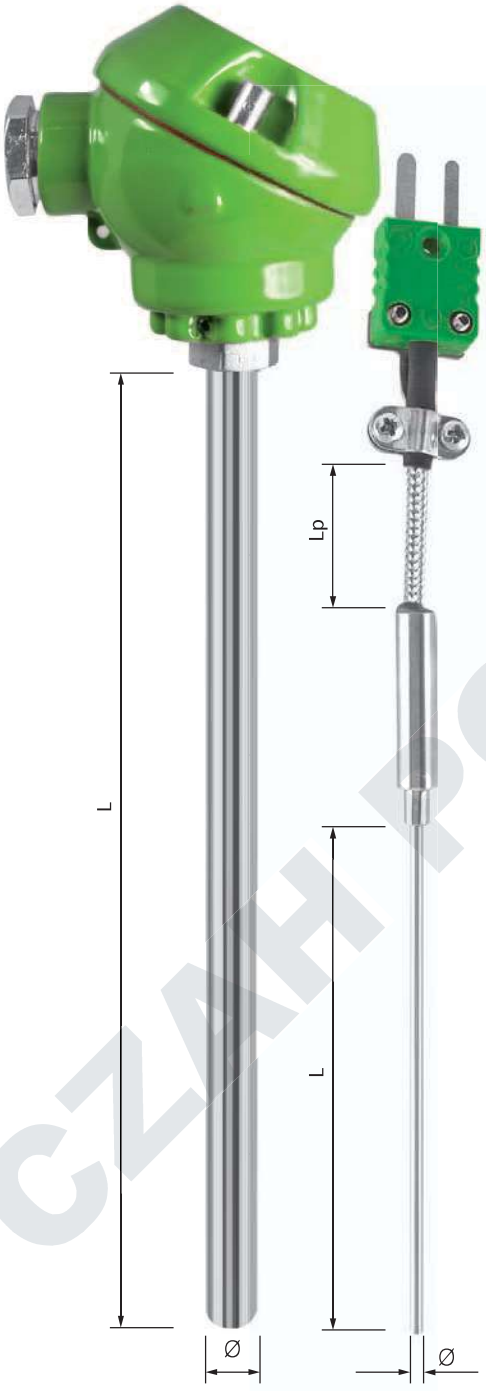
Calibration certificate of
our Accredited Laboratory upon request

CALIBRATION CERTIFICATE

02

MINERAL INSULATED THERMOCOUPLES

- MI thermocouples are designed for temperature measurement in various technological processes and in many different industries such as chemical, metallurgical, energy, plastic processing, etc.
- Various probe sheath materials are available and the sensors are suitable to measure the temperature in environments with diverse chemial composition.
- Thermocouples are suitable for use at high temperatures



02	sensor type	accuracy class	length	thermo-well	diameter	hot junction	termination type	cable length	cable type	com-pression fitting	temperature transmitter

Give type and number of sensor (table 1) eg.
1K – simplex
2K – duplex

Give accuracy class eg. 1, 2 or 3; table I, page 63

Give length 'L' [mm] always beneath the end of a sensor eg. beneath a terminal head or a tube

Give thermowell material (table 2)

Give outer diameter Ø (table 3)

Give type of hot junction, (table 4)

Give required construction (table 5)

Give cable length 'Lp' [mm]

Give cable type (table 6a) in case of expansion joint give its type (table B, page 51)

Give compression fitting type (table 7) skip it if not requested

Give transmitter details (for thermocouples with head), type and range (table 8)

TAB. ORDERING CODE:

02	1K	1	1000	310	6,0	I1	T2H	1500	TS201	UG121 D6M	—

02 – 1K – 1 – 1000 – 310 – 6,0 – I1 – T2H – 1500 – TS201 – UGM126

Temperature sensor model 02 (MI thermocouple). Type K (NiCr-NiAl), accuracy class: 1, length beneath a tube: 1000 mm, sheath material 310, diameter: 6,0 mm, single insert with insulated hot junction. MI cable tipped with a pot seal (T2H) wih epoxy reisin for max teperature 220 °C. Cable 1500 mm² long 2x 0.22 mm² silicone insulated. Sensor additionally equipped with the moveable brass fitting with a ferrule.

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TAB. 1 TEMPERATURE RANGE *)

SENSOR TYPE	TYPE OF THERMO-ELECTRODES	LONG-TERM OPERATING RANGE [°C] *)	SHORT-TERM OPERATING RANGE [°C] *)
J	Fe - CuNi	+20 ÷ 700	-180 ÷ 750
T	Cu - CuNi	-185 ÷ 300	-250 ÷ 400
K	NiCr - NiAl	0 ÷ 1100	-180 ÷ 1350
N	NiCrSi - NiSi	0 ÷ 1100	-270 ÷ 1300
E	NiCr - CuNi	0 ÷ 800	-40 ÷ 900
S	PtRh10 - Pt	0 ÷ 1550	-50 ÷ 1750
R	PtRh13 - Pt	0 ÷ 1600	-50 ÷ 1700

*) Given temperature ranges are mostly dependent on the outer sheath material of a cable. Tolerance to PN-EN 60584-1, table I, page 63

TAB. 2 SHEATH MATERIAL

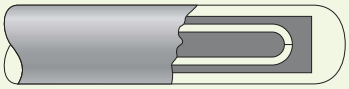
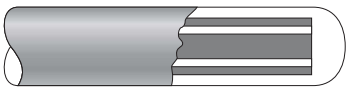
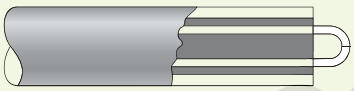
MATERIAL	DESCRIPTION	AIR OPERATING TEMPERATURE
INC (Inconel 600; 2.4816)	Nickel – chrome – iron alloy, with very good oxidation resistance and great high temperature resistance (to 1150 °C). Suitable for neutral, oxidising environment or vacuum.	to 1150 °C
310 (H25N20S2; 1.4841)	Steel comprised of 25%Cr – 20%Ni. Stainless steel, heatproof, oxidation-proof up to temperature of 1150 °C	to 1150 °C
NIC (Nicrobell®)	Nicrobell is nickel-chrome alloy with 1,4% of silicon oxide. Silicon ensure high oxidation resistance and strength at high temperature, up to 1250 °C	to 1250 °C
OXL (OMEGACLAD® XL)	OMEGACLAD® XL type of steel ensures excellent resistance at high temperature. It is resistant to oxidation, carburization and chlorination. Continuous operating temperature is up to 150 °C and short-term operation temperature: 1335 °C	to 1335 °C
PYR (PYROSIL®)	PYROSIL® ensures perfect mechanical strength, high corrosion resistance as well as durability and stability of EMF level during long-term usage at high temperature up to 1250 °C.	to 1250 °C
321 (1.4541; 1H18N9T)	Steel similar to grade 304 (18% Cr, 10% Ni) but with titanium as a stabilizer.	to 900 °C
316 (1.4401; H17N13M2T)	Steel similar to 304 (17% Cr, 9% Ni) with 3% of molybdenum. Because this steel grade is more corrosion resistant than 321 and 304, it is good for humid environment and for aplication in places threatened by corrosion (sea water).	to 900 °C
304 (1.4301; 0H18N9)	Austentic stainles steel 18%Cr-8%Ni. Corrosion resistant (with no excess oxidation and no resistance lost) up to 80 800 °C. It is the most popular acidproof material, easy for metalworking and welding.	to 800 °C
PtRh10	Recommended for operating temperature 1550 °C, its melting point is 1850 °C. Most often used in neutral, oxidising environment or vacuum.	to 1850 °C

TAB. 3 STANDARD SENSOR DIAMETERS *)

OUTER DIAMETER ∅		MINIMUM DIAMETER OF THERMO-ELECTRODES [mm]
mm	INCHES	
0.5	0.020	0.08
1.0	0.039	0.15
1.5	0.059	0.23
2.0	0.079	0.30
3.0	0.118	0.45
4.5	0.177	0.68
6.0	0.236	0.90
8.0	0.315	1.20

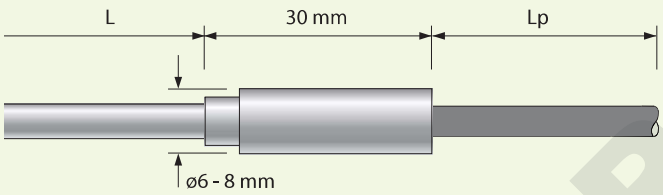
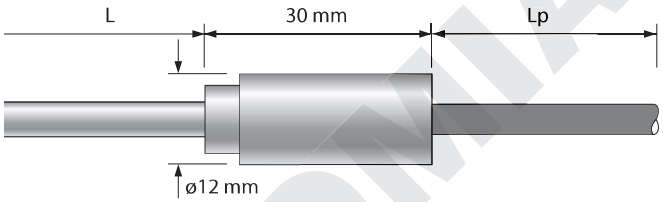
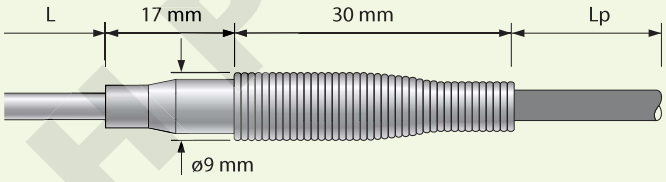
*) Other diameters on request

TAB. 4 HOT JUNCTION TYPES

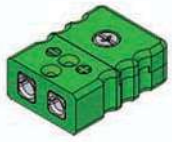
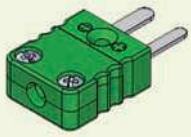
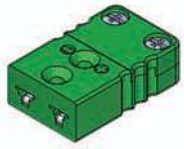
PART NUMBER OF HOT JUNCION	DESCRIPTION	DRAWING
I1	Simplex Insulated Junction	
I2	Duplex insulated junction **)	
Z1	Grounded simplex junction	
Z2	Grounded duplex junction *)	
O1	Exposed simplex junction	
O2	Exposed duplex junction	

*) in case of duplex senssor, hot junctions are grounded also with each other.
**) hot junctions are insulated from each other

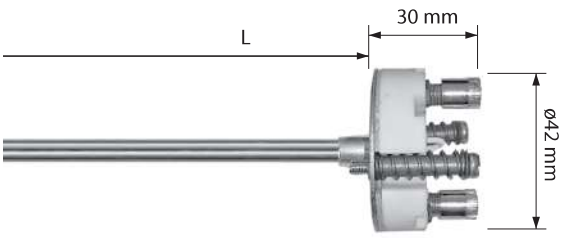
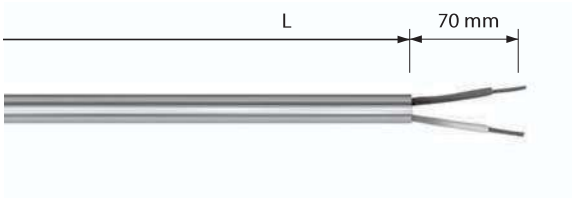
TAB. 5 THERMOCOUPLE TERMINATION OPTIONS (TOO CHOOSE FROM)

TYPE	POT SEAL WITH A CABLE *)
T1 to 120 °C **T1H** to 220 °C	For diameters from 0.5 mm to 4.5 mm. Connector operating range: 120 °C; T1H version to 220 °C 
T2 to 120 °C **T2H** to 220 °C	For diameter 6.0 mm. Connector operating range: 120 °C, T2H version to 220 °C 
T3 to 120 °C **T3H** to 220 °C	For diameter 6.0 mm. Connector operating range: 120 °C, T3H version to 220 °C. The additional seal protects a cable against breaking during bending. 

*) if you require a connector for higher temperature, please contact the sales department
**) different pot seals available on request

TYPE	COMPENSATED CONNECTORS *) **)
SW1 to 220°C **SW10** to 350°C **SW100** to 650°C	
SG1 to 220°C **SG10** to 350°C **SG100** to 650°C	
MW1 to 220°C **MW10** to 350°C **MW100** to 650°C	
MG1 to 220°C **MG10** to 350°C **MG100** to 650°C	

*) colour depends on the type of a thermocouple
**) other LEMO types available on request

TERMINAL BLOCK OR MI CABLE WITH ELECTRODES *)		
MODEL	**WK1**	**WK2** */**
	 Fixing screws M4 (33 mm distance)	

*) other lenths available on request **) diameter of thermo-electrodes depends on a diameter of MI cable

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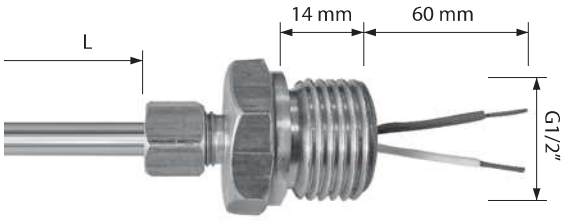
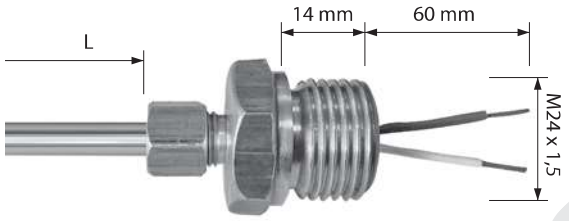
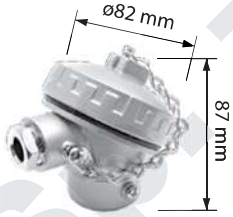
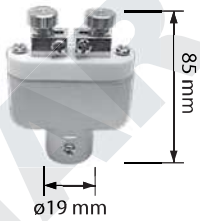
COMPRESSION FITTING *)

MODEL	**KR12** with thread G1/2"	**KR24** with thread M24x1.5
		

*) other threads available on request

TERMINAL HEAD *) **)

TYPE	**B**	**NA**	**MA**	**G1**	**G2**
					
TYPE	**DA**	**TL**	**TS**	**SEG** (stal 316)	**KNN** (plastic)
					

*) different terminal heads available on request
**) for technical data see table A, page 50

TAB. 6 CABLE TYPES

The sensors can be supplied complete with cables of various design. The following isulation types are available: : PCV, PTFE, fiberglass, Kapton or combination of the mentioned materials. Standards cable sections are 0.22mm² (7/0.2 mm). To choose the right cable, please see table D, page 54. If you required a cable not mentioned in the catalogue, please contact the sales department.

The most common cables:
TS201 - 2x0,22 mm² – silicone insulated
TW204 - 2x0,22 mm² – fiberglass insulated / stainless steel overbraid
TT201 - 2x0,22 mm² – Teflon insulated
TT204 - 2x0,22 mm² - Teflon insulated / stainless steel overbraid

TAB. 8 TEMPERATURE TRANSMITTER

If the in-head signal tramsmitter is requested eg. for signal 4...20 mA, please provide all necessary details, such as: transmitter type, temperature range. List of transmitters is available in the table E, page 60.

TAB. 7 COMPRESSION FITTINGS

The additional element used to mount a thermocouple at the measuring location. In our offer there are many different types available. To choose the right fitting, see table F, page 61. Other types available on request.

TAB. 9 ESTIMATED RESPONSE TIME

Response time of a temperature sensor depends mostly on the medium in which the temperature is measured. The results in the column on the righe, are given for temperature sensors with an insulated hot junction and refer to water 0.4 m/s and value $t_{0,9}$ ($t_{0,9}$ = the time required for a sensor to reach 90% of the maximum, regarding its response for temperature change)

MM	$T_{0,9}$ [S]
0.5	0.06
1.0	0.15
1.5	0.21
2.0	0.40
3.0	1.20
4.5	2.50
6.0	4.00
8.0	6.50