

High-Temperature Thermocouples



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Section 1

Introduction

This **product data sheet** is intended to be a complete reference and ordering guide of thermocouples and accessories for technical measurements mainly at high temperatures and their specific applications in a temperature range between 600 °C and 1800 °C.

Section 2

Thermocouples – Technical References

Describes the basic concepts of temperature measurement with thermocouples. Includes information on limit tolerances and application specific changes in the thermoelectric voltage and, in addition, important notes for installation of high temperature thermocouples.

Section 3

Standard-Application Thermocouples

Includes descriptions, specifications, and ordering information on Series 1075 Thermocouples with different protective tube designs.

Section 4

Thermocouples for Glass Industry

Includes descriptions, specifications, and ordering information on glass industry applications.

Section 5

Calibration and Certificates

Includes a description of tests and measurements of thermocouples, a performance overview of the DKD-calibration laboratory, and test specifications of calibrated Series 1075 Thermocouples.

Section 6

Accessories

Includes descriptions, specifications, and ordering information on transmitters, connection heads, mounting accessories, thermocouple wires, extension and compensating cables.

Thermocouple Questionnaire

Colour Coding Table for Extension and Compensating Cables

Colour coding table according to different standards.

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Overview

This Product Data Sheet (PDS), entitled "High-Temperature Thermocouples", contains standard thermocouples which conform to the German DIN standards and special thermocouples for applications in glass industry.

In addition to the products in this data sheet, Rosemount offers a wide range of other products for high-temperature measurements. Protective tubes made of special materials – such as Kanthal, silicon carbide, Stellite, tantalum, titanium, Hastelloy-alloys, Monel etc. – allow the use in different fields of application, e.g. ceramic, steel, and chemical industry as well as mining.

Beyond that, Rosemount provides a special thermocouple for high-pressure and high-temperature applications. For one particular production-scale gas reactor, operating at a temperature of 1400 °C and a pressure of 65 bars, Rosemount Heraeus Sensor developed an insulated thermocouple enclosed in a special capsule in order to protect it from corrosive gases. For this thermocouple-type we have a patent.

Series 1075 Thermocouples conform to the requirements of the DIN EN 60584-1/2 (IEC 584) standards. The DIN 43772 and DIN 43733 standards define all protective tube designs. Rosemount's high-temperature thermocouples are manufactured of material of excellent quality. The state-of-the-art manufacturing process enables the use of the thermocouples in very different fields of application, among other things the monitoring and control of process temperatures up to 1800 °C.

High-temperature measurement requires a specialised knowledge. On the basis of our 100-years' experience of innovation and application of thermometers, we offer a complete range of highly accurate temperature measuring solutions for process control.

It is our primary concern to steadily extend the service life of our products in operation by a continuous information exchange with the customer and to take up the resultant improvements in our research and development department.

Our DKD-authorized calibration laboratory certifies thermocouples and resistance thermometers on the basis of comparative and fixed-point measurements according to the regulations of the German Calibration Service. This enables the calibration and certification of every sensor for our customers.

As the DIN EN/ISO 9000 standards set growing requirements on a company's quality assurance system, the documented supervision of test equipment is becoming increasingly an issue of international competitiveness.

Rosemount and the Rosemount logo are registered trade marks of Rosemount Inc.
Inconel und Monel are registered trade marks of International Nickel Co.
Hastelloy is registered trade mark of Cabot Corp.
Kanthal is registered trade mark of Kanthal Sweden.
Stellite is registered trade name of Deloro Stellite (UK Ltd.).

Thermoelectric Effect

A thermocouple consists of a connection of two different metals which produces a change of the thermoelectric EMF in comparison with a temperature change. A thermocouple provides a thermoelectric voltage in millivolts d.c.

which depends on the temperature difference between the hot and cold junctions.

The hot junction is that junction which is exposed to the temperature of measurement.

The cold junction is the one for which the temperature is known. A thermocouple consists of two connected different leads, called positive or negative leg. In practice, these leads are connected to extension or compensating cable, or directly to the transmitter in the local connection head. The simplest practicable thermocouple consists of two wires welded together at one end, which forms the measuring tip.

Thermocouple Materials

The DIN EN 60584 (IEC 584) standards define the basic values and tolerances of the thermocouple types at a temperature range between 0 °C and 1800 °C. High-temperature measurements of 1200 °C up to 1800 °C can be carried out with precious-metal thermocouples only. Generally, precious-metal (platinum) thermocouples are the most stable. In comparison with base-metal types, they can be used up to 1800 °C, although their electrical outputs are low (see **Table 1**). Type K is a commonly used base-metal thermocouple and covers most industrial applications.

Rosemount transmitters are programmable for the majority of thermocouple inputs. The thermoelectric voltage is amplified and, for example, converted into a 4 - 20 mA output signal in proportion to temperature.

Table 1: Characteristics of standard thermocouples.

Thermocouple Type	Alloy of Leads +/-	Temperature Range [°C]	Output [mV d.c.]
J	Fe-CuNi	0 to 700	0 to 39.130
K	NiCr-Ni	0 to 1200	0 to 48.828
R	PtRh87/13%-Pt	0 to 1600	0 to 18.842
S	PtRh90/10%-Pt	0 to 1600	0 to 16.771
B	PtRh70/30%-PtRh94/6%	0 to 1800	0 to 13.585

Limit Tolerances

All thermocouples manufactured and supplied by Rosemount are in accordance with the DIN EN 60584-2 (IEC 584-2) limit tolerances. Calibration of one or more customer-specific measuring points can be provided on request with a DKD-certificate up to 1200 °C and a works certificate up to 1300 °C.

Important Reasons for a Change in the Thermoelectric Voltage during Operation

Above 1200 °C, precious-metal thermocouples are stable because of their excellent oxidation and corrosion resistance. Thermocouples based on platinum (type R, S, and B) are by far the most common. However, even PtRh thermocouples cannot guarantee reliable temperature measurement, for a longer period and without careful control. This may cause considerable measuring errors or even early failure. The thermoelectric voltage of precious-metal thermocouples can change due to environmental influences outside the protective tube. Above 1300 °C, in oxidizing and reducing atmospheres, impurities (mainly iron) of the protective tubes result in faulty measurements.

If thermocouples are used in reducing atmospheres, even a small amount of silicon causes rapid embrittlement and, therefore, a change in the thermoelectric voltage. Gas-tight alumina protection tubes are to be used for these applications. A complete range of Rosemount high-temperature thermocouples are available with 99.7% recrystallised alumina protective tubes to avoid early deterioration of the thermocouple wires.

Change in the Thermoelectric Voltage due to Interdiffusion

The thermoelectric voltage (EMF) between a material and a reference element depends on the composition of the thermocouple wires. As precious-metal thermocouples are generally used in a temperature range where solid state reactions and diffusion processes may occur on a large scale, a constant composition of the thermocouple wires cannot be guaranteed. One of the reasons for instability is an interdiffusion at the hot junction. Interdiffusion via gas phase is largely avoided by using high-purity alumina ceramic insulators in all high-temperature thermocouple assemblies.

Change in the Thermoelectric Voltage by Selective Evaporation

Different bonding energies and thus different evaporation rates of the alloying elements of a wire change the concentration during operation. The evaporation rate in a reducing atmosphere is lower than in an oxidizing atmosphere. Rh evaporation in a PtRh wire may cause considerable measuring errors if the other leg is Pt on a PtRh-Pt thermocouple. Therefore, the use of a thermocouple with a PtRh alloy in both legs (type B) is recommended in order to have a more stable signal for a longer period (Rh evaporation in both legs).

The rhodium diffusion at the measuring tip is based on the affinity of pure platinum for contamination and alloy components. The unalloyed platinum wire extracts rhodium from the alloyed wire. The microstructural change on both sides of the measuring tip causes measuring errors. For this reason, the use of type B-thermocouples is recommended as both legs contain rhodium parts. The long-term stability of the platinum-rhodium thermocouples increases with a growing rhodium content.

Change in the Thermoelectric Voltage due to Environmental Influences

The most important effect in practice is the influence of the environment, which has been intensively investigated. Diffusion by impurities in thermocouple wires changes their thermoelectric output, or even destroys them. At high temperatures and reducing atmospheres, the release of arsenic, silicon, phosphorus, sulphur and boron is very dangerous because they form eutectic phases which lead to a total failure.

For this reason, all Rosemount high-temperature thermocouples are protected by high-quality ceramic closed end tubes. In all our manufacturing areas, special care is taken to avoid any contamination with oil, grease, sulphur, and metallic impurities which eventually cause serious errors during operation.

Uncertainty due to Electrical Interference

The thermocouple output can be influenced by electromagnetic radiation, e.g. in electrically heated furnaces. Depending on the strength of the electrical field, serious reading errors may occur. Normally, shielded compensating cables are used to lead the output signal to the control room. In practice however, this measure is not sufficient to avoid all possible signal disturbances. Rosemount offers special, electrically shielded high-temperature thermocouples up to 1800 °C, supplied with gas-tight, ceramic protective tubes.

Important Information about Installation of High-Temperature Thermocouples

To reduce any risk of damage of gas-tight, ceramic protective tubes by thermal shock, it is necessary to pre-heat the thermocouple assembly before installation. Slow insertion into the ceramic protective tubes avoids possible damaging, caused by rapid changes in temperature. At high temperatures, it is recommended to assemble thermocouples vertically, so that distortion or breakage is prevented. Even hair-line cracks may cause contamination and drifts at thermocouples. To avoid bending or breakage, horizontally assembled thermocouples are to be supported. Furthermore, it has to be taken into consideration that the temperature at the connection head and the terminal block must not exceed 200 °C.

Introduction

The Series 1075 thermocouples conform to DIN 43772 and 43733 standards, and can be ordered as complete thermocouple assemblies. The model number from the respective ordering table defines the thermocouple type, material, nominal length, process connection, protective tube and connection head.

The limit tolerances of thermocouples acc. to DIN EN 60584-2 standards are the defined by values in °C or the percentages referred to the actual temperatures in °C.

Table 2: Limit tolerances of thermocouples.

Type	Alloy	Standard	Temperature Range [°C]	Limit Tolerance DIN EN 60584-2	Tolerance Class
Base-Metal Thermocouples					
J	Fe-CuNi	DIN EN 60584-1	-40 °C to 375 °C	1.5 °C	1
			375 °C to 750 °C	0.004 x (t)	
			-40 °C to 333 °C	2.5 °C	2
			333 °C to 750 °C	0.0075 x (t)	
K	NiCr-Ni	DIN EN 60584-1	-40 °C to 375 °C	1.5 °C	1
			375 °C to 1000 °C	0.004 x (t)	
			-40 °C to 333 °C	2.5 °C	2
			333 °C to 1200 °C	0.0075 x (t)	
N	NiCrSi-NiSi	DIN EN 60584-1	-40 °C to 375 °C	1.5 °C	1
			375 °C to 1000 °C	0.004 x (t)	
			-40 °C to 333 °C	2.5 °C	2
			333 °C to 1200 °C	0.0075 x (t)	
L	Fe-CuNi	1)	-40 °C to 400 °C	3 °C	
			400 °C to 750 °C	0.0075 x (t)	
Precious-Metal Thermocouples					
R	PtRh87/13%-Pt	DIN EN 60584-1	0 °C to 1100 °C	1 °C	1
			1100 °C to 1600 °C	[1+0.003 x (t-1100 °C)]	
			0 °C to 600 °C	1.5 °C	2
			600 °C to 1600 °C	0.0025 x (t)	
S	PtRh90/10%-Pt	DIN EN 60584-1	0 °C to 1100 °C	1 °C	1
			1100 °C to 1600 °C	[1+0.003 x (t-1100°C)]	
			0 °C to 600 °C	1.5 °C	2
			600 °C to 1600 °C	0.0025 x (t)	
B	PtRh70/30%-PtRh94/6%	DIN EN 60584-1	600 °C to 1700 °C	0.0025 x (t)	2

1) DIN 43710 has been cancelled and replaced by a works standard.

Rosemount provides thermocouples of tolerance class 1 (except types L and B). In this product data sheet, types K, R, S, and B are defined as standard thermocouple types. All other types are available on request.

Type L, according to the works standard, can be supplied for the spare-part demand of older plants.

The thermocouple wire diameter varies in the design of the thermocouple. The standard diameter for precious-metal thermocouples is 0.5 mm for long-term stability. Other thermocouple wire diameters are available on request. The price of precious metals is subject to daily quotation and, therefore, it will be quoted separately. Please see corresponding additional clause at the end of this section.

Table 3: Recommended thermocouple wire diameter depending on the application temperature.

Thermocouple Type	0.35 mm	0.5 mm	0.8 mm	1 mm	1.38 mm	2 mm	3 mm
J / L		400 °C	400 °C	600 °C	600 °C	700 °C	700 °C
K / N		700 °C	800 °C	800 °C	1000 °C	1200 °C	1200 °C
R / S	1400 °C	1600 °C					
B	1500 °C	1800 °C					

Thermocouples have to be protected from pressure, flow, corrosion and other mechanical and chemical influences. A protective tube is used to resist these influences permanently. The selection of a suitable protective tube is the crucial factor for the actual service life of the thermocouple assembly. A multiplicity of proven designs of different materials and alloys was standardized for the use of our thermocouple assemblies. Depending on the process conditions, we offer a wide range of application-specific protective tubes.

Metal protective tubes of heat-resistant materials, such as Inconel or CrNi-steel, provide the advantages of high-mechanical stress and can be used at temperatures up to 1200 °C. As standard design, we offer protective tubes of following materials: AISI 446 (1,4762) and AISI 314 (1,4841). Protective tubes of Kanthal AF and Kanthal Super are suitable for temperatures of 1350 °C or 1700 °C, e.g. in corrosive furnace atmospheres. Particularly in refuse incinerators, the Kanthal protective tubes find multiple application.

Ceramic protective tubes are predominantly used for high-temperature ranges. **Table 4** shows the characteristics and fields of application for standard materials and ceramic types C 530, C 610 and C 799.

Gas-tight protective tubes, made of silicon carbide for use in high dust loads and corrosive environments up to 1400 °C, are available on request. Special characteristics of reaction-sintered, silicon-infiltrated silicon-carbide protective tubes guarantee high service lives under extreme operating conditions.

Note:

If protective tubes in this data sheet seem to be unsuitable for special applications, please provide us with exact information on the operating conditions, so that an appropriate offer can be submitted.

High-temperature thermocouples are used for technical temperature measurements in heat treatment and combustion processes, and hot-gas environments of glass, ceramic, and metal industry.

The most frequent fields of application are temperature monitoring and control of incinerators, industrial furnaces, and reactors.

Table 4: Characteristics and types of application for metallic and ceramical protective tubes.

Material	Max. Temperature	Particularly Suitable	Less Suitable	Field of Application
Metal Protective Tubes				
1.0305 (St 35.8)	600 °C	For air, average resistance to nitrogenous gases	Poor resistance to sulphurous gases	Temperature furnaces for thermal treatment processes, galvanisation and tinning plants, carbon-dust-air mixture pipelines in steam power stations
1.0305 enamelled (St 35.8 enamelled)	600 °C	For corrosive applications within the dew-point range of flue gases	Sensitive to shock, inflexibility	Flue-gas desulphurisation plants, bearing metal, lead and tin melts
1.4762	1200 °C	High resistance to sulphurous gases	Poor resistance to nitrogenous gases	Combustion exhausts, cement and ceramic furnaces, thermal treatment processes, annealing furnaces
1.4749	1200 °C	Very high resistance to sulphurous gases	Poor resistance to nitrogenous gases	Flue ducts, cooling furnaces
Kanthal AF™ 1.4767	1350 °C	High heat resistance, high resistance to sulphurous gases, high abrasion resistance	Poor resistance to nitrogenous gases	Industrial furnaces, glass, ceramic and cement industry, refuse incinerators
Kanthal Super™ (Molybdenum Disilicide)	1700 °C	Very high heat resistance, high resistance to corrosion, high thermal conductivity, excellent hardness characteristics, high abrasion resistance	Poor resistance to nitrogenous gases	Glass and ceramic industry, carbon pressure-gasification, refuse incinerators
1.4841	1200 °C	High resistance to nitrogenous and low-oxygen gases	Poor resistance to sulphurous gases	Combustion chambers, industrial furnaces, petrochemical industry, nitrogenous blast heaters, cyanide baths
Ceramic Protective Tubes acc. to DIN VDE 0335 Standards (except Silicon Carbide)				
Type C 530 (Al ₂ O ₃ Content: 73 - 75%)	1600 °C	Resistant to thermal shocks	Fine pored, not gas-tight, sensitive to shock	Electrically heated furnaces up to 1300 °C and other industrial furnaces, glass tank furnaces, regenerator checkerwork
Type C 610 (Al ₂ O ₃ Content: 60%)	1400 °C	Gas-tight, high refractory quality, average resistance to thermal shocks	Low Al ₂ O ₃ -purity, sensitive to shock	Gas-tight furnaces, diffusion furnaces
Type C 799 (Al ₂ O ₃ Content: 99.7%)	1800 °C	Very gas-tight, highest refractory quality, resistant to acids, alkalines and hot steam, high flexibility	Poor resistance to thermal shocks, sensitive to shock	Protective gas furnaces as well as gas-tight and electrically heated furnaces up to 1700 °C (glass tank furnaces), flue-gas desulphurisation, chemical industry, cement production
Silicon-Infiltrated, Reaction Sintered, Silicon Carbide (e.g. Halsic™, Protec™, Silit SK™)	1400 °C	Very high consistency, extremely high corrosion resistance to acids and alkalines, excellent thermal conductivity, very resistant to thermal shocks, high abrasion resistance	Low mechanical stress	Flue-gas desulphurisation plants, carbon mills, combustion chambers, flue-gas channels (in corrosive environment and at high temperatures)

Usually, the ceramic protective tube is cemented into a holding tube, for easy installation of the connection head. As the temperature above the fitting is generally low, unalloyed steel is used for holding tubes. If the holding tube reaches into the body of the furnace, heat resistant steel is to be used.

Several connection head versions are available, which differ in sizes and type of covers. All connection heads have a rubber o-ring-seal on the cable entry, which limits the permissible temperature at this point to about 80 °C. If, instead of rubber, a silicone o-ring-seal is used, the max. temperature at the aluminium-alloy connection heads is 200 °C. You will find suitable connection heads in **Section 6**.

Besides our standard connection heads with inserted terminal block, the thermocouples of this product data sheet are also available with head-mounted transmitters of series 244 and 644.

It is recommended to insert these transmitters into the cover of the connection head TZ-A/BL or TZ-/AL. The permissible temperature at the connection head is reduced to 70 °C. You will find a summary of all available transmitters in **Section 6**.

The process connections are mainly supplied with adjustable and removable mounting elements, which are sealed with a stuffing bush. As standard, we offer adjustable stop flanges and threaded fittings in appropriate sizes. The process connection at the metal protective tubes is freely movable. The mounting element of ceramic protective tubes with stop and counter flange is situated at the end of the holding tube with a seal on the protective tube. The position of the threaded fitting or welded-on flange on the holding tube can be selected as desired. To avoid gas penetration into the connection head after breakage of the protective tube, the connection head is to be sealed. For further details see **Section 6**.

Table 5: Summary of material standards.

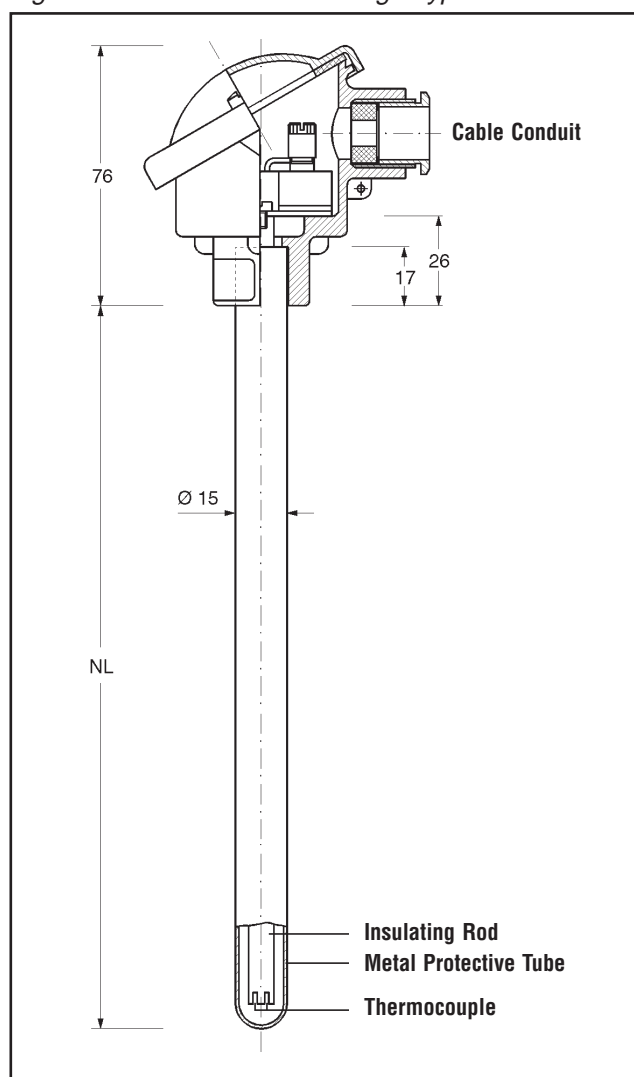
Material No. DIN	Material Code	AISI (USA)	B.S. (Great Britain)	AFNOR NF (France)	Product Group
1.0305	St. 35.8				Carbon steels
1.4749	X 18 CrN 28	446			Heat-resistant steels
1.4762	X 10 CrAl 24	446		Z 10 CAS 24	Heat-resistant steels
1.4767	CrAl 20 5 (Kanthal AF™)				Heat-resistant steels
1.4841	X 15CrNiSi 25 20	314	314 S 25	Z 12 CNS 25-20	Heat-resistant steels
Super Kanthal™	Molybdenum disilicide				Sintered metals

Series 1075 Immersion Thermocouples, Type BM – with Metal Protective Tube and without Ceramic Inner Tube (Max. Temperature 1200 °C)

This design consists of a ceramic-insulated thermocouple and a housing with a protective tube, type BM according to DIN 43733 (form 1 in accordance with DIN 43772).

The single or double thermocouple legs are insulated with ceramic elements. Oxygen-poor, neutral and reducing atmospheres, particularly in conjunction with humidity or carbon monoxide, can produce “selective chrome oxidation “ at temperatures between 800 °C and 1000 °C.

Figure 3: Dimensional drawing - Type BM.



Mass_03.tif



V4_02a.tif

Figure 2: Immersion thermocouples Series 1075, type BM.

This process changes the EMF of the thermocouple (type K). If the operating temperature is constantly within this range, we recommend the use of a mineral-insulated thermocouple.

For gas-tight installation of the protective tube, a gas-tight threaded fitting is necessary (pressure load up to max. 1 bar). The standard heat resistant materials for protective tubes are 1.4762 and 1.4841. Protective tubes of material 1.4762 have a longitudinal weld. This causes a brittleness which may be responsible for superficial fissures. For temperatures up to 1200 °C, we therefore recommend weldless protective tubes made of material 1.4749, instead of the above mentioned material.

Flue-gas thermocouples with a fire enamelled protective tube (up to 600 °C) in dimensions of 15 x 3 mm and of material 1.0305 (St 35.8) are available on request. The maximal length is 2,000 mm.

Fields of Application:

- Tempering furnaces for thermal treatment processes
- Pipelines
- Curtains and air ducts
- Flue-gas desulphurization plants
- Bearing metal-, lead- and tin melts

Ordering Information: Series 1075, Type BM, (Form 1, DIN 43772), (Previously, Type T-EA 15) – High-Temperature Thermocouple with Metal Protection Tube and without Ceramic Inner Tube (Max. Temperature 1200 °C)

Model	Product Description		
1075BM	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
L ⁽¹⁾	TZ-A/BL (BUZH), Aluminium	54	M20 x 1.5
U	GN-BL, Aluminium, DIN 43729	43	M20 x 1.5
Y	HR-A/BL (BUS), Aluminium	54	M20 x 1.5
Code	Sensor Connection		
2	Terminal block, Form B		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
K	K		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
13	1.38 (duplex)	K	1000
20	2	K	1200
Code	Protective Tube Material / Dimensions	Inner Tube Material / Dimensions	Max. Temperature [°C]
A	1.4762 (AISI 446 - heat-resistant steel), 15 x 2	without	1200
B	1.4841 (AISI 314 - heat-resistant steel), 15 x 2	without	1200
Code	Nominal Length (NL) in Millimeters		
0250	250		
0500	500		
0710	710		
1000	1000		
XXXX	Other lengths (max. 2,000 mm)		
Code	Process Connection	Material	
A1	Adjustable stop flange	GTW-35 (cast iron)	
B1	Adjustable threaded fitting with G 3/4	1.0711 (steel)	
NN	No fitting		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options: <ul style="list-style-type: none"> • Other connection heads • Other protective tube materials • Calibration and material certificates (see page 43) • Other types of thermocouples • Other process connections 			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Ordering Example

	Model	Connection Head	Sensor Connection	Number of Elements	Thermo-couple Type	Wire Diameter	Material Prot. Tube	Nominal Length	Process Connection	Additional Options
Typical Model-No.:	1075BM	Y	2	01	K	20	A	0250	NN	

Series 1075 Immersion Thermocouples, Type AM(K) – with Metal Protective Tube and **with/without** Ceramic Inner Tube (Max. Temperature 1700 °C)

It consists of a base-metal thermocouple type K or precious-metal thermocouples types R, S, or B, and a housing with a protective tube type AM according to DIN 43733.

The single or double type K thermocouple legs are insulated with ceramic elements. Precious-metal thermocouples are insulated with a 4-hole insulating rod and provided with a gas-tight inner tube of 15 x 2 mm of ceramic type C 610.

For gas-tight installation of the protective tube, a gas-tight threaded fitting is necessary (pressure load up to max. 1 bar). Our standard heat-resistant materials for protective tubes are 1.4762 and 1.4841. In addition, we supply one protective tube type made of heat-resistant Kanthal with an outer diameter of 22 mm.

Protective tubes of **Kanthal AF** offer following advantages:

- Application temperature up to 1350 °C
- High service life, even with a low wall thickness of 1.3 mm
- Faster heat transfer due to low wall thickness leads to a fast response time of the thermocouples
- High temperatures form a tight and adhered alumina film, which keeps away impurities
- Protective tube length max. 6,000 mm.



V4_04.tif

Figure 4: Series 1075 immersion thermocouple, type AM(K).

Figure 5: Measuring tip – type AM(K).



VD_06.tif

Flue-gas thermocouples with a fire-enamelled protective tube (up to 600 °C) in dimensions of 22 x 2 mm and made of material 1.0305 (St 35.8) are available on request. The max. length is 2,000 mm.

Fields of Application:

- Pipelines
- Curtains and air ducts
- Flue-gas desulphurization plants
- Cooling furnaces in glass tank furnaces in glass melts
- Refuse incinerators

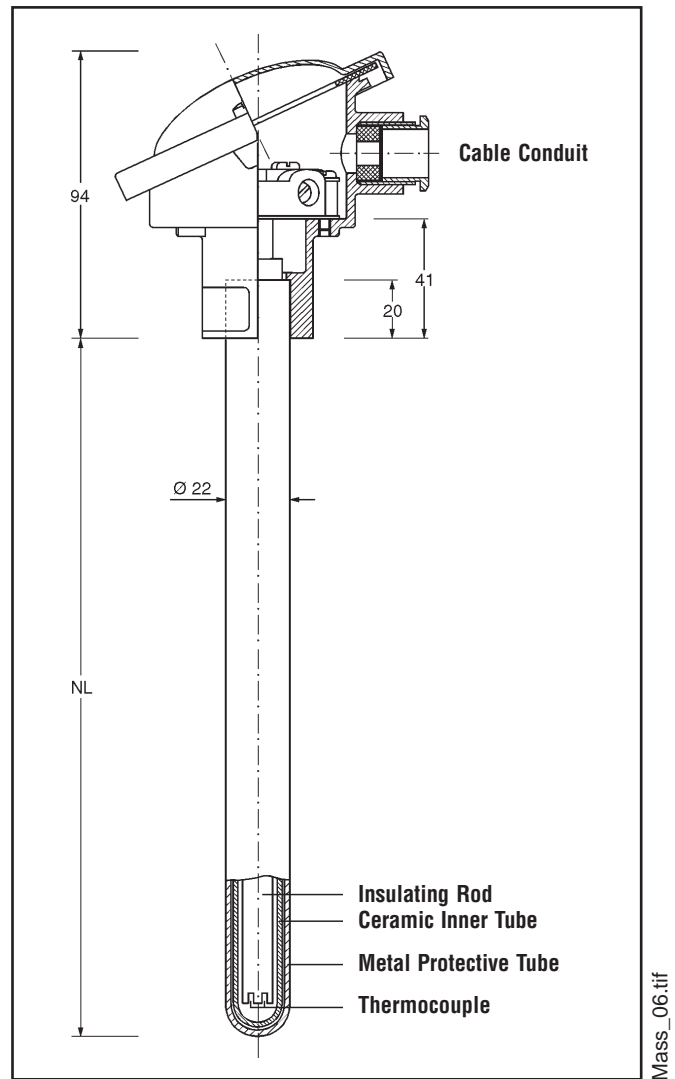


Figure 6: Dimensional drawing – type AM(K).

Ordering Information: Series 1075, Type AM(K), (Previously, Type T-EA 22) – High-Temperature Thermocouple with Metal Protection Tube and with/without Ceramic Inner Tube (Max. Temperature 1700 °C)

Model	Product Description		
1075AM	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
Code	Sensor Connection		
3	Terminal block, Form A		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
B	B		
K	K		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05	0.5	B, R, S	1600 / R, S; 1800 / B
20	2	K	1200
30 ⁽²⁾	3	K	1200
Code	Protective Tube Material / Dimensions	Inner Tube Material / Dimensions	Max. Temperature [°C]
C	1.4762 (AISI 446 - heat-resistant steel), 22 x 2	without	1200 / K
D	1.4841 (AISI 314 - heat-resistant steel), 22 x 2	without	1200 / K
E	1.4762 (AISI 446 - heat-resistant steel), 22 x 2	Typ C 610 / 15 x 2	1200 / R, S
F	1.4841 (AISI 314 - heat-resistant steel), 22 x 2	Typ C 610 / 15 x 2	1200 / R, S
G	1.4767 (Kanthal AF) 22 x 1.3	Typ C 610 / 15 x 2	1350 / R, S; 1200 / K
Code	Nominal Length (NL) in Millimeters		
0500	500		
0710	710		
1000	1000		
1400	1400		
XXXX	Other lengths (max. 6,000 mm)		
Code	Process Connection	Material	
A2	Adjustable stop flange	GTW-35 (cast iron)	
B2	Adjustable threaded fitting with G 1	1.0711 (steel)	
NN	No fitting		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options: <ul style="list-style-type: none"> • Other connection heads • Other types of thermocouples • Other protective tube materials • Other process connections • Calibration and material certificates (see page 43) 			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

(2) 3 mm suitable for better longterm stability

Ordering Example

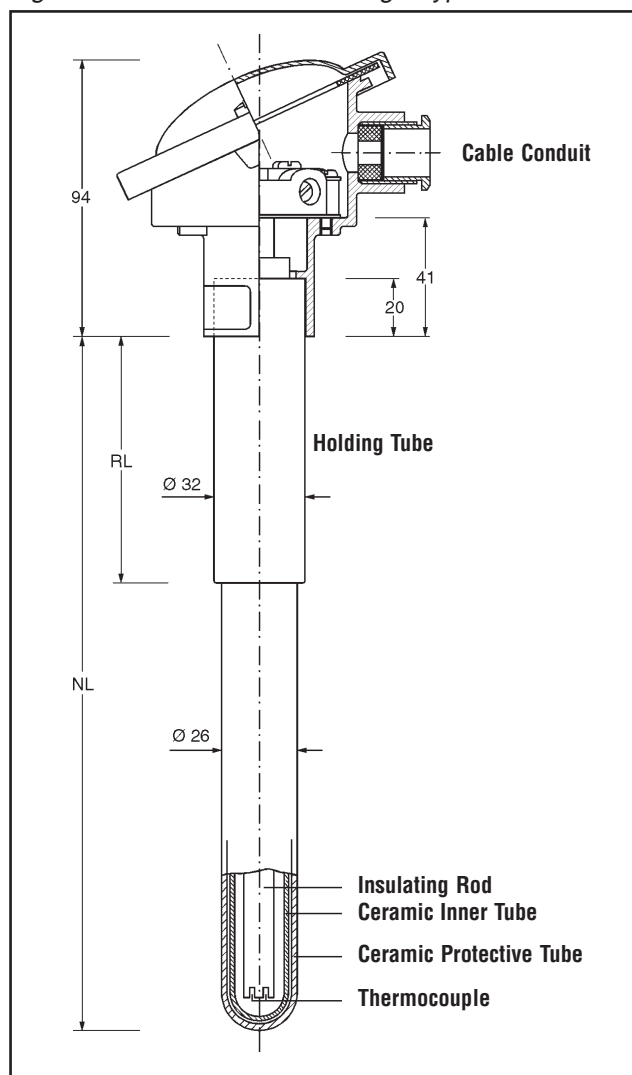
	Model	Connection Head	Sensor Connection	Number of Elements	Thermo-couple Type	Wire Diameter	Material Prot. Tube	Nominal Length	Process Connection	Additional Options
Typical Model-No.:	1075AM	G	3	01	S	05	E	1000	A2	

Series 1075 Immersion Thermocouples, Type AKK – with Ceramic Protective Tube and Ceramic Inner Tube (Max. Temperature 1800 °C)

This design consists of a base-metal thermocouple type K or precious-metal thermocouples type R, S or B and a housing with a protective tube type AKK according to DIN 43733.

The single or double type K thermocouple legs are insulated with ceramic elements. Precious-metal thermocouples are insulated with a 4-hole insulating rod and provided with a gas-tight inner tube made of ceramic type C 610 or C 799.

Figure 9: Dimensional Drawing – type AKK.



Mass_09.tif



V4_07.tif

Figure 7: Series 1075 immersion thermocouple, type AKK.

Figure 8: Measuring tip – type AKK.



V4_08.tif

Stop flanges or threaded fittings are necessary for installation. Standard materials for the protective tubes are ceramic types C 530, C 610 and C 799. Gas-tight ceramic materials are sensitive to thermal shock and impact stress. The tolerance level is optimized by correct selection of materials for protective tube and inner tube.

We recommend following combinations of ceramic protective tubes and inner tubes (see **Table 6**).

The holding tube is made of material 1.0305. At temperatures above 200 °C, it is recommended to use holding tubes made of heat-resistant materials AISI 446 (1.4762) or AISI 314 (1.4841).

Table 6: Protective and inner tube combinations.

Outer Protective Tube Material	Inner Tube	Thermocouple Type	Applications	Max. Application Temperature
C 530	C 610	K	Ceramic furnaces in brickworks	1200 °C
C 530	C 799	R	Glass tank furnaces: regenerator checkerwork (above)	1600 °C
C 799	C 799	B	Glass tank furnaces: side walls, crown, bottom (in pre-drilled channels up to 50 mm below the bottom)	1800 °C
C 799	C 799	B	Glass melting pot	1800 °C

Protective tubes of **Kanthal Super** consist of sinter material and have following properties:

- Application temperature up to 1700 °C
- Lower porosity and embrittlement, therefore, used at high temperatures and in corrosive furnace atmospheres

- Metal protective tubes are influenced among other things by electromagnetic oscillations, which may disturb the function of the thermocouple. Protective tubes of Kanthal Super suppress these oscillations
- Protective tube length max. 1,500 mm.

Ordering Information: Series 1075, Type AKK, (Previously Type T-EZI 26) – High-Temperature Thermocouple with Ceramic Protective Tube and Ceramic Inner Tube (Max. Temperature 1800 °C)

Model	Product Description		
1075AKK	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
Code	Sensor Connection		
3	Terminal block, Form A		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
B	B		
K	K		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05	0.5	R, S, B	1600 / R, S; 1800 / B
20	2.0	K (double)	1200
30	3.0	K (single)	1200

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Model	Product Description		
1075AKK	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Protective Tube Material / Dimensions	Inner Tube Material / Dimensions	Max. Temperature [°C]
H	Kanthal Super / 25 x 5	Typ C 799 / 10 x 1.5	1700 / B
T	Type C 530 / 26 x 4	Type C 610 / 15 x 2	1200 / K
U	Type C 530 / 26 x 4	Type C 610 / 15 x 2	1400 / R, S
V	Type C 530 / 26 x 4	Type C 799 / 15 x 2.5	1600 / S
W	Type C 799 / 24 x 3	Type C 799 / 15 x 2.5	1600 / R, S
Z	Typ eC 799 / 24 x 3	Type C 799 / 15 x 2.5	1800 / B
Code	Nominal Length (NL) in Millimeters		
0500	500		
0710	710		
1000	1000		
1400	1400		
2000	2000		
XXXX	Other lengths (upon request)		
Code	Process Connection	Material	
A3	Adjustable stop flange	GTW-35 (cast iron)	
B3	Adjustable threaded fitting with G 1 1/4	1.0711 (carbon steel)	
NN	No fitting		
Code	Holding Tube Material	Dimensions in Millimeters	
G	1.4762 (AISI 446 - heat-resistant steel)	32 x 2	
H	1.4841 (AISI 314 - heat-resistant steel)	32 x 2	
J	1.0305 (mild steel)	32 x 2	
Code	Holding Tube Length (RL) in Millimeters		
200	200		
XXX	Other lengths		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options: <ul style="list-style-type: none">• Other connection heads• Other protective tube materials• Other holding tube materials• Other types of thermocouples• Other process connections• Calibration and material certificates (see page 43)			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Ordering Example

Typical Model-No.:	Model	Connection Head	Sensor Connection	Number of Elements	Thermo-couple Type	Wire Ø	Material Prot. Tube	Nom. Length	Process Connec.	Holding Tube Material	Holding Tube Length	Additional Options
	1075AKK	P	3	01	S	05	W	1400	NN	H	200	

Series 1075 Immersion Thermocouples, Type BK – with Ceramic Protective Tube and **without** Ceramic Inner Tube (Max. Temperature 1800 °C)

It consists of a base-metal thermocouple type K or precious-metal thermocouples type R, S, or B and a housing with a protective tube type BK according to DIN 43733.

The single or double type K thermocouple legs are insulated with ceramic elements. Precious-metal thermocouples are insulated with a 4-hole insulating rod.

Figure 11: Dimensional drawing – type BK.

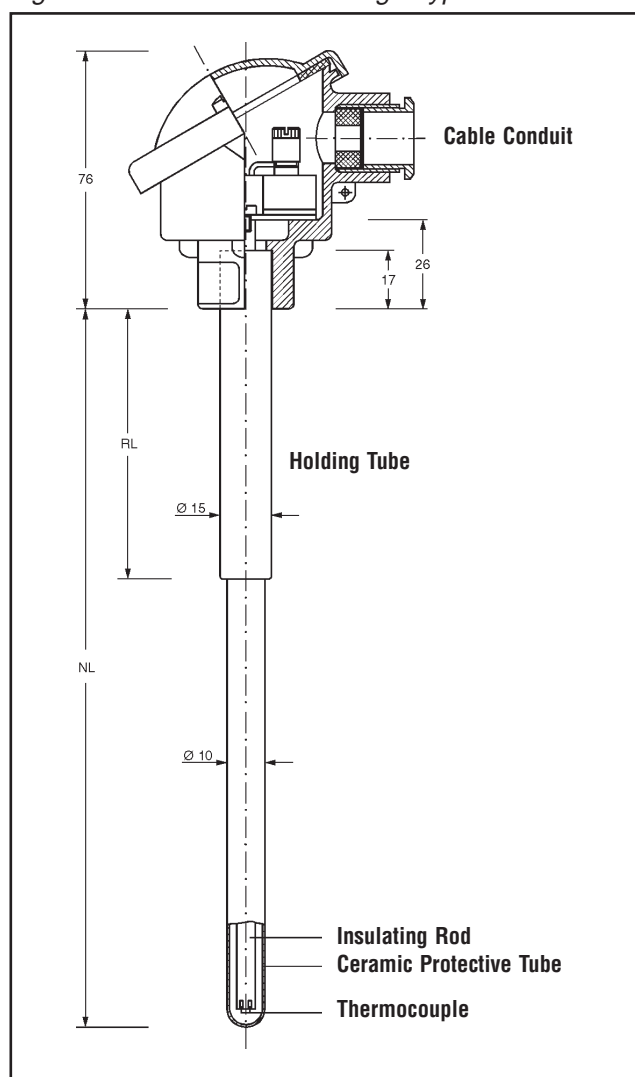


Figure 10: Series 1075 immersion thermocouples, type BK.

Stop flanges and threaded fittings are necessary for installation. Standard materials for the protective tubes are ceramic types C 610 and C 799. The holding tube is made of materials AISI 314 (1.4841), AISI 446 (1.4762) or mild steel (1.0305).

Fields of Application:

- Glass industry
- Vitrified clay furnaces
- Hardening bays
- Steel industry

Ordering Information: Series 1075, Type BK, (Previously, Type T-EZI 10) – High-Temperature Thermocouple with Ceramic Protective Tube, without Ceramic Inner Tube (Max. Temperature 1800 °C)

Model	Product Description		
1075BK	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
L ⁽¹⁾	TZ-A/BL (BUZH), aluminium	54	M20 x 1.5
U	GN-BL, aluminium, DIN 43729	43	M20 x 1.5
Y	HR-A/BL (BUS), aluminium	54	M20 x 1.5
Code	Sensor Connection		
2	Terminal block, Form B		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
B	B		
K	K		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple type	Max. Temperature [°C]
05	0.5	R, S, B	1600 / R, S; 1800 / B
13	1.38	K	1200
Code	Protective Tube Material / Dimensions	Inner Tube Material / Dimensions	Max. Temperature [°C]
J	Type C 610 / 10 x 1.5	without	1000 / K
K	Type C 610 / 10 x 1.5	without	1400 / R, S
L	Type C 799 / 10 x 1.5	without	1600 / R, S
M	Type C 799 / 10 x 1.5	without	1800 / B
Code	Nominal Length (NL) in Millimeters		
0250	250		
0500	500		
0710	710		
XXXX	Other lengths (max. 1,000 mm)		
Code	Process Connection	Material	
A1	Adjustable stop flange	GTW-35 (cast iron)	
B1	Adjustable threaded fitting with G 3/4	1.0711 (carbon steel)	
NN	No fitting		
Code	Holding Tube Material	Dimensions in Millimeters	
A	1.4762 (AISI 446 - heat-resistant steel)	15 x 2	
B	1.4841 (AISI 314 - heat-resistant steel)	15 x 2	
C	1.0305 (mild steel)	15 x 2	
Code	Holding Tube Length (RL) in Millimeters		
080	80		
XXX	Other length		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options: <ul style="list-style-type: none"> Other connection heads Other protective tube materials Other holding tube materials Other types of thermocouples Other process connections Calibration and material certificates (see page 43) 			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Ordering Example

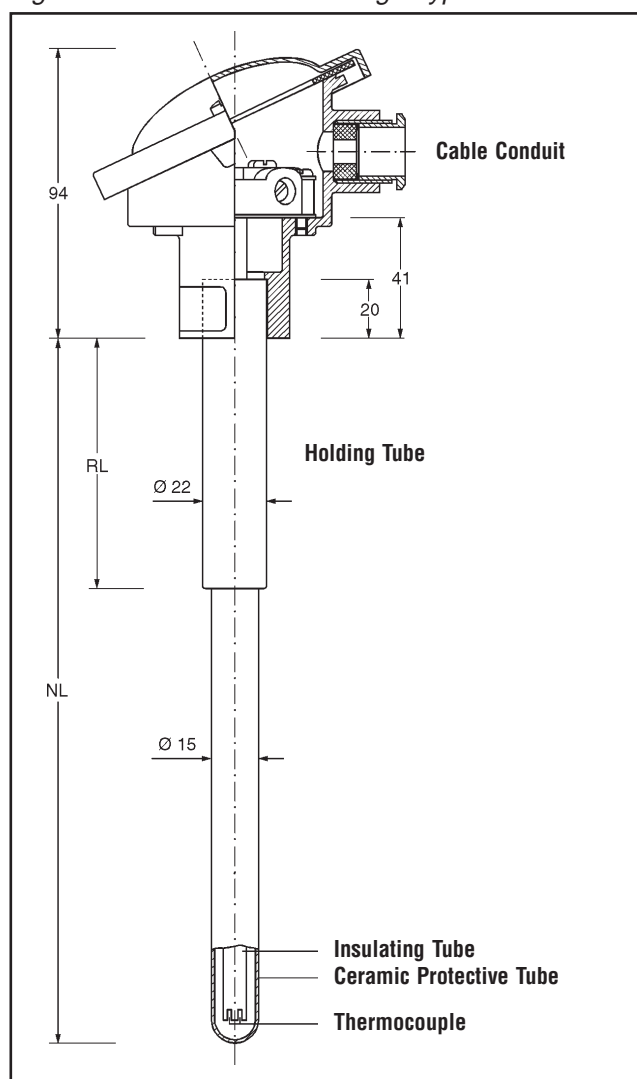
	Model	Connection Head	Sensor Connec.	Number of Elements	Thermo-couple Type	Wire Ø	Material Prot. Tube	Nom. Length	Process Connec.	Holding Tube Material	Holding Tube Length	Additional Options
Typical Model-No.:	1075BK	Y	2	01	S	05	L	0500	A1	A	080	

Series 1075 Immersion Thermocouple, Type AK – with Ceramic Protective Tube and **without** Ceramic Inner Tube (Max. Temperature 1800 °C)

It consists of a base-metal thermocouple type K or precious-metal thermocouples type R, S, or B and a housing with a protective tube type AK according to DIN 43733.

The single or double type K thermocouple legs are insulated with ceramic elements. Precious-metal thermocouples are insulated with a 4-hole insulating rod.

Figure 13: Dimensional drawing – type AK.



Mass_13.tif



V4_12.tif

Figure 12: Series 1075 immersion thermocouple, type AK.

Stop flanges and threaded fittings are necessary for installation. Standard materials for the protective tubes are ceramic types C 610 and C 799. The holding tube is made of materials AISI 314 (1.4841), AISI 446 (1.4762) or mild steel (1.0305).

Fields of Application:

- Glass industry (e.g. regenerator checkerwork, tempering furnaces)
- Vitrified clay furnaces
- Steel industry (annealing and tempering areas)

Ordering Information: Series 1075, Type AK, (Previously, Type T-EZI 15) – High-Temperature Thermocouple with Ceramic Protective Tube, without Ceramic Inner Tube (Max. Temperatur 1800 °C)

Model	Product Description		
1075AK	Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
Code	Sensor Connection		
3	Terminal block, Form A		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
B	B		
K	K		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05	0.5	R, S, B	1600 / R, S; 1800 / B
13	1.38	K (double)	1000
30	3.0	K (single)	1200
Code	Protective Tube Material / Dimensions	Inner Tube Material / Dimensions	Max. Temperature [°C]
P	Type C 610 / 15 x 2	without	1200 / K
Q	Type C 610 / 15 x 2	without	1400 / R, S
R	Type C 799 / 15 x 2.5	without	1600 / R, S
S	Type C 799 / 15 x 2.5	without	1800 / B
Code	Nominal Length (NL) in Millimeters		
0500	500		
0710	710		
1000	1000		
1400	1400		
XXXX	Other lengths (max. 2,000 mm)		
Code	Process Connection	Material	
A2	Adjustable stop flange	GTW-35 (cast iron)	
B2	Adjustable threaded fitting with G 1	1.0711 (carbon steel)	
NN	No fitting		
Code	Holding Tube Material	Dimensions in Millimeters	
D	1.4762 (AISI 446 - heat-resistant steel)	22 x 2	
E	1.4841 (AISI 314 - heat-resistant steel)	22 x 2	
F	1.0305 (mild steel)	22 x 2	
Code	Holding Tube Length (RL) in Millimeters		
150	150		
XXX	Other length		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options: <div><div><ul style="list-style-type: none">• Other connection heads• Other protective tube materials• Other holding tube materials</div><div><ul style="list-style-type: none">• Other types of thermocouples• Other process connections• Calibration and material certificates (see page 43)</div></div>			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Ordering Example

	Model	Connection Head	Sensor Connec.	Number of Elements	Thermo-couple Type	Wire Ø	Material Prot. Tube	Nom. Length	Process Connec.	Holding Tube Material	Length	Additional Options
Typical Model-No.:	1075AK	P	3	01	B	05	S	0710	B2	E	150	

Price Calculation of Precious Metals

The thermocouple wire diameter varies depending on the thermocouple. We offer a wire diameter of 0.5 mm for precious-metal thermocouples, as the long-term stability is much better with a thicker thermocouple wire. Other thermocouple wire diameters, e.g. 0.35 mm, are available on request.

The price of precious metals is subject to daily quotation and, therefore, it will be quoted separately. For the price calculation of precious metals, the nominal length (NL), the thermocouple type and the wire diameter are taken over from the corresponding ordering table with the help of the model number.

Depending on the connection head size, 55 mm or 80 mm have to be added to the nominal length (NL), in order to get the actual thermocouple length (TL). With the assistance of the table below, the total weight of precious metals per thermocouple can be calculated. After delivery, the confirmed precious metal weight will be changed into the real weight on our invoice. Due to the daily quotation, precious metal prices have to be inquired at our company.

Afterwards, all variables are added to the corresponding formula.

Following information helps for the **price calculation**:

Precious Metal of following Model-No: _____ Length (NL) / Wire Diameter / Weight (g/m) / (see Weight Table) _____ Date / Daily Quotation (Euro/g) ¹⁾ _____

¹⁾ For daily quotation, please contact Rosemount.

Price Calculation for Thermocouples

1. In Connection with DIN-Form B-Connection Head (Protective Tubes, Type BM & BK):

$$\text{Price} = \frac{\text{NL (mm)} + 55 \text{ (mm)}}{1,000 \text{ (mm)}} \times G \text{ (g/m)} \times T \text{ (€/g)}$$

Example:

Price for 5 pieces
Model-No.: 1075BK-Y-2-01-S-05-L-0500-A1-A-080

$$\frac{500 \text{ mm} + 55 \text{ mm}}{1,000 \text{ mm}} \times 8.2 \text{ g/m} \times 16.10 \text{ €/g} = \mathbf{73.27 \text{ €}}$$

--> 5 pieces = **366.35 €**

2. In Connection with DIN-Form A-Connection Head (Prot. Tubes, Type AM, AK & AKK):

$$\text{Price} = \frac{\text{NL (mm)} + 80 \text{ (mm)}}{1,000 \text{ (mm)}} \times G \text{ (g/m)} \times T \text{ (€/g)}$$

NL = Nominal length
G = Weight
T = Daily quotation

Example:

Price for 5 pieces
Model-No.: 1075AK-P-3-01-B-05-S-0710-B2-E-150

$$\frac{710 \text{ mm} + 80 \text{ mm}}{1,000 \text{ mm}} \times 7.6 \text{ g/m} \times 18.25 \text{ €/g} = \mathbf{109.57 \text{ €}}$$

--> 5 pieces = **547.85 €**

Note

Please double the price for double thermocouples.

Precious Metal Exchange

The reasons for the change in the thermoelectric voltage mentioned in **Section 2** require the replacement of precious-metal thermocouple wires in time. Rosemount offers an exchange of the recycling material, returned by the customer, for new thermocouple material. The new material will be charged to an exchange price.

Table 7: Weight table (both legs).

Wire Diameter [mm]	Weight [g/m]		
	Type R	Type S	Type B
0.35	3.9	4.0	3.7
0.5	8.1	8.2	7.6

Introduction

Rosemount supplies high-temperature thermocouples worldwide for measurement and control of temperatures in furnaces and chambers, e.g. in glass industry. Because of high temperatures and corrosive environment conditions, platinum-cladded or coated ceramic protective tubes are used in these applications. According to the melting composition, strong oxidations may occur. Depending on the specific process conditions, the service life of thermocouples with platinum protective tubes can be up to 4 - 6 years. Generally, the use of platinum parts is not recommended in reducing atmospheres.

In glass melts, present reducing conditions may cause low melting phases of oxides (aluminium, silicon, arsenic, lead) with platinum, which quickly penetrate into the grain boundaries. Furthermore, conventional alloys show strong coarse-grain formation at higher operating temperatures. Structure damage by contamination leads to loss of stability and breakage of components.

The introduction of dispersion hardening (DPH) for platinum and its alloys solved these problems to a large extent. The finely dispersed oxides impede grain growth and dislocations just below the melting point. This results in a clear reduction of the creep rate and an increase in stress rupture strength especially at high temperatures. Because grain growth is impeded, a fine-grained structure is formed, which remains stable even at the highest application temperatures. Compared to non-dispersion hardened materials, this characteristic microstructure guarantees clear improvement in corrosion resistance.

The current platinum DPH materials (Pt-DPH, PtRh90/10%-Pt DPH) distinguish themselves through following **advantages**:



Figure 14: Special thermocouples.

V4_14.tif

Figure 15: Special thermocouple measuring tips.



V4_15.tif

- High creep and stress-rupture up to the highest application temperatures
- Excellent corrosion resistance, even in aggressive glass melts
- Ideal microstructural stability in long-term service
- Good formability
- Weldability comparable to non-dispersion hardened platinum materials

Thermocouples with Platinum Protective Tubes

Introduction

Depending on application-specific conditions, like temperature measurement in the molten glass, clad or coated protective tubes are used with platinum or platinum alloys. As a result, the lifetime of the thermocouple is substantially increased.

Construction

This design consists of single or double thermocouples type R, S, or B and a housing with a ceramic protective tube type C 799, whose measuring tip is either clad or coated with precious metal. The platinum-covered protective tube is ground in and the precious-metal tube is cemented-up. To achieve a longer service life, the wire diameter of the thermocouple is 0.5 mm. The thermocouple legs are insulated with a 4-hole insulating rod.

Usually, the ceramic protective tube is cemented into the holding tube. For easy installation, the connection head is mounted on the holding tube. As the temperature above the fitting is generally low, unalloyed steel is used for holding tubes. If the holding tube reaches into the body of the furnace, heat-resistant steel is to be used.

Stop flanges and threaded fittings are necessary for installation. You will find an appropriate selection in **Section 6 - Accessories**.

Temperature Range

Depending on the type of glass, thermocouples with platinum protective tubes can be used in molten glass at temperatures up to 1,650 °C. Alloys with a higher rhodium content have a longer lifetime.



V4_16.tif

Figure 16: Thermocouple with Pt-protective tube.



V4_17.tif

Figure 17: Thermocouple with coated protective tube.

Price Calculation

The total price includes the prices for the thermocouple, the thermocouple precious metal wires, and the precious-metal tube or coating. The precious-metal prices are subject to daily fluctuations and, therefore, to be inquired at the thermocouple supplier.

Ordering Notes

The thermocouples – with protective tubes coated or clad with Pt – are manufactured almost exclusively according to customer's specification.

For this reason, a thermocouple can be described only approximately with the help of an ordering table. The indicated options are only an ordering help. If none of the specified options applies, it is absolutely necessary for the handling of an inquiry to fill in all empty fields (options with the codes 0 or X) the appropriate technical information.

Ordering Example

T-EYI-E-2-01-S-05-X-1500-C-560-NN-D-940

Figure 18: Dimensional drawing – thermocouple with Pt-tube.

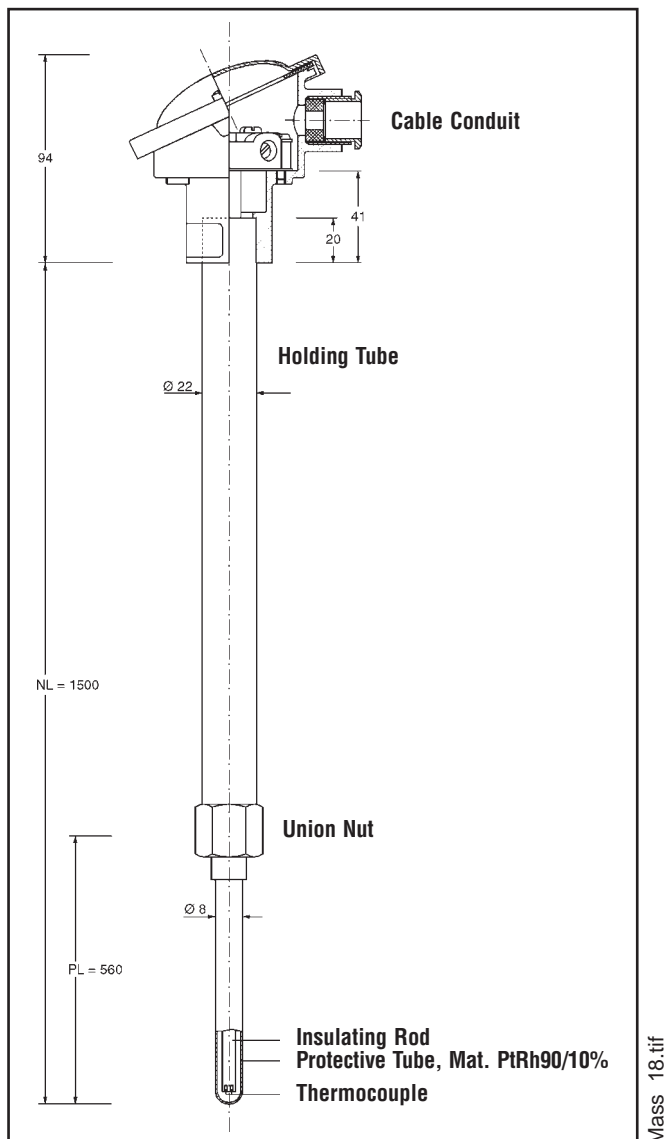
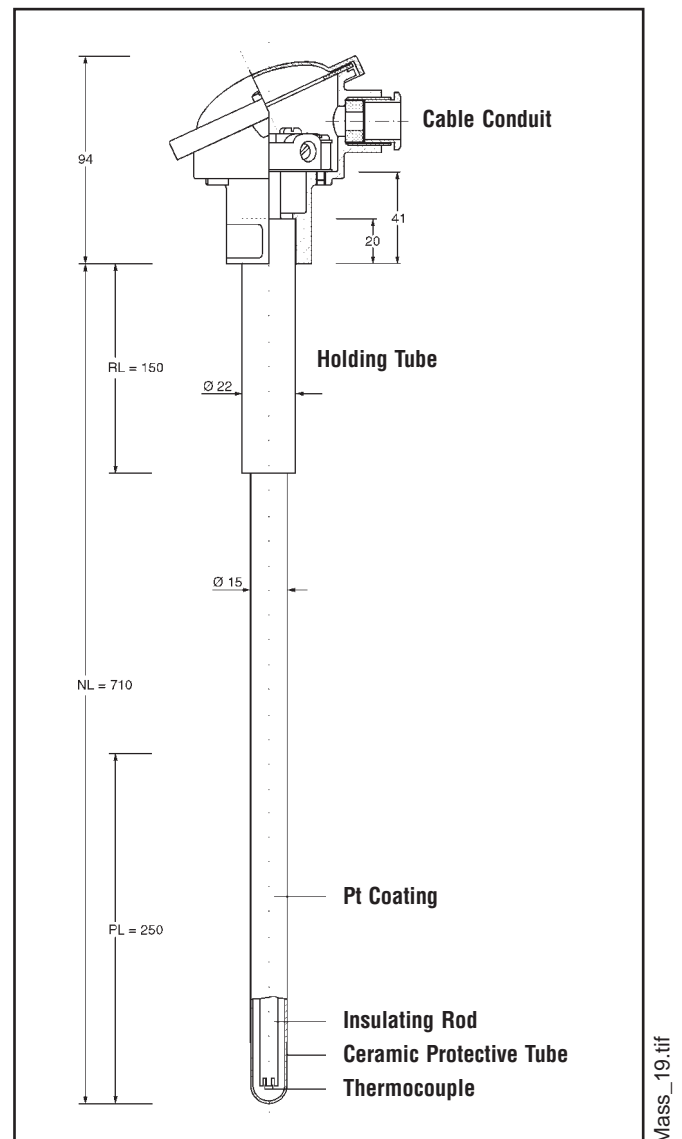


Figure 19: Dimensional drawing – thermocouple with Pt-coated protective tube.



Study: Platinum-Coating Technology

Coating technology of ceramic protective tubes represents an alternative to the platinum-covered ceramic protective tubes. These thermocouples are manufactured by applying a thin platinum or a platinum-alloy film on a ceramic tube. The use of platinum-coated thermocouples is particularly suitable for applications where high temperatures exist and excellent corrosion resistance is required.

The use of coating instead of cladding offers following **advantages**:

- Substantial cost saving by reduction of precious metal weight of 40 to 60%
- To increase the protective effect, Pt coatings can be increased where it is necessary, e.g. at the glass line
- Solder-free design: the risk, that platinum falls off the thermocouple because of a soft junction and is lost in the furnace, is impossible
- Suitable for a large number of ceramic substrates

However, there is following **disadvantage**:

- Sensitivity in relation to mechanical damage which substantially influences the service life

Table 8: Relationship between Pt coating and operation temperature.

Operating Temperature	Recommended Substrate	Type of Coating
1600 °C	Ceramic type C 530 (resistant to thermal shocks)	Pt
1600 °C	Ceramic type C 799	Pt
1650 °C	Ceramic type C 799	Pt/Rh90/10%

Table 8 shows the different coating combinations, recommended for the different temperature ranges.

Application

Due to empirical values two standard designs developed:

- Thermocouples for the forehearth zone and
- Thermocouples for the crown zone

Installation Notes

To reduce the risk of a thermal shock, it is recommended to pre-heat the thermocouple assembly before installation into the gas-tight, ceramic protective tube.

Like all other platinum-containing parts, the assemblies are not suitable for a use in reducing atmospheres.

Recycling

At the end of their service life, Pt coatings can be completely recycled.

Ordering Information: Immersion Thermocouple – with Pt-(Alloy) Clad or Coated Protective Tube (Max. Temperature 1650 °C)

Model	Product Description		
T-EYI	Immersion Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
Y	HR-A/BL (BUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
L ⁽¹⁾	TZ-A/BL (BUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
U	GN-BL, aluminium, DIN 43729	43	M20 x 1.5
X	Other connection head		
Code	Sensor Connection		
1	Terminal block, Form A		
2	Terminal block, Form B		
0	Other connection		
Code	Number of Elements		
01	Single		
02	Double		

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Model	Product Description		
T-EYI	Immersion Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Thermocouple Type		
B R S	B R S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05 XX	0.5 Other diameter	R, S, B	1600 / R, S; 1800 / B
Code	Protective Tube Material	Dimensions in Millimeters	Max. Temperature [°C]
A B C D X	Type C 799 Type C 799 Type C 530 Type C 530 Other material	10 15 10 15	1800 1800 1600 1600
Code	Nominal Length (NL) in Millimeters		
XXXX	Customer-specified length		
Code	Precious-Metal Tube / Coating Material		
A B C D E F G N X	Pt Pt-DPH (dispersion hardened) PtRh90/10% PtRh90/10%-DPH (dispersion hardened) PtRh80/20% Pt (coated) PtRh90/10% (coated) Without tube / coating Other material		
Code	Length of Precious-Metal Tube / Coating (PL) in Millimeters		
XXX	Customer-specified length		
Code	Process Connection	Material	
A1 B1 NN XX	Adjustable stop flange Adjustable threaded fitting No fitting Other connection	GTW-35 (cast iron) 1.0711 (carbon steel)	
Code	Holding Tube Material	Dimensions in Millimeters	
A B C D E F X	1.4762 (AISI 446 - heat-resistant steel) 1.4841 (AISI 314 - heat-resistant steel) 1.0305 (mild steel) 1.4762 (AISI 446 - heat-resistant steel) 1.4841 (AISI 314 - heat-resistant steel) 1.0305 (mild steel) Other material	15 15 15 22 22 22	
Code	Holding Tube Length (RL) in Millimeters		
150 XXX	150 Other length		
Code	Additional Options		
R24 M99 X1	TAG plate, stainless steel Order specific drawing Fit sensor to temperature transmitter		
Other Options: <ul style="list-style-type: none">• Calibration and material certificates (see page 43)			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Multipoint Thermocouples

Introduction

The production of glass depends greatly on temperature. Even slight variations in temperature can change the yield of the final product. For exact temperature measurement, different types of thermocouples are used. Single, sometimes double thermocouples are placed in the crown of the furnace above the glass surface. The "forehearth thermocouple" consists of a pure alumina (Al_2O_3) protective tube, and the Pt-coated or clad measuring tip. The feeder channel is within the liquid glass. Platinum and its alloys (e.g. with rhodium) are not soluble in molten glass, have a high melting point, and highly stable.

Application

Currently, multipoint gradient thermocouple assemblies are being used to measure temperatures at different depths in the molten glass to control and maintain a uniform temperature throughout the melt.

Construction

This design consists of precious multipoint-thermocouples type R, S, or B and a housing with a ceramic protective tube type C 799, whose measuring tip is covered optionally with precious metal. Usually, the protective tube is ground in and the precious metal tube is cemented up. To achieve a longer service life, the wire diameter of the thermocouple is 0.5 mm. The multipoint thermocouple legs are insulated with ceramic elements.

According to the ambient temperature, the holding tube is made of unalloyed or heat-resistant steel. For easy installation, an aluminium connection head is mounted on the holding tube according to DIN-standards. The size of the connection head varies in the outer diameter of the holding tube. On the connection head, a glassfibre/silicone/glassfibre-insulated compensating cable can be connected. Stop flanges and threaded fittings are necessary for installation. You will find an appropriate selection in **Section 6 - Accessories**.



Figure 20: Multipoint thermocouples.

V4_20.tif

Temperature Range

Depending on the type of glass, thermocouples with platinum protective tubes can be used in the molten glass at temperatures up to 1,650 °C. Alloys with higher rhodium contents or dispersion-hardened platinum (Pt-DPH) have a longer lifetime.

Table 9 illustrates the relationship between protective tube material, type of thermocouple and max. application temperature.

Table 9: Relationship between protective tube material, type of thermocouple and max. application temperature.

Protective Tube Material	Thermocouple Type	Max. Temperature
Pt	Type R/S	1600 °C
PtRh90/10%	Type B	1650 °C
Pt-DPH	Type B	1600 °C
PtRh80/20%	Type B	1650 °C

Price Calculation

The total price for a multipoint-thermocouple includes the prices for thermocouple, thermocouple precious-metal wires and the precious-metal tube or coating. Precious-metal prices are subject to daily fluctuations and, therefore, to be inquired at the thermocouple supplier.

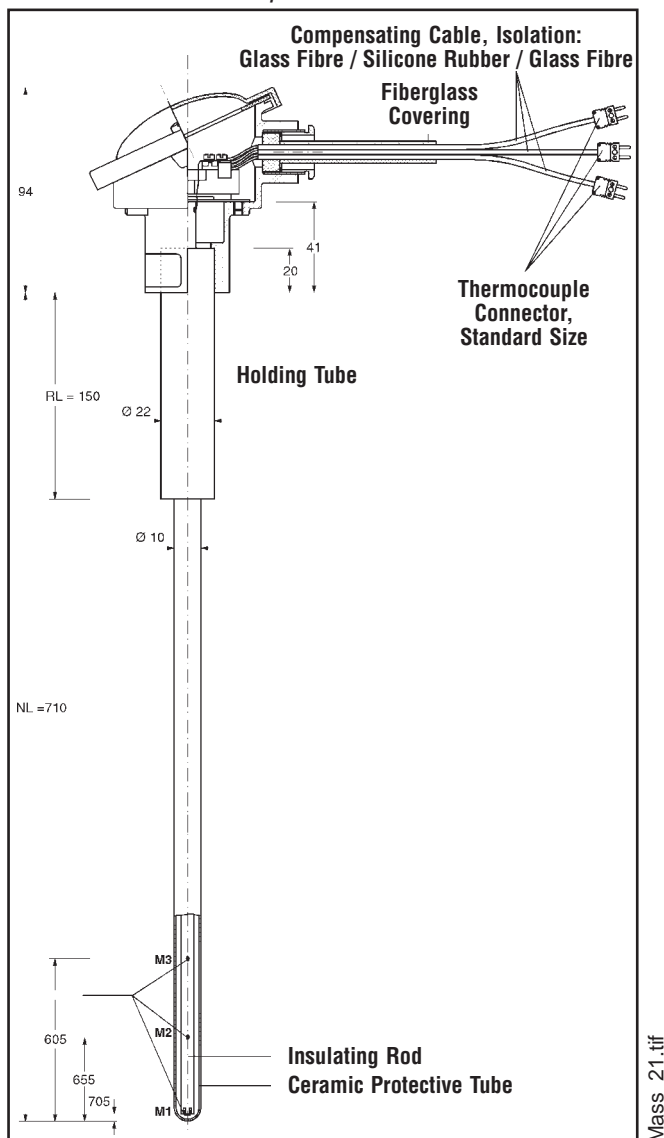
Ordering Notes

The multipoint thermocouples are manufactured almost exclusively according to customer's specification. For this reason, a thermocouple can be described only approximately with the help of an ordering table. The indicated options are only an ordering help. If none of the specified options applies, it is absolutely necessary for the handling of an inquiry to fill in the appropriate technical information in all empty fields (options with the codes 0 or X).

Ordering Example

TX-EYI-P-1-03-S-05-A-0710-N-000-NN-B-150-M1-0705-M2-0655-M3-0605-AGL2-1000

Figure 21: Dimensional drawing – multipoint thermocouples.



Order Information: Multipoint Thermocouple – with Ceramic Protective Tube; Optionally, with Precious-Metal Clad or Coated Protective Tube (Max. Temperature 1800 °C) – Part 1

Model	Product Description		
TX-EYI	Multipoint Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
Y	HR-A/BL (BUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
L ⁽¹⁾	TZ-A/BL (BUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
U	GN-BL, aluminium, DIN 43729	43	M20 x 1.5
X	Other connection head		
Code	Sensor Connection		
1	Terminal block, Form A		
2	Terminal block, Form B		
0	Other connection		
Code	Number of Elements		
03	Triple		
XX	Multipoint: number to be stated		
Code	Thermocouple Type		
B	B		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05	0.5	R, S, B	1600 / R, S; 1800 / B
XX	Other diameter		
Code	Protective Tube Material	Dimensions in Millimeters	Max. Temperature [°C]
A	Type C 799	10	1800
B	Type C 799	15	1800
X	Other material		
Code	Nominal Length (NL) in Millimeters		
XXXX	Customer-specific length		
Code	Precious-Metal Tube / Coating Material		
A	Pt		
B	Pt-DPH (dispersion hardened)		
C	PtRh90/10%		
D	PtRh90/10%-DPH (dispersion hardened)		
E	PtRh80/20%		
F	Pt (coated)		
G	PtRh90/10% (coated)		
N	No tube / coating		
X	Other material		

Multipoint Thermocouple – with Ceramic Protective Tube; **Optionally**, with Precious-Metal Clad or Coated Protective Tube (Max. Temperature 1800 °C) – Part 2

Code	Length of Precious-Metal Tube / Coating (PL) in Millimeters		
000	No tube		
XXX	Customer-specified length		
Code	Process Connection	Material	
A1	Adjustable stop flange	GTW-35 (cast iron)	
B1	Adjustable threaded fitting	1.0711 (carbon steel)	
NN	No fitting		
XX	Other connection		
Code	Holding Tube Material	Dimensions in Millimeters	
A	1.4762 (AISI 446 - heat-resistant steel)	15	
B	1.4841 (AISI 314 - heat-resistant steel)	15	
C	1.0305 (mild steel)	15	
D	1.4762 (AISI 446 - heat-resistant steel)	22	
E	1.4841 (AISI 314 - heat-resistant steel)	22	
F	1.0305 (mild steel)	22	
X	Other material		
Code	Holding Tube Length (RL) in Millimeters		
XXX	Customer-specified length		
Code	Length of Measuring Point (ML) in Millimeters		
M1-XXXX	Measuring point 1		
M2-XXXX	Measuring point 2		
M3-XXXX	Measuring point 3		
MX-XXXX	Measuring point X		
Code	Additional Options		
AGL1-XXXX	Glass fibre/silicone rubber/glass fibre insulated compensating cable with connected miniature thermocouple plug incl. specified length		
AGL2-XXXX	Glass fibre/silicone rubber/glass fibre insulated compensating cable with connected standard thermocouple plug incl. specified length		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options:			
• Calibration and material certificates (see page 43)			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Thermocouples with Electrical Shielding

Introduction

The thermocouple output can be influenced by electromagnetic radiation, e.g. in electrically heated furnaces. Depending on the strength of the electrical field, serious reading errors may occur. Usually, shielded compensating cables are used to lead the output signal to the control room. In practice however, this measure is not sufficient to avoid all possible signal disturbances. Rosemount offers special, electrically shielded high-temperature thermocouples up to 1800 °C, supplied with gas-tight, ceramic protective tubes.

Application

Thermocouples with electrical shielding are used among other things in glow processes, e.g. during fluorescence powder manufacturing. Additionally, these thermocouples are used in the production of technical ceramics for electrotechnical and mechanical applications.

Construction

This design consists of single or double thermocouples type R, S, or B and a housing with a gas-tight, ceramic protective tube type C 799 or porous type C 530. To achieve a longer service life, the wire diameter of the thermocouple is 0.5 mm. The thermocouple legs are insulated with a 4-hole insulating rod. The Pt electrical protection is reeled up the insulating rod and extended by a nickel wire to the terminal block.

From the connection head shielded compensating cables lead the output signal to the control room.



V4_22.tif

Figure 22: Thermocouple with electrical shielding.

Usually, the ceramic protective tube is cemented into the holding tube. For easy installation, the connection head is mounted on the holding tube. As the temperature above the fitting is generally low, unalloyed steel is used for holding tubes. If the holding tube reaches into the body of the furnace, heat-resistant steel is to be used. Stop flanges and threaded fittings are necessary for installation. You will find an appropriate selection in **Section 6 – Accessories**.

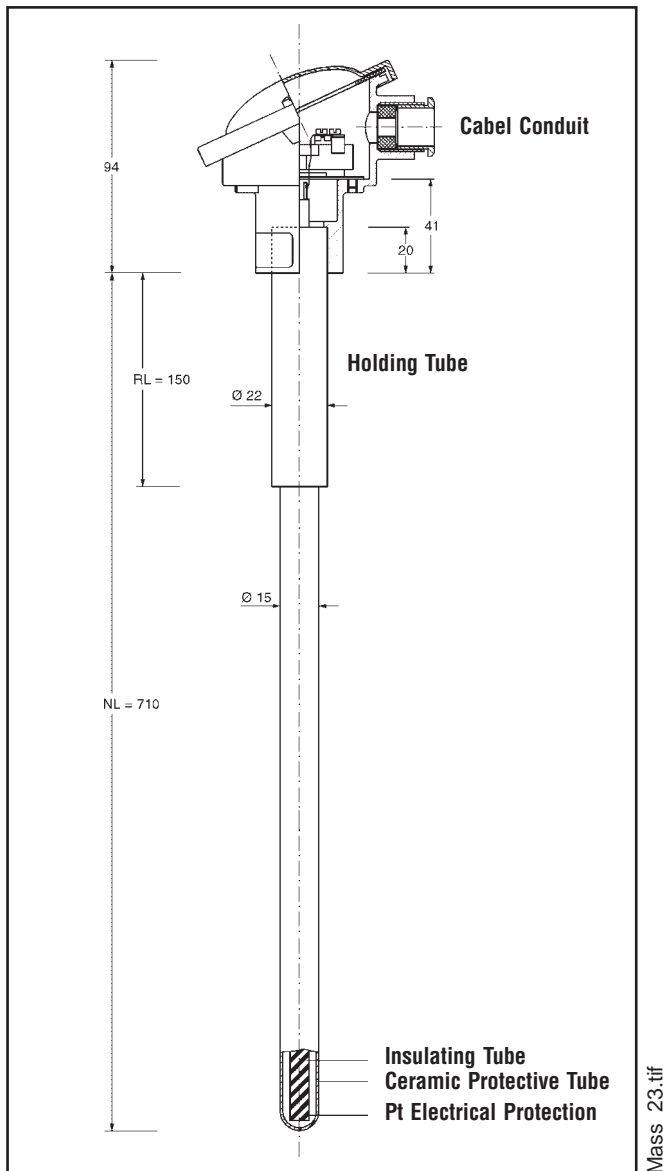


Figure 23: Dimensional drawing – thermocouples with electrical shielding.

Temperature Range

Thermocouples with electrical shielding can be used at temperatures up to 1800 °C.

Price Calculation

The total price for a thermocouple with electrical shielding includes the prices for thermocouple, thermocouple precious metal wires and band. The precious metal prices are subject to daily fluctuations and, therefore, to be inquired at the thermocouple supplier.

Ordering Notes

Thermocouples with electrical shielding are manufactured almost exclusively according to customer's specification. For this reason, a thermocouple can be described only approximately with the help of an ordering table. The indicated options are only an ordering help. If none of the specified options applies, it is absolutely necessary for the handling of an inquiry to fill the appropriate technical information in all empty fields (options with the codes 0 or X).

Ordering Example

TEP-P-2-01-S-05-B-0710-B-720-NN-D-150

Ordering Information: Immersion Thermocouple – with Electrical Shielding (Max. Temperature 1800 °C)

Model	Product Description		
TEP	Immersion Thermocouple, DIN EN 60584-1 (IEC 584), Tolerance Class 1 acc. to DIN EN 60584-2 (IEC 584)		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
Y	HR-A/BL (BUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
L ⁽¹⁾	TZ-A/BL (BUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
U	GN-BL, aluminium, DIN 43729	43	M20 x 1.5
X	Other connection head		
Code	Sensor Connection		
1	Terminal block, Form A		
2	Terminal block, Form B		
0	Other connection		
Code	Number of Elements		
01	Single		
02	Double		
Code	Thermocouple Type		
B	B		
R	R		
S	S		
Code	Wire Diameter in Millimeters	Thermocouple Type	Max. Temperature [°C]
05	0.5	R, S, B	1600 / R, S; 1800 / B
XX	Other diameter		
Code	Protective Tube Material	Dimensions in Millimeters	Max. Temperature [°C]
A	Type C 799	10	1800
B	Type C 799	15	1800
C	Type C 530	10	1600
D	Type C 530	15	1600
X	Other material		
Code	Nominal Length (NL) in Millimeters		
XXXX	Customer-specific length		
Code	Electrical Shielding	Dimensions in Millimeters	
A	Pt electrical protection	2 x 0.1	
B	Pt electrical protection	2 x 0.05	
X	Other material		
Code	Length of Electrical Shielding		
XXX	Customer-specific length		
Code	Process Connection	Material	
A1	Adjustable stop flange	GTW-35 (cast iron)	
B1	Adjustable threaded fitting	1.0711 (carbon steel)	
NN	No fitting		
XX	Other connection		
Code	Holding Tube Material	Dimensions in Millimeters	
A	1.4762 (AISI 446 - heat-resistant steel)	15	
B	1.4841 (AISI 314 - heat-resistant steel)	15	
C	1.0305 (mild steel)	15	
D	1.4762 (AISI 446 - heat-resistant steel)	22	
E	1.4841 (AISI 314 - heat-resistant steel)	22	
F	1.0305 (mild steel)	22	
X	Other material		
Code	Holding Tube Length (RL) in Millimeters		
XXX	Customer-specified length		
Code	Additional Options		
AGL3-XXXX	Glass fibre/silicone rubber/glass fibre insulated and shielded compensating cable incl. specified length		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		
Other Options:			
• Calibration and material certificates (see page 43)			

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Glass-Level Electrodes

Introduction and Application

These sensors are a very efficient tool for accurate level measurement. Our sensors are provided with two electrodes (double sensor), which avoids an unintended burn-out of an electrode, due to potential differences between molten glass and earth, as happened to single sensors. This clearly extends the service life of the sensor.

Typical measuring circuits are shown in **Figures 25** and **26** for single and double sensor system.

Construction

This design consists of one (single sensor) or two (double sensor) precious-metal wires, platinum or its alloys and a housing with a ceramic protective tube type C 799, whose measuring tip is provided with an electrode. The electrode tip has usually an outer diameter of 3 mm and a length of 20 mm. It is cemented into the ceramic protective tube. The diameter of the Pt wire, insulated with ceramic elements, is normally 1 mm.

According to the ambient temperature, the holding tube is made of unalloyed or heat-resistant steel. For easy installation, an aluminium connection head is mounted on the holding tube. The size of the connection head varies in the outer diameter of the holding tube. Stop flanges and threaded fittings are necessary for installation. You will find an appropriate selection in **Section 6 – Accessories**.

Temperature Range

Depending on the type of glass, thermocouples with a precious-metal electrode can be used in the molten glass at temperatures up to 1650 °C. Alloys with higher rhodium parts have a longer lifetime.



Figure 24: Glass-level electrodes.

Ordering Notes

Thermocouples with glass-level electrodes are manufactured almost exclusively according to customer's specification. For this reason, a thermocouple can be described only approximately with the help of an ordering table. The indicated options are only an ordering help. If none of the specified options applies, it is absolutely necessary for the handling of an inquiry to fill the appropriate technical information in all empty fields (options with the codes 0 or X).

Ordering Example

GLE-P-2-01-S-10-A-0710-NN-B-150

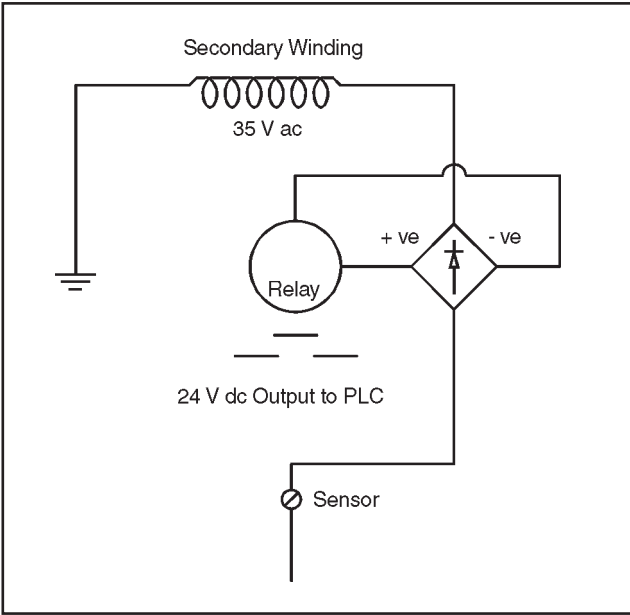


Figure 25: Single-sensor system.

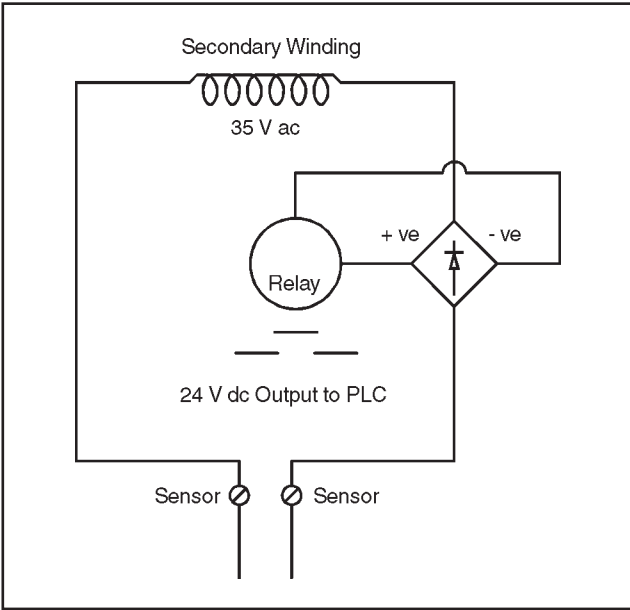


Figure 26: Double-sensor system.

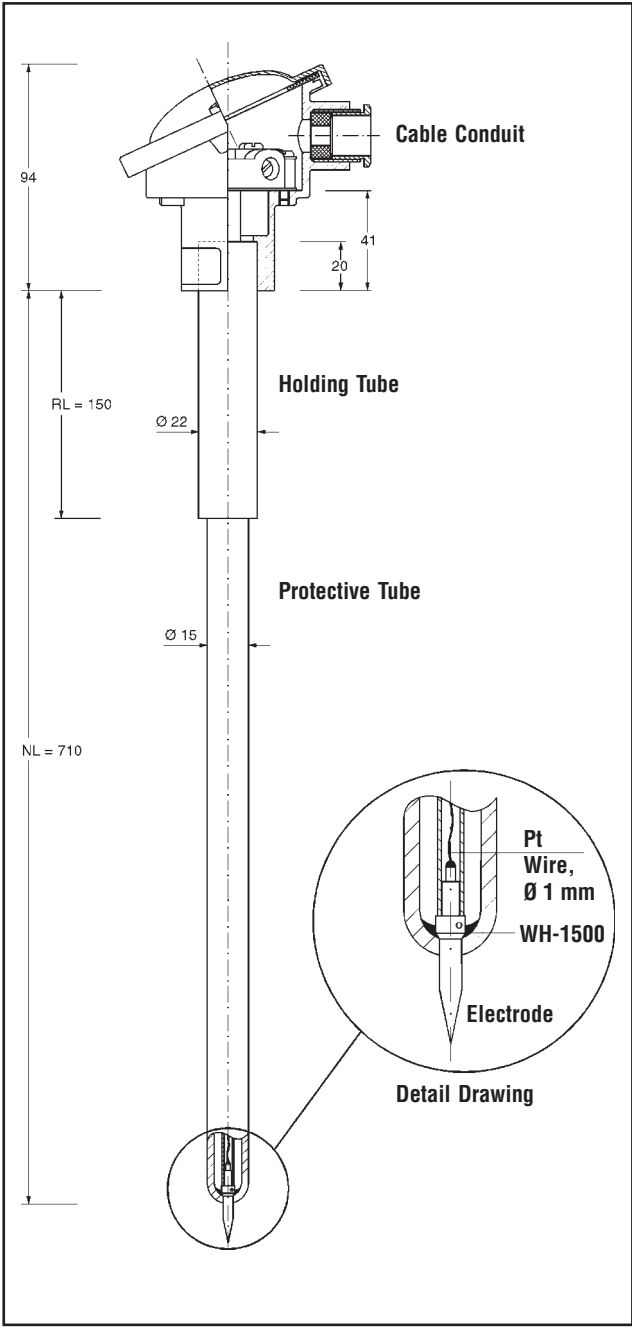


Figure 27: Dimensional drawing – glass-level electrode.

Ordering Information: Glass-Level Electrode – with Ceramic Protective Tube, Measuring Tip with Precious-Metal Electrode (Max. Temperature 1650 °C)

Model	Product Description		
GLE	Glass-Level Electrode with Precious-Metal Electrode		
Code	Connection Head	IP Rating	Conduit Connection Thread
E	HR-AL (AUS), aluminium	54	M20 x 1.5
Y	HR-A/BL (BUS), aluminium	54	M20 x 1.5
G ⁽¹⁾	TZ-AL (AUZH), aluminium	54	M20 x 1.5
L ⁽¹⁾	TZ-A/BL (BUZH), aluminium	54	M20 x 1.5
P	GN-AL, aluminium, DIN 43729	43	M20 x 1.5
U	GN-BL, aluminium, DIN 43729	43	M20 x 1.5
X	Other connection head		
Code	Sensor Connection		
1	Terminal block, Form A		
2	Terminal block, Form B		
0	Other connection		
Code	Number of Elements		
01	Single		
02	Double		
Code	Electrode Wire Material		
S	PtRh90/10%		
X	Other material		
Code	Wire Diameter in Millimeters		
10	1		
XX	Other diameter		
Code	Protective Tube Material	Dimensions in Millimeters	
A	Type C 799	15	
X	Other material		
Code	Nominal Length (NL) in Millimeters		
XXXX	Customer-specified length		
Code	Process Connection	Material	
A1	Adjustable stop flange	GTW-35 (cast iron)	
B1	Adjustable threaded fitting	1.0711 (carbon steel)	
NN	No fitting		
XX	Other connection		
Code	Holding Tube Material	Dimensions in Millimeters	
D	1.4762 (AISI 446 - heat-resistant steel)	22	
E	1.4841 (AISI 314 - heat-resistant steel)	22	
F	1.0305 (mild steel)	22	
X	Other material		
Code	Holding Tube Length (RL) in Millimeters		
XXX	Customer-specified length		
Code	Additional Options		
R24	TAG plate, stainless steel		
M99	Order specific drawing		
X1	Fit sensor to temperature transmitter		

(1) Connection head suitable for mounting a transmitter inside (Model 144, 244 and 644)

Tests and Measurements on Thermocouples

General Principles

Verification in compliance with quality characteristics, properties, characteristic data and specific requirements is defined in standard EN 10204. This standard specifies who may issue certificates on which conditions.

EN 10204

This standard deals with the certification of metallic materials (protective tubes, thermocouple wires) by means of works test certificates and acceptance test certificates.

Material Testing

Material testing ensures the identifiability of certified material from melting to the end product and thus that chemical and mechanical data are verifiable.

- **Works certification according to EN 10204-2.1**

In the works certification the manufacturer confirms on the basis of non-specific tests and without expressly stated test results that the product supplied meets the requirements of the order.

- **Works certificate according to EN 10204-2.2**

In the works certificate the manufacturer confirms on the basis of non-specific tests and with the stated test results that the product supplied is in accordance with official regulations, the corresponding material and manufacturing process and meets the requirements of the order.

- **Works test certificate according to EN 10204-2.3**

In the works test certificate the manufacturer confirms on the basis of specific tests and with the stated test results that the product supplied is in accordance with official regulations, the corresponding material and manufacturing process and meets the requirements of the order.

- **Acceptance test certificate according to EN 10204-3.1A**

In the above mentioned acceptance test certificate an officially authorized expert confirms on the basis of specific tests and with the stated test results that the product supplied is in accordance with official regulations, the corresponding material and manufacturing process and meets the requirements of the order.

- **Acceptance test certificate according to EN 10204-3.1B**

In the above mentioned acceptance test certificate a works expert, authorized by the manufacturer, confirms on the basis of specific tests and with the stated test results that the product supplied is in accordance with official regulations, the corresponding material and manufacturing process and meets the requirements of the order. The necessary tests have to be carried out by a checking station, which is independent of the production department.

All above mentioned certificates are available upon request.

Calibration with DKD-Certificate

The calibration of temperature sensors is to be effected in our calibration laboratory DKD-K-05601.

For many applications, especially in connection with the quality assurance system ISO 9000, precise documentation of carried out measurements is essential. Maximum measurement reliability is guaranteed by the calibration certificates of our calibration laboratory, represented in the German Calibration Service (DKD). It provides documentation with traceability to national standards on temperature representation in conformity with the international standards (SI).

During the process of compiling a DKD or works certificate, the thermocouple or measuring system, e.g. transmitter with connected thermocouple, is checked on precise and traceable comparison standards regarding measurement accuracy. DKD-certified thermocouples are used as a secondary reference for checking subordinate measuring systems within a customer's QA system. Thermocouples with a works certificate can be used for documentation of carried out measurements at the service and quality assurance department.

Our DKD laboratory is authorized to issue DKD calibration certificates for temperature in relation to thermocouples as calibration subject in the measurement ranges shown in **Table 10**. The measurement uncertainties are defined in the various calibration points and based on the double standard deviation ($k = 2$), (probable coincidence approx. 95%).

The calibrations carried out by the Calibration Laboratory are services for the customer. It is our intention to meet the high quality requirements of the customer in relation to thermocouple calibration including traceability to national standards and to accomplish always the contract commitments with the accreditation authority – PTB (German Physical Technical Authority). The thermocouple, which provides the measurement result on its own or as a measuring chain, is compared with the national standards. This comparison measurement produces quantitative verification of traceability. A report giving results is issued in form of a calibration certificate according to DKD specifications (**Figure 28**).

Table 10: Measured quantities, for which the DKD-laboratory is authorized (extract).

Subject of Calibration	Temperature Range	Measurement Conditions	Measurement Uncertainty	Remarks
Thermocouples	0 °C to 1200 °C	Comparison with standard thermocouples in tube furnaces	1.5 K	
Thermocouples Type S and R			1 K	Comparison without protective tube in a Pt tube
Transmitter with connected thermocouples	as for thermocouples	as for thermocouples	$U(TE) + 500 \text{ mK}$	$U(TE)$ is the measurement uncertainty of calibrating the thermocouple by itself

Works Certificates

The calibrated values can also be certified on a works certificate by using the comparison method. The max. test temperature is 1,300 °C.

A pre-condition for the calibration is a suitable design of the thermocouple, e.g. it has to have a certain minimum insertion length.

When ordering a thermocouple, the customer has to inform about the number and values of the test variables, at which the thermocouple is to be calibrated.

Note

Before specifying a temperature value, consider the temperature limits of the thermocouple.

For individual order options see **Table 11**.

Table 11: Ordering information for calibration options.

Type of Certificate	Code
Works Certificate: Comparison measurement at thermocouple	
with 1 temperature point	W1
with 2 temperature points	W2
with 3 temperature points	W3
with 4 temperature points	W4
with 5 temperature points	W5
for measuring system with 1 thermocouple	W12
DKD Calibration Certificate: DKD Certificate	
for 1 temperature point specified by the customer	K1
for 2 temperature points specified by the customer	K2
for 3 temperature points specified by the customer	K3
for 4 temperature points specified by the customer	K4
for 5 temperature points specified by the customer	K5
for measuring system with 1 thermocouple	K12

Of course it is possible to calibrate more than 5 temperatures. Prices upon request.

DEUTSCHER KALIBRIERDIENST

DKD

Kalibrierlaboratorium für die Meßgröße Temperatur

Calibration laboratory for measuring of temperature

Akkreditiert durch die / accredited by the

Akkreditierungsstelle des DKD bei der

PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

ROSEMOUNT

TEMPERATURE

Deutscher Kalibrierdienst

DKD-K-05601

000

DKD-K-05601

00-00

Kalibrierschein

Calibration Certificate

Kalibrierzeichen

Calibration label

Gegenstand

Objekt

Immersion thermocouple type S

Hersteller

Manufacturer

Rosemount Temperature GmbH

Typ

Type

1075AMP301S05F0710B2K12

Fabrikat/Serien-Nr.

Serial number

thermocouple 00000000/000000

Auftraggeber

Customer

Fa. Mustermann

Auftragsnummer

Order No.

000 00 000

Anzahl der Seiten des Kalibrierscheines

Number of pages of the certificate

3

Datum der Kalibrierung

Date of calibration

00.00.0000

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.

This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel

Datum

Leiter des Kalibrierlaboratoriums

Beglaubigter

Seal

Date

Head of the calibration laboratory

Person in charge

00.00.0000

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Deitingen

Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

DEUTSCHER KALIBRIERDIENST

DKD

ROSEMOUNT

TEMPERATURE

Seite

zum Kalibrierschein vom

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Kalibrierzeichen

Page

of calibration certificate of

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Calibration label

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DKD-K-05601

00-00

Object / type

thermocouple assembly type S

Manufacturer

Rosemount Temperature GmbH

Customer

Fa. Mustermann

Order number

000 00 000

Equipment / reference standards

Thermocouple sn 72472729/1 (000PTB00); Digital-Multimeter type 3040 Fa. Prema (000DKD00)

Calibration mark

DKD-000

Table of basic values

DIN EN 60584-1

Thermocouple description

Type: 1075AMP301S05F0710B2K12

Serial number: 00000000/000000

Length: 710 mm

Diameter: 22,0 mm

Maximum application temperature: 1200 °C

Procedure

The thermocouple was calibrated by comparison to one reference thermocouple in accordance to the guideline DKD-R 5-3 december 2000 (German Calibration Service) for the calibration of thermocouples.

Conditions

The temperature points were realized in a calibration furnace type TPK Fa. Heraeus with an insert of sicromal

immersion depth during calibration: 400 mm

The calibration has been started with the highest temperature point and finished with the lowest.

For the calibration the thermocouple has been removed from its housing.

Environmental Conditions

The ambient conditions of the Calibration laboratory are controlled within the following limits:

temperature: 23 °C ± 2 °C

relative humidity: 60 % ± 15 %

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Deitingen

Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

DEUTSCHER KALIBRIERDIENST

DKD

ROSEMOUNT

TEMPERATURE

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DKD-K-05601

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Results

The calibration results refer to a cold junction temperature of 0 °C.

temperature t ₀ in °C	thermoelectric E in mV	dev. against DIN EN 60584 in mV	dev. against DIN EN 60584 in °C	uncertainty in K
100	0,6424	-0,0035	-0,48	1,5
200	1,4338	-0,0070	-0,83	1,5
300	2,3144	-0,0087	-0,95	1,5
400	3,2479	-0,0115	-1,20	1,5
500	4,2205	-0,0128	-1,29	1,5
600	5,2222	-0,0165	-1,62	1,5
700	6,257	-0,0182	-1,73	1,5
800	7,3256	-0,0194	-1,78	1,5
900	8,4296	-0,0196	-1,75	1,5
1000	9,5694	-0,0177	-1,63	1,5
1100	10,7434	-0,0131	-1,11	1,5
1200	11,9379	-0,0126	-1,05	1,5

Uncertainty

All uncertainties were determined at the various calibration points and are based on two times the standard deviation (k=2). They were calculated according to DKD-3 taking into account the reference standards, calibration equipment, environmental conditions, contribution of the calibrated instruments, repeatability, etc. (confidence probability of not less than 95%). Possible longterm drifts are not included.

00.00.0000

date

seal

person in charge

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Deitingen

Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

Figure 28: DKD certificate for thermocouples – example.

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Werkszertifikat Specific Test Report

Rosemount Temperature GmbH
Frankenstraße 21
63791 Karlstein
Germany

T +49 (0) 6188 992 -0
F +49 (0) 6188 992 -112
www.fisher-rosemount.de/rtemp

Kalibriergegenstand : Eintauch –Thermoelement der Serie 1075, Bauform AM, Typ K
Object..... : thermocouple assembly with mounted fitting T-EA 22 type K
Hersteller / Manufacturer..... : Rosemount Temperature GmbH
Firma / Antragsteller / Customer..... : Fa. Mustermann
Auftragsnummer / Order number..... : 000 00 000
Messeinrichtungen / Bezugsnormale..... : Thermoelement sn 39/97 (00PTB00);
Equipment / Reference standards : reference thermocouple sn 39/97 (00PTB00);
Digital-Multimeter Typ 3040 Fa. Prema (000DKD00);
Digital-Multimeter type 3040 Fa. Prema (000DKD00)
Kalibriernummer / Calibration mark..... : A-0000
Grundwertreihe / table of basic values..... : DIN EN 60584-1

Beschreibung des Kalibriergegenstandes/ Description

Typ/ type: 1075AME301K20D1000NNW3
Seriennummer / serial number: 00000000/000000
Gesamtlänge / Length: 1000 mm
Durchmesser / Diameter: 22,0 mm

Kalibrierverfahren/ Procedure

Die Kalibrierung wurde im Vergleich gegenüber ein Normal-Thermoelement nach der Richtlinie DKD-R 5-3 vom Dezember 2000 des Deutschen Kalibrierdienstes (DKD) für die Kalibrierung von Thermoelementen durchgeführt.
The calibration was made by comparison to one reference thermocouple in accordance to the guideline DKD-R 5-3 december 2000 for the calibration of thermocouples.

Messbedingungen/ Conditions

- Die Temperaturpunkte wurden in einem Kalibrierofen der Fa. Heraeus mit einem Einlegeteil aus Sicromal aufgenommen
The temperature points were realized in a calibration furnace Fa. Heraeus with an insert of sicromal

Die Kalibrierung erfolgte bei einer Eintauchtiefe von 400 mm.
The calibration was performed with an immersion depth of 400 mm.

Das Thermoelement wurde im ausgebauten Zustand kalibriert.
For the calibration the thermocouple has been removed from its housing.

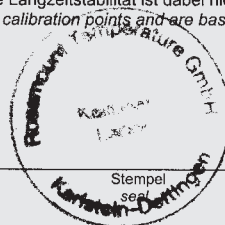
Messergebnisse/ Results

Temperatur t_{90} temperature t_{90} in °C	Thermospannung $E(t_{90})$ thermovoltage $E(t_{90})$ in mV	Abw. gegen Dev. against DIN EN 60584 in mV	Abw. gegen Dev. against DIN EN 60584 in °C	Messunsicherheit uncertainty in K
500	20,593	-0,051	-1,20	1,5
800	33,203	-0,073	-1,78	1,5
900	37,272	-0,054	-1,35	1,5

Messunsicherheit/ Uncertainty

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor $k = 2$ ergibt. Ein Anteil für die Langzeitstabilität ist dabei nicht enthalten.
All uncertainties were determined at the various calibration points and are based on two times the standard deviation ($k=2$).
Possible longterm drifts are not included.

05.09.02
Datum der Kalibrierung
Date of calibration



Bearbeiter/in
person in charge

Seite: 1 von 1 / page 1 of 1

Firmensitz:
Rosemount Temperature GmbH
Frankenstraße 21
63791 Karlstein
Deutschland/Germany

Registergericht:
Amtsgericht Aschaffenburg
HRB 6516

Geschäftsführer:
Kenneth Biele
John Jeffreys
Eric Manos

Ronald Migliorini
Manfred Scheer
Stephen Shonka

Bankverbindung:
Dresdner Bank AG
63739 Aschaffenburg
Germany
Konto-Nr. 151 899 900
BLZ 795 800 99



Figure 29: Works certificate for thermocouples – example.

DEUTSCHER KALIBRIERDIENST **DKD**

Kalibrierlaboratorium für die Maßgröße Temperatur
 Calibration laboratory for measuring of temperature
 Akkreditiert durch die / accredited by the
 Akkreditierungsstelle des DKD bei der
 PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

**ROSEMOUNT
TEMPERATURE**

DKD-K-05601

Kalibrierschein
Calibration CertificateKalibrierzeichen
Calibration label

000
DKD-K-05601
00-00

Gegenstand
Object: Immersion thermocouple series 1075 with mounted transmitter

Hersteller
Manufacturer: Rosemount Temperature GmbH

Typ
Type: thermocouple 1075AKK301S05V1000A3G200X1K5S transmitter: 644HIQ4A1X1 thermocouple 00000000/000000 transmitter: 000000/0000

Fabrikat/Serien-Nr.
Serial number: Fa. Mustermann

Auftraggeber
Customer: Fa. Mustermann

Auftragsnummer
Order No.: 000 00 000

Anzahl der Seiten des Kalibrierscheins
Number of pages of the certificate: 3

Datum der Kalibrierung
Date of calibration: 00 00.0000

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.
 This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Datum
Date: 00.00.0000

Leiter des Kalibrierlaboratoriums
Head of the calibration laboratory: A. Meyer

Beisitzer
Person in charge: B. Kubitza

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Dettingen
 Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

DEUTSCHER KALIBRIERDIENST **DKD****ROSEMOUNT
TEMPERATURE**

Seite 2 zum Kalibrierschein vom 00.00.00
 Page of calibration certificate of

Kalibrierzeichen
 Calibration label

000
DKD-K-05601
00-00

Kalibriergegenstand: Eintauch - Thermoelement der Serie 1075 mit angeschlossenem Messumformer

Hersteller: Rosemount Temperature GmbH

Firma / Antragsteller: Fa. Mustermann

Auftragsnummer: 000 00 000

Messeinrichtungen / Bezugsnormale: Normal-Thermoelement sn 39/97 (00PTB00); Digital-Multimeter Typ 2002 Fa. Keithley (000DKD00); QuaT-System Typ QuaT100 + QuaT200 (000DKD00)

Kalibriernummer: DKD-000

Beschreibung des Kalibriergegenstandes

Thermoelement

Typ: 1075AKK301S05V1000A3G200X1K5S

Seriennummer: 00000000/000000

Länge: 1000 mm

Durchmesser: 26,0 mm

Messumformer

Typ: 644HI1Q4A1X1

Seriennummer: 000000/0000

Eingangstyp: T/C S, mit Vergleichsstellenkompensation

Eingang: 600 °C bis 1000 °C

Ausgang: 4 bis 20 mA

Versorgungsspannung: 12 ... 42,4 V DC

Kalibrierverfahren

Die Kalibrierung erfolgte im Vergleich gegenüber Normal-Thermoelement nach der Richtlinie 5-3 vom Dezember 2000 des Deutschen Kalibrierdienstes (DKD) für die Kalibrierung von Thermoelementen.

Messbedingungen

Die Messwerte des Normal-Thermoelementes zur Berechnung der Temperatur t_0 sowie das Ausgangssignal des Messumformers wurden mit einem Digital-Multimeter Typ 2002 der Fa. Keithley aufgenommen.

Der Temperaturtransmitter Typ 644HI1Q4A1X1 liefert an seiner analogen Schnittstelle ein zur Sensortemperatur proportionales Ausgangssignal (4 bis 20 mA). Der Transmitter ist auf einen Messbereich von 600 bis 1000 °C konfiguriert.

Die Temperaturpunkte wurden in einem Kalibriertopf Typ TPK der Fa. Heraeus mit einem Einlegeteil aus Sicromal realisiert

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Dettingen
 Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

DEUTSCHER KALIBRIERDIENST

DKD**ROSEMOUNT
TEMPERATURE**

Seite 3 zum Kalibrierschein vom 00.00.00
 Page of calibration certificate of

Kalibrierzeichen
 Calibration label

000
DKD-K-05601
00-00

The immersion depth amounted 400 mm.

For the calibration the thermocouple has been removed from its housing.

Environmental Conditions

The ambient conditions of the Calibration laboratory are controlled within the following limits:

temperature: 23 °C ± 2 °C
 relative humidity: 60 % ± 15 %

Results

The calibration results refer to a cold junction temperature of 0 °C.

temperature t_0 in °C	thermovoltage E in mV	dev. against DIN EN 60584	dev. against DIN EN 60584	uncertainty in K
601.06	26.80	4.0340	600.85	-0.21
699.27	26.80	7.9648	699.12	-0.15
798.66	27.10	11.9492	798.73	+0.07
896.27	27.15	15.8460	896.15	-0.12
996.53	27.17	19.9340	996.35	-0.18

Uncertainty

All uncertainties were determined at the various calibration points and are based on two times the standard deviation ($k=2$). They were calculated according to DKD-3 taking into account the reference standards, calibration equipment, environmental conditions, contribution of the calibrated instruments, repeatability, etc. (confidence probability of not less than 95%). Possible longterm drifts are not included.

This Certificate is only valid for the immersion thermocouple and the transmitter with the serial numbers mentioned above. A Calibration label is attached to all components of the measuring system.

00.00.0000

date

Stempel

person in charge

Rosemount Temperature GmbH, Frankenstraße 21, 63791 Karlstein-Dettingen
 Tel.: +49 (6188) 992-182 Telefax: +49 (6188) 992-112, DKD-Kalibrierlaboratorium 05601

Figure 30: DKD certificate – transmitter with thermocouple connected.

Transmitters

Into the extended cover of the connection head types TZ-A/BL (BUZH) or TZ-AL (AUZH), Rosemount transmitter models **244EH** and **644H** can be inserted.

These transmitters have following common properties:

- User selectable inputs with a variety of RTDs and thermocouples
- High RFI immunity
- Linearization of RTD and thermocouple inputs
- Galvanically isolated inputs / outputs
- Electronics module completely sealed in epoxy resin within a housing. This enhances transmitter stability and reliability
- Thermocouple outputs are automatically provided with a comparison junction.
- μ P-based for enhanced accuracy and stability
- Ambient temperature effects reduced by temperature-corrected electronics

The **Model 244EH** is PC-programmable using Windows®-based software.

The **Model 644H** communicates using HART®-protocol (Highway Adressable Remote Transducer) and is compatible with Rosemount HART-communicator, HART-based control systems, and μ P-based AMS software (Asset Management Solutions). The model 644H enables sensor trimming (one-point or two-point trimming) for enhanced total system accuracy.



Figure 31: Transmitters and connection heads.

V4_31.tif

In addition Rosemount offers a wide range of rail- or field-mounted transmitters.

See the corresponding product data sheets:

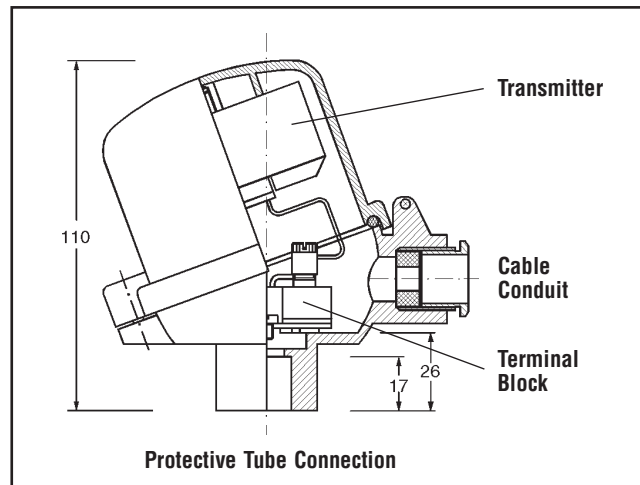
- **Model 244EH and 244ER** – PC-Programmable Temperature Transmitters (publication no. 00813-0101-4737)
- **Model 644H and 644R** – Smart Head- Mount and Rail-Mount Temperature Transmitters (publication no. 00813-0101-4728)
- **Model 3144 and 3244MV** – Smart Temperature Transmitters (publication no. 00813-0100-4021)



V4_32.tif

Connection Heads

The present section includes the technical data of all connection heads mentioned in this product data sheet. The screwed cable gland is available with thread M 20 x 1.5. A silicone gasket is used at temperatures up to 200 °C. This gasket is necessary for protection class IP 65.



Mass_33.tif

Model: TZ-A/BL (BUZH) (Fig. 33)

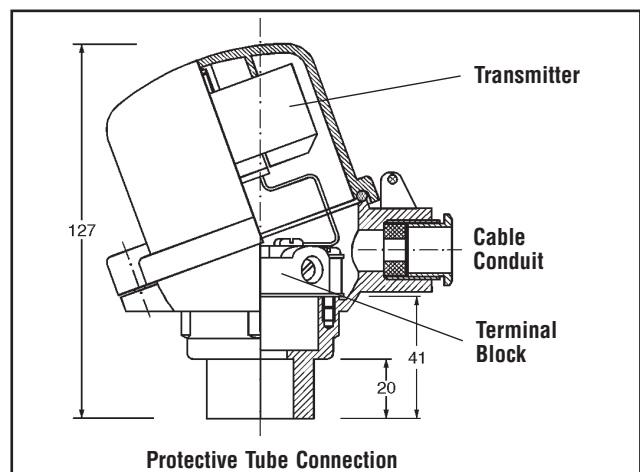
Materials

Housing	Aluminium Form B acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.20 kg
Protection Class	IP 54
Cover	Hinged lid, screwed
Transmitter Inst.	Within cover

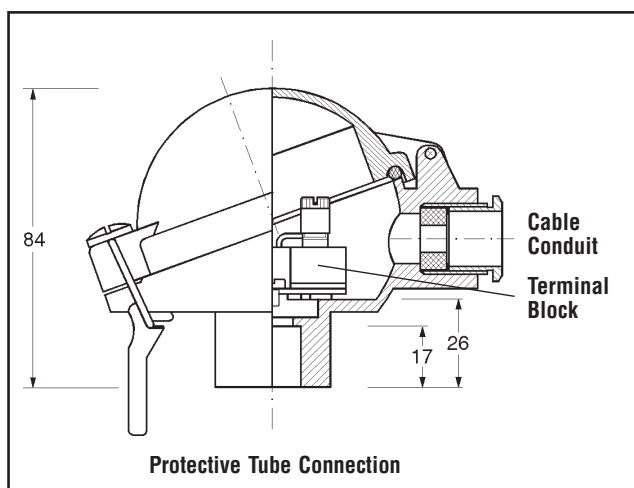
Model: TZ-AL (AUZH) (Fig. 34)

Materials

Housing	Aluminium Form A acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.22 kg
Protection Class	IP 54
Cover	Hinged lid, screwed
Transmitter Inst.	Within cover



Mass_34.tif



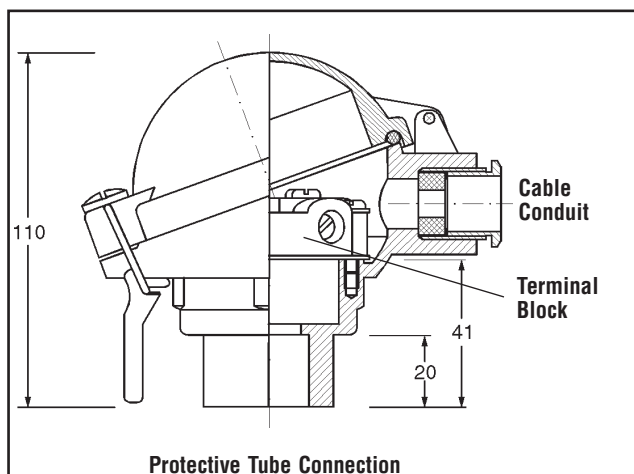
Mass_35.tif

Model: HR-A/BL (BUS) (Fig. 35)**Materials**

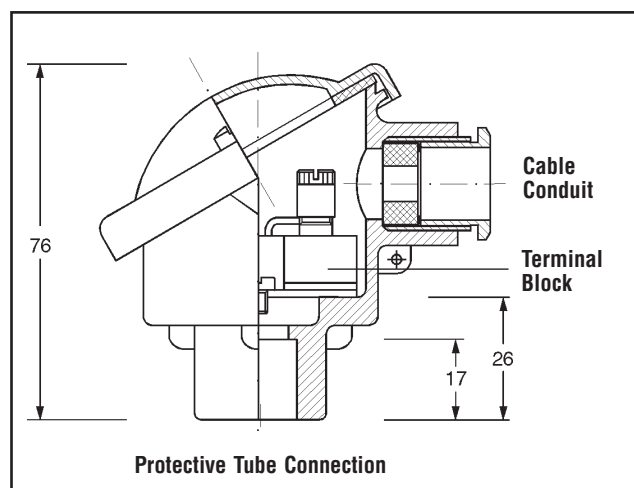
Housing	Aluminium Form B acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.24 kg
Protection Class	IP 54
Cover	Hinged lid, with lever lock
Transmitter Inst.	Possible

Model: HR-AL (AUS) (Fig. 36)**Materials**

Housing	Aluminium Form A acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.24 kg
Protection Class	IP 54
Cover	Hinged lid, with lever lock
Transmitter Inst.	Possible



Mass_36.tif



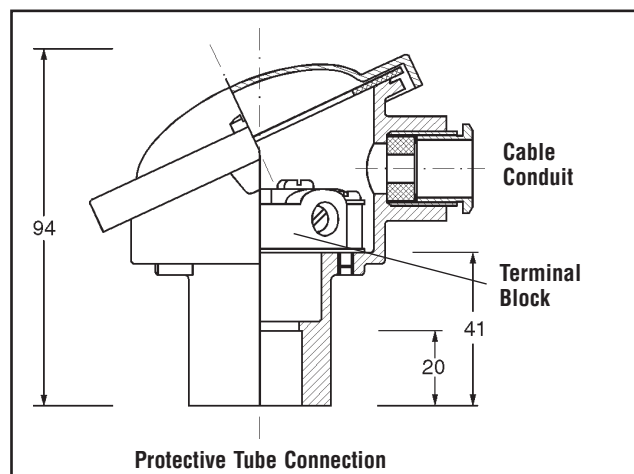
Mass_37.tif

Model: GN-BL (B) (Fig. 37)**Materials**

Housing	Aluminium Form B acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.18 kg
Protection Class	IP 43
Cover	Lose lid, with 2 screws
Transmitter Inst.	Not possible

Model: GN-AL (A) (Fig. 38)**Materials**

Housing	Aluminium Form A acc. to DIN 43729
Finish	Aluminium lacquer
O-Ring-Seal	Rubber
Temp. Limits	-40 to +80 °C
Weight	0.20 kg
Protection Class	IP 43
Cover	Lose lid, with 2 screws
Transmitter Inst.	Not possible



Mass_38.tif

Mounting Accessories

The connection fittings of thermocouples are supplied mainly with detachable mounting elements, sealed with a stuffing bush:

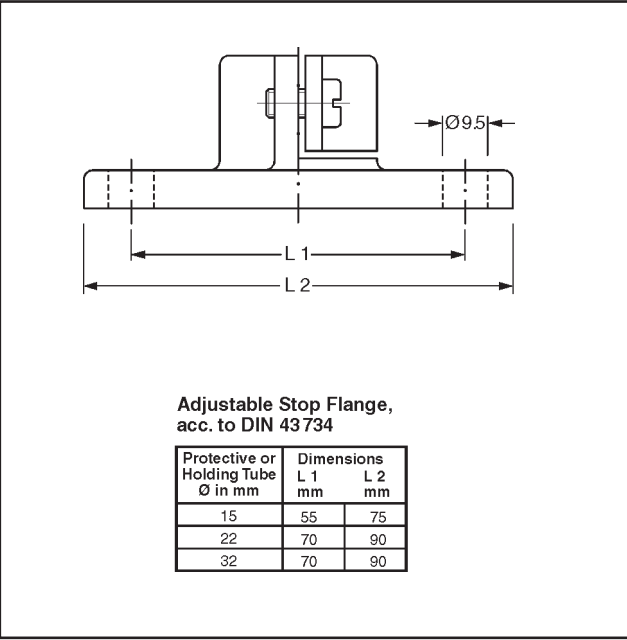
- Adjustable stop flanges
- Adjustable threaded fittings



V4_39.tif

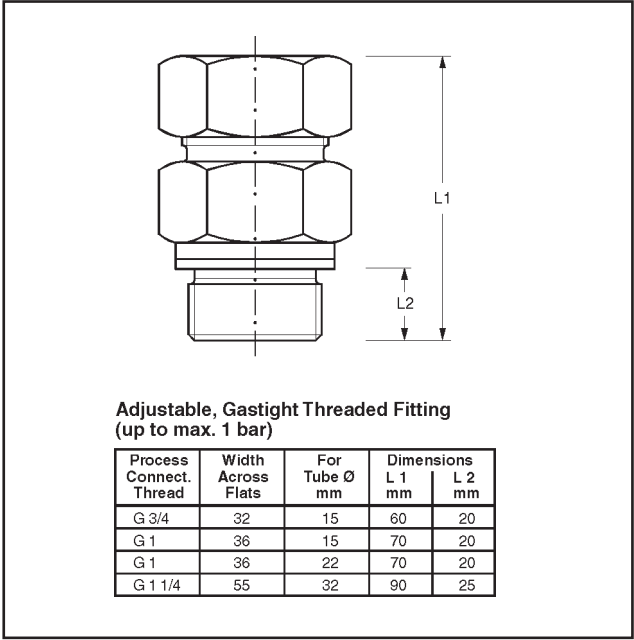
Figure 39: Connection fittings.

Figure 40: Dimensional drawing – adjustable stop flange.



Mass_40e.tif

Figure 41: Dimensional drawing – adjustable threaded fitting.



Mass_41e.tif

Ordering Information

Code	Description	Material	Tube Diameter [mm]	Inner Diameter / Process Connection
HSG 32400011	Stop flange	GTW-35 (cast iron)	15	16
HSG 32400021	Stop flange	GTW-35 (cast iron)	22	23
HSG 32400031	Stop flange	GTW-35 (cast iron)	32	33
HSG 32395216	Threaded fitting	1.0711 (mild steel)	15	G ³ / ₄ A
HSG 32395386	Threaded fitting	1.0711 (mild steel)	15	G1A
HSG 32395426	Threaded fitting	1.0711 (mild steel)	22	G1A
HSG 32395496	Threaded fitting	1.0711 (mild steel)	32	G1 ¹ / ₄ A

Thermocouple Wires, Extension and Compensating Cables

Thermocouple Wires

Thermocouple wires are used to manufacture thermocouples for temperature measurement. The tolerances and application temperatures of DIN EN 60584-1/2 standards are valid for the thermocouple wires.

Our thermocouple wires are selected and tested in the laboratory. The tolerances between desired and actual values are recorded. This guarantees a uniform and stable quality of the delivered goods. The indicated basic values and their tolerances are only valid for thermocouple wires supplied in pairs. The individual thermocouples are designated by a letter, e.g. K for NiCr-Ni thermocouple. The **colour coding table** is on the back page of this product data sheet.

Thermocouple materials with restricted tolerances are obtained by selection. When ordering from stock it is therefore recommended to inquire about the available quantity.

Works certificates may be issued for batches and individual elements on request. Insulated thermocouples are used in heat treating processes in the metallurgy, furnace optimization, material tests, aerospace technology, laboratories etc. Rosemount offers a flexible solution for any application within a temperature range of -265 °C up to +1200 °C.

DIN 43722 Standards for Extension and Compensating Cables

The DIN 43722 standards include the German version of the European Harmonization Document HD 446.3 S, which contains the International Standard IEC 584-3: 1989 with common alterations made by CENELEC.

This standard specifies limit tolerances (of thermoelectric voltages) for extension and compensating cables, in accordance with the basic values of part 1 of the IEC 584-1 standard. Furthermore, this standard specifies the method for identification of insulated extension and compensating cables. This standard is not valid for mineral insulated cables.



V4_42.tif

Figure 42: Cables.

Definitions

Extension and compensating cables are used for the electrical connection between the open ends of a thermocouple and the comparison junction in those installations where the thermocouple legs are not directly connected to the comparison junction.

Limit Tolerances

The limit tolerances of an extension or compensating cable are the maximum possible deviation in microvolts caused by insertion of the extension or compensating cable into the measuring circuit.

Extension Cables

Extension cables are manufactured of the same material as the corresponding thermocouple. They are available as stranded lead or solid wire with different insulations. They are designated by letter "X" following the designation of the thermocouple, e.g. "KX" – extension cable for NiCr-Ni-thermocouple, type K.

For thermocouple cables two limit tolerance classes are defined. For the thermocouple types J, E, K, and N the limit tolerance in class 1 is ± 1.5 °C, and in class 2 is ± 2.5 °C. The limit tolerances for extension cable are only valid for an application temperature range of -25 °C up to +200 °C.

The application temperature range indicates the ambient temperature, which the whole cable may be exposed to, from connection point to comparison junction, in order to keep the stated tolerances.

With regard to the thermoelectrical properties, the maximum temperature is limited to 200 °C, even if the insulating materials would tolerate higher temperatures.

Compensating Cables

Compensating cables are manufactured of special materials which have the same thermoelectrical properties in limited temperature ranges as the thermocouple.

They are available as stranded lead or solid wire with different insulations.

They are designated by letter "C" following the designation of the thermocouple, e.g. "SC" – compensating cable for PtRh10%-Pt thermocouple, type S.

Different alloys may be used for the same thermocouple type. They are to be distinguished by an additional letter, e.g. KCA and KCB.

For compensating cables only limit tolerance class 2 is defined. For the types KCA, KCB, NC, RCA, and SCA the limit tolerance is ± 2.5 °C, for types RCB and SCB ± 5.0 °C. Depending on the type of compensating cable limit tolerances for an application temperature range of 0 °C up to 100 °C, 150 °C, or 200 °C are valid.

For special purposes, additional requirements are to be fulfilled with regard to the cable construction (kind of wiring, number of twists, shield, additional leads) as well as insulation.

Rosemount offers cables with a high chemical resistance and excellent protection against magnetic and electrical influences as well as cables with a high mechanical shield and wide ambient temperature range.

Table 12 shows an overview of maximum application temperatures of the most important insulation materials. The indicated values are to be regarded only as reference values. The maximum application temperature for glass fibre, special glass fibre, and Q-fibres is valid only for single measurements. In this case the cable is not to be moved and the insulation is wrapped. The maximum temperature for wrapped glassfibre insulation is 250 °C. Information about the insulation material is related to the single lead only. Looking at the outer sheath, a mechanical armouring could be attached. That means that the outer sheath is the most external insulation position of the cable construction.

Our special catalogue – **Thermocouple Wires, Extension and Compensating Cables** – includes all standard cables available from stock. Special cables are delivered on request.

Tabelle 12: Maximal application temperatures of insulation materials.

Insulation Material	Max. Temperature [°C]
PVC	105
FEP	200
Silicon rubber	200
PFA Teflon	260
PTFE Teflon	260
Kapton	285
Glass fibre	400
Special glass fibre	700
Q-fibres	1200

Please return to our local sales office in your area.
Addresses and fax numbers are listed on the last page of this product data sheet.

Thermocouple Questionnaire

I. General Information

Name, Department _____
Telephone No. _____ Telefax _____
Company _____
Address _____
Inquiry / Ordering No. _____

II. Thermocouple Assembly

- ☐ Series 1075 standard thermocouples with deviations
☐ Special thermocouples, e.g. for glass industry

III. Operating Conditions

1 Field of Application _____
1.1 Place of installation _____
1.2 Position of installation _____
1.3 Temperature Operating temperature _____
 Temperature range _____
1.4 Temperature change ☐ often ☐ middle ☐ rarely ☐ min. ☐ max.
1.5 Medium _____
1.6 Pressure Nominal pressure _____
 Operating pressure _____
1.7 Flow rate _____
1.8 Vibration _____
1.9 Miscellaneous _____

IV. Environmental Conditions

Ambient temperatures [°C] _____
Air humidity [% RH] _____
Electrical interferences ☐ existing ☐ not existing

V. Thermocouple Configuration

- 1 **Temperature Sensor** _____
- 1.1 Tolerance _____
- 1.2 Configuration _____
- 1.3 IP rating _____
- 2 **Protective Housing** _____
- 2.1 Protective tube _____
- 2.2 Mounting details _____
- 2.3 Extension / holding tube _____
- 2.4 Insertion / nom. length _____
- 3 **Material Certificates** _____
- 4 **Connection** _____
- 4.1 Connection head / box _____
- 4.2 Cable / lead _____
- 4.3 Transmitter _____
- 4.4 Others _____
- 5 **Test, Certificates** _____
- 6 **Accessories** _____
- 7 **Add. Requirements** _____

VI. Additional Information

- 1 Competition _____
- 2 Target price _____
- 3 Quantity _____ Monthly _____ Annually _____ Once _____
- 4 Requested delivery date _____
- 5 Packing instruction _____

Remarks, sketch, plan of installation, photographs (on a separate page, if necessary)

Colour Coding for Extension and Compensating Cables

Thermocouple Type	Designation	Positive (+)	Negative (-)	Sheath	Standards
NiCr-Ni	K	green	white	green	DIN EN 60584-3
Fe-CuNi	J	black	white	black	DIN EN 60584-3
Cu-CuNi	T	brown	white	brown	DIN EN 60584-3
NiCr-CuNi	E	violet	white	violet	DIN EN 60584-3
PtRh13%-Pt	R	orange	white	orange	DIN EN 60584-3
PtRh10%-Pt	S	orange	white	orange	DIN EN 60584-3
PtRh70%-PtRh6%	B	grey	white	grey	DIN 43722
NiCrSi-NiSi	N	pink	white	pink	DIN 43722
NiCr-Ni	K	red	green	green	DIN 43714
Fe-CuNi	L	red	blue	blue	DIN 43714
Cu-CuNi	U	red	brown	brown	DIN 43714
PtRh13%-Pt	R	red	white	white	DIN 43714
PtRh10%-Pt	S	red	white	white	DIN 43714
PtRh70%-PtRh6%	B	red	grey	grey	DIN 43714

Note

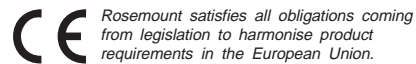
For the outer insulation of glass fibre or steel wire braiding, the colour coding is to be effected with a coloured tracer acc. to DIN EN 60584-3 standards, and the colour of the positive leg.

This document is available electronically at www.emersonprocess.com

Rosemount Temperature GmbH

Frankenstraße 21
63791 Karlstein
Germany
Phone +49 (6188) 992-0
Fax +49 (6188) 992-286

www.emersonprocess.com



Rosemount satisfies all obligations coming from legislation to harmonise product requirements in the European Union.

Emerson Process Management Ltd.

Heath Place
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