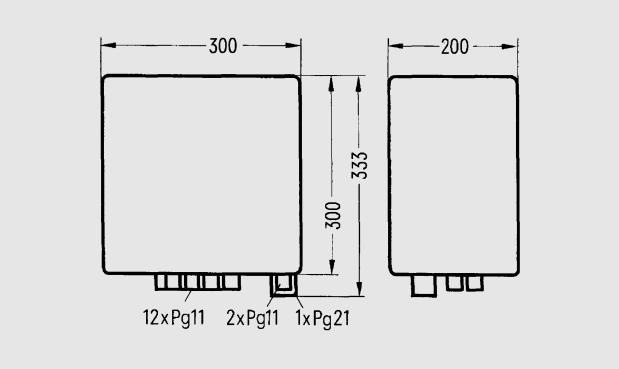


Fig. 2/18 Cold junction thermostat 7MC2933, dimensions

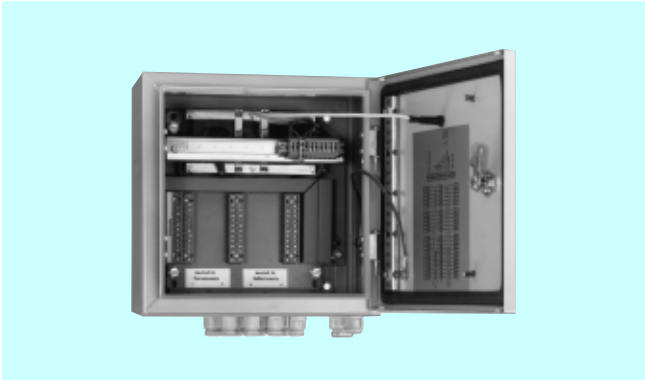


Fig. 2/19 Cold junction thermostat 7MC2933

Technical data

Number of measuring points	6 or 12		
Reference temperature	50, 60 or 70 °C		
Error limits	0.5 °C		
Effect of ambient temperature	0.2 °C/10 K temperature change		
Error limits of control	0.05 °C		
Perm. ambient temperature	-20 to +45 °C		
Power supply (depending on version)	Warm-up time		
AC 48 to 63 Hz, 24, 110 or 220 V ± 15 %, approx. 30 VA	Approx. 10 min		
DC 24 V, approx. 30 W	Approx. 10 min		
DC 24 V, approx. 17 W	Approx. 20 min		
Degree of protection	IP 54 to DIN 40 050		
Resistance to vibration	Frequency	Acceleration	Test period
	5 to 55 Hz	1 g, constant	4 min
	30 Hz	10 g	1 min
Weight	Approx. 9.5 kg		

Ordering data

Designation			Order No.
Cold junction thermostat			**7MC2933-**
Ref. temperature	50 °C		1
	60 °C		2
	70 °C		3
Thermocouple element	Fe-CuNi	Type L	A
	Ni Cr/Ni	Type K	B
	Pt 10 % Rh/Pt	Type S	C
	Cu-Cu Ni	Type U	D
Number of reference junctions		6	A
		12	B
Power supply	AC 220 V		1
	AC 110 V		2
	AC 24 V		3
	DC 24 V, 30 W		4
	DC 24 V, 17 W		5
Temperature control			
Without			0
With resistance thermometer			1
With electronic monitoring unit			2

Cold junction thermostat (for 12 or 24 measuring points)

7MC2930

Application

The device is used to keep the cold junction temperature constant when measuring temperature using thermocouples.

Design

The cold junction thermostat consists of an aluminium block in which 12 or 24 reference elements are fitted, a controller, a heater and a power supply unit.
The aluminium block, controller, heater and power supply unit are designed as crystal modules. In this manner, uniform temperature distribution and protection against external effects are ensured.
A Pt 100 resistance thermometer or an electronic monitoring unit with relay output or DC 24 V output are fitted to permit checking of the temperature in the aluminium block (thermostat). The monitoring unit is triggered when the maximum or minimum temperature of the cold junction block is violated or if the power supply fails.
A signalling lamp "Operation" is present in the door.
The cold junction thermostat has a sheet-steel housing.

Mode of operation

The temperature of the aluminium block is held constant at a reference temperature of 50, 60 or 70 °C by an electronic two-step controller with low hysteresis.
With a constant cold junction temperature, the difference between the voltage of the measuring element and that of the reference element is a measure of the temperature at the measuring point. The thermocouples are electrically isolated from one another and from the power supply.

Technical data

Number of measuring points	12 or 24
Reference temperature	50, 60 or 70 °C
Error limits	0.5 K

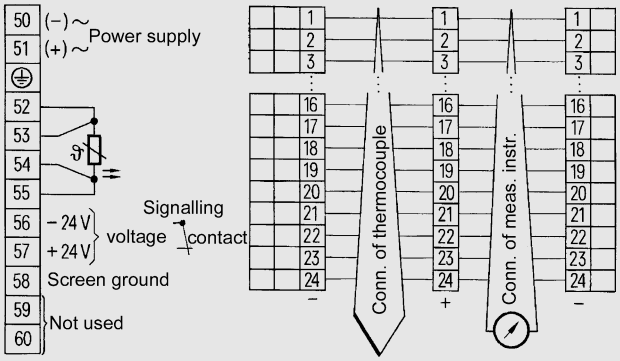


Fig. 2/20 Cold junction thermostat 7MC2930, connection diagram

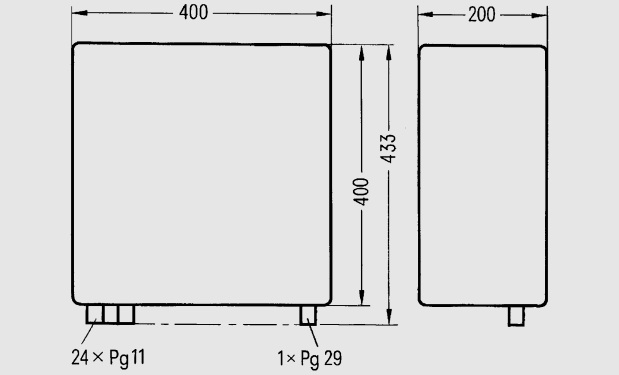


Fig. 2/21 Cold junction thermostat 7MC2930, dimensions

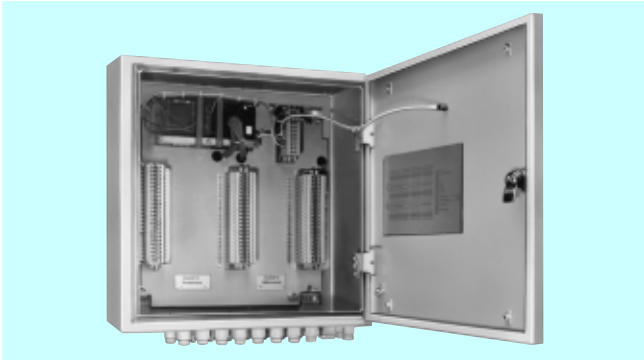


Fig. 2/22 Cold junction thermostat 7MC2930

Permissible ambient temperature with reference temp.	50 °C	-20 to +45 °C
	60 or 70 °C	-20 to +65 °C
Effect of ambient temperature		0.2 K per 10 K temperature change
Error limits of temperature control		0.05 K
Monitoring circuit		
Upper switching point		≤ reference temperature + 5 K
Lower switching point		≤ reference temperature - 5 K
Signalling relay		NC contact opens with fault
Rating		Max. 10 VA (max. AC 240 V, max. 0.5 A)
Power supply		AC 47 to 63 Hz, 24, 110 or 220 V ± 15 %, approx. 30 VA DC 24 V ± 10 %, approx. 30 W
Explosion protection		According to DIN EN 50 014, DIN EN 50 017, DIN EN 50 019 and DIN EN 50 020
Type of protection		[EEx ib] IIC Device only outside | EEx [ib] eq IIC T5 Device permissible inside potentially explosive atmosphere
Conformity certificate		PTB No. Ex-90.C.2055 and PTB No. Ex-90.C.2056
Warm-up time		Approx. 10 min
Degree of protection		IP 55 to DIN 40 050
Weight		Approx. 13 kg

Ordering data

Designation			Order No.
Cold junction thermostat			**7MC2930-**
Reference temp.	50 °C		1
	60 °C		2
	70 °C		3
Explosion prot.	Thermocouple element		
Without	Fe-CuNi	Type L	A
	Ni Cr/Ni	Type K	B
	Pt 10 % Rh/Pt	Type S	C
	Cu-CuNi	Type U	D
[EEx ib] IIC	Fe-CuNi	Type L	F
	Ni Cr/Ni	Type K	G
	Pt 10 % Rh/Pt	Type S	H
	Cu-CuNi	Type U	J
EEx [ib] eq IIC T5	Fe-CuNi	Type L	K
	Ni Cr/Ni	Type K	L
	Pt 10 % Rh/Pt	Type S	M
	Cu-CuNi	Type U	N
Number of reference junctions		12	A
		24	B
Power supply	AC 220 V		1
	AC 110 V		2
	AC 24 V		3
	DC 24 V		4
Temperature control with resistance thermometer; electronic monitoring of temperature in thermostat	with relay output		1
	with DC 24 V output		2

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