Kamet

Your supplier of
High temperature thermocouples

ARi

ARi Industries Inc.

Kamet & Mineral insulated thermocouple cable

Kamet is your supplier of mineral insulated thermocouple cable, RTD cable and other high quality components for industrial temperature sensors in greater Europe. Kamet has been a trustworthy partner since 1988 for industries where temperature is key focus. We supply excellent products from top class suppliers, together with whom we continuously strive to improve our products and service. We stock over 700,000 meters of Okazaki mineral insulated thermocouple cable & RTD cable in our 1000 m^2 warehouse, located in Utrecht, the Netherlands. Get in contact with our Area Sales Managers today to receive a quote or log onto our website.

ARi Industries

Our American partner ARi Industries was established in 1952 and is among the first companies to ever manufacture mineral insulated cable. Since the establishment, the company actively refined the production process of MI cable and high temperature thermocouples. ARi Industries is our main partner for high temperature thermocouples, heater cables and special MI cables. ARi Industries is a subsidiary of Okazaki, our main partner for MI cable.

Typical applications for high temperature thermocouples are e.g. vacuum furnaces, gas furnaces, high temperature ovens and reaction furnaces. Besides producing tailor-made high temperature thermocouples, ARi Industries also supplies Kamet with special MI cables, such as type S, R and B mineral insulated thermocouple cable. Furthermore, ARi Industries is also Kamet's supplier of special MI cables with heavy wall and/or thick conductors.

ARi Industries Inc.

High temperature thermocouples

Principle of high temperature thermocouples

High temperature thermocouples, also called exotic thermocouples, are used in applications where base metal thermocouples cannot be used because of extreme temperatures up to 2200°C and hazardous environments. The exotic thermocouples can be used in vacuum, inert, oxidizing and reducing atmospheres.

Extreme conditions

The high temperature thermocouples produced by ARi Industries are insulated with material varying from Magnesium oxide, Alumina oxide to Hafnium oxide. These insulation materials provide long term stability to the thermocouples. Applications where the thermocouples are being used can vary from gas furnaces and high temperature ovens to vacuum furnaces and reaction furnaces.

How to decide what thermocouple is suitable

There are two important variables for selecting the proper exotic thermocouple for a particular application in hazardous environments.

1. What is the temperature range you need to measure?

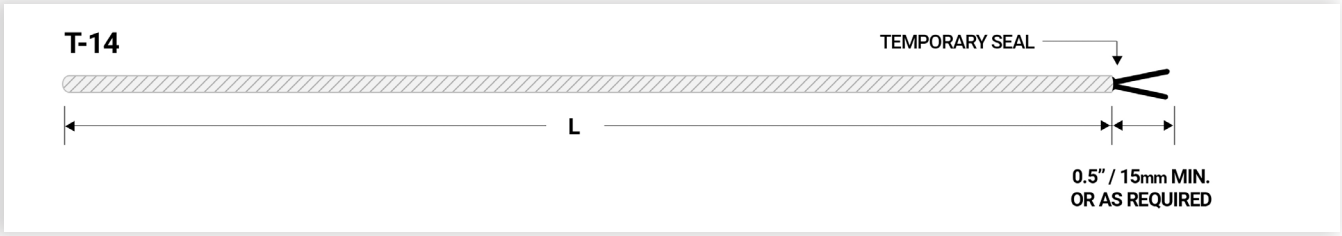
2. What is the atmosphere the thermocouple will be exposed to during operation?

Why ARi Industries high temperature thermocouples from Kamet?

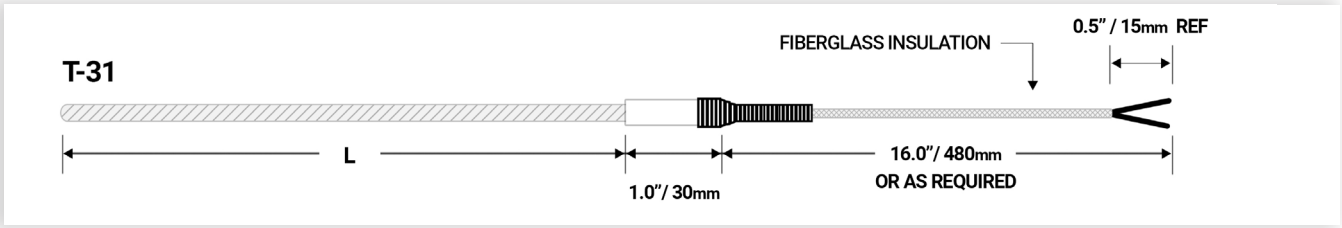
- Cost efficient options for oxidizing environments up to 1700°C
- Robust hot junction on Type C & D through patented wire wrap / welding procedure
- Custom material combination and sizes to meet demanding applications
- Special non-destructive testing with ARi standards, traceable to US NIST
- ARi is the industry pioneer due to 60+ years of knowledge and experience

STYLE NUMBERS

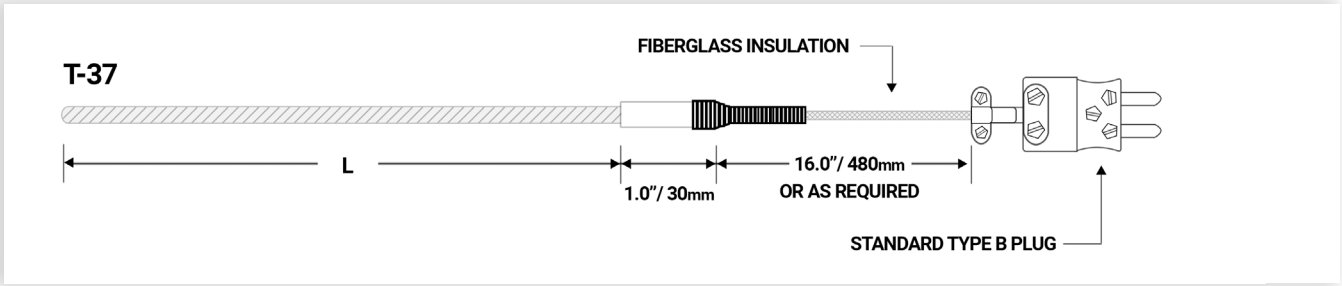
STYLE NUMBER	INSULATION MATERIAL	INSERT SHEATH LENGTH	SHEATH DIAMETER	THERMOCOUPLE WIRE TYPE	JUNCTION NUMBER CODE	SHEATH MATERIAL	LENGHT OF EXTENSION
T-107	N	12	B	AE	(8.1)	N	24



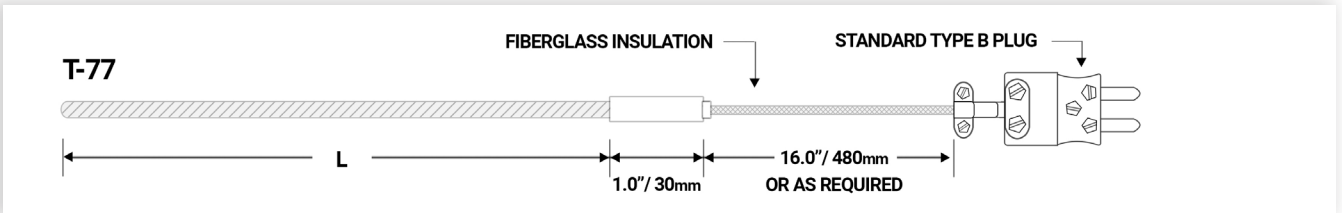
± 15 mm / 0.5" bare wire leads with epoxy seal.



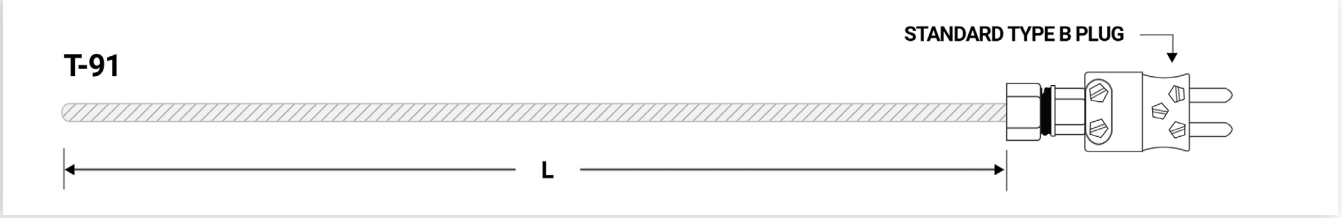
200°C Transition with spring strain relief, fiberglass insulated extension wire and ± 15 / 0.5" mm bare wire leads



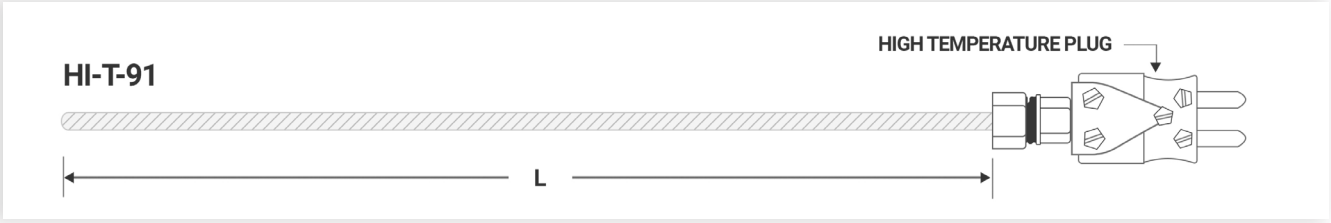
200°C Transition with spring strain relief, fiberglass insulated extension wire and standard 200°C male plug



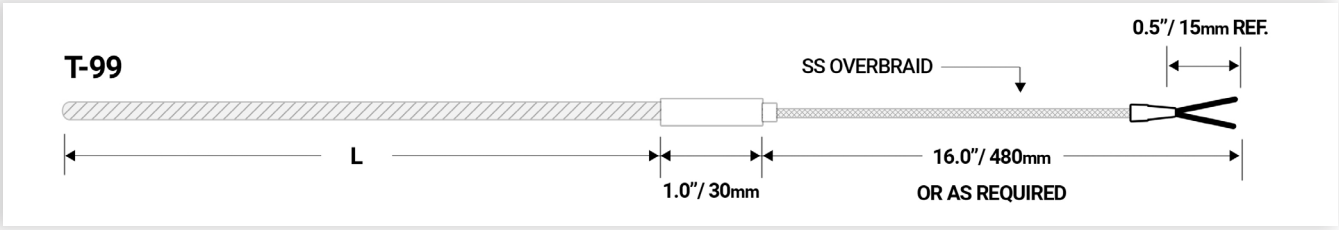
200°C Transition with fiberglass insulated extension wire and standard 200°C male plug



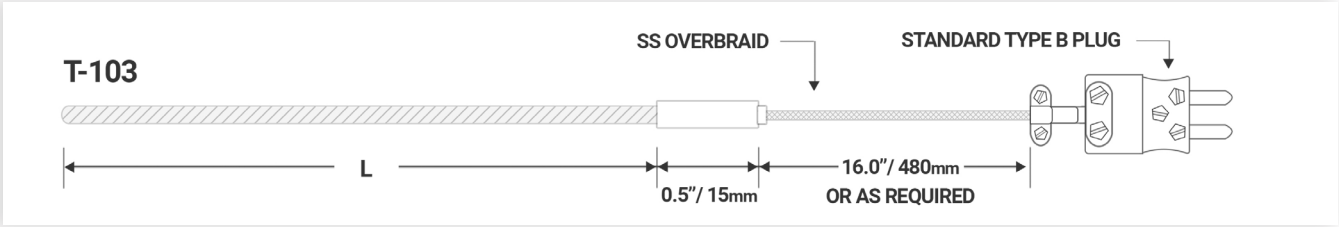
200°C Standard male plug



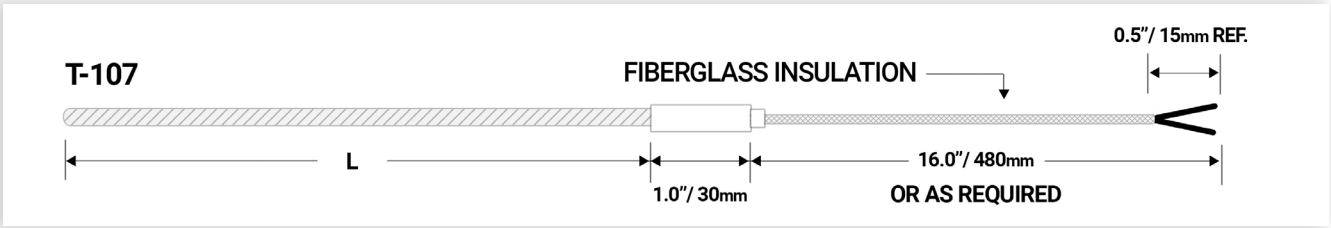
427°C High temperature male plug



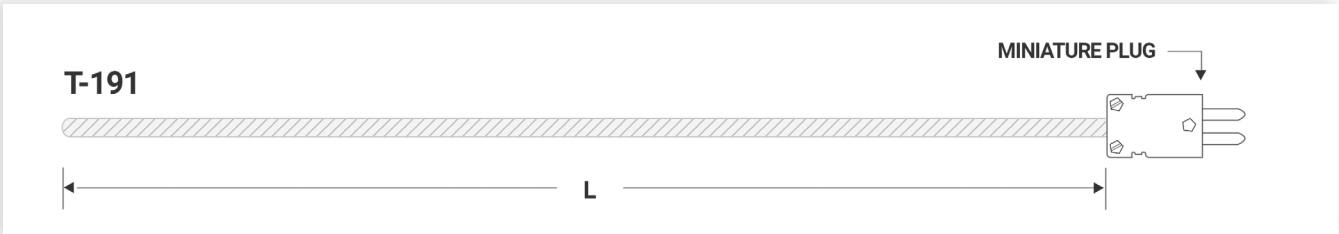
200°C Transition with fiberglass insulated extension wire with stainless steel over braid and ± 15 mm / 0.5" bare wire leads



200°C Transition with spring strain relief, fiberglass insulated extension wire with stainless steel over braid and standard 200° male plug



200°C Transition with fiberglass insulated extension wire and ± 15 mm / 0.5" bare wire leads



200°C Miniature male plug

High Temperature termination

In applications where the cold end termination will see temperatures in excess of 200°C, standard epoxy seals may breakdown causing failure. In this case, ARi can supply a ceramic cement seal which can withstand temperatures up to 450°C. To specify this option, add prefix HI- in front of the part number selected.

Example HI—T-107N-12DEA(9.5)

Mating Jack

If required with any of our male plug type thermocouples (T-91, T-191 and HI-T-91) ARi can supply the appropriate mating jack with the assembly. To specify this modification, add (MOD) after the part number and specify "supplied with mating jack"

Teflon insulated extension wires

For designs where extension wire attachment is required, in some cases ARi can supply Teflon insulated extension wire in place of the standard fiberglass.

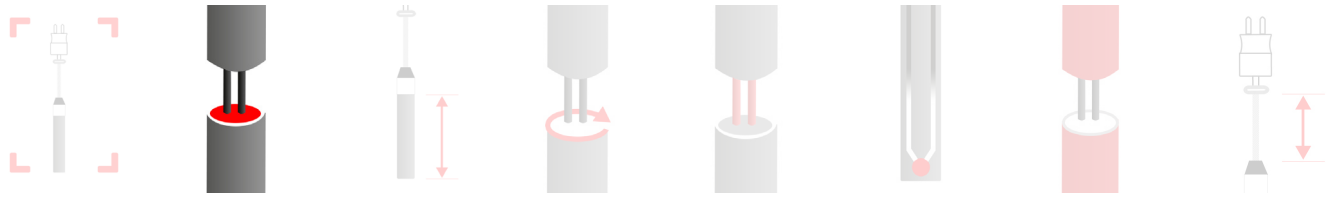
Duplex sensors

In case of a duplex element with extension wire, two separate cables are connected rather than one duplex wire. This is due to the availability of material.

Solid wires

For all designs with extension wire, the conductor inside is solid. This is due to the availability of material. For type S, R and B this is AWG 20 (Ø 0.81 mm) and for type C and D this is AWG 24 (Ø 0.51 mm).

INSULATION MATERIAL



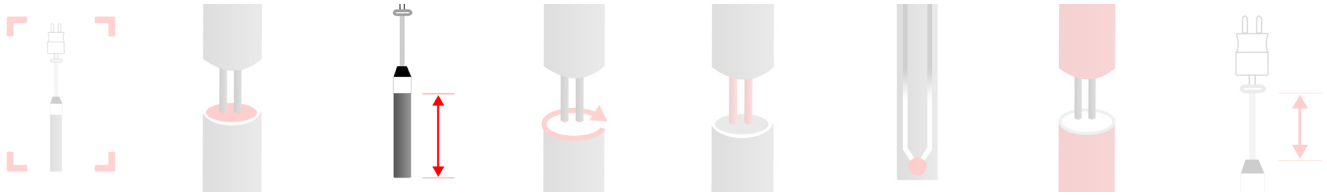
STYLE NUMBER	INSULATION MATERIAL	INSERT SHEATH LENGTH	SHEATH DIAMETER	THERMOCOUPLE WIRE TYPE	JUNCTION NUMBER CODE	SHEATH MATERIAL	LENGHT OF EXTENSION
T-107	**N**	12	B	AE	(8.1)	N	24

Insulation type	Symbol	Recommended maximum operating temperature	Approximate melting temperature	Comments
Magnesium Oxide (MgO)	N	1700°C	2800°C	Very hygroscopic and used mostly in compacted sheaths
Alumina Oxide (AL203)	A	1550°C	2040°C	Excellent with Platinum alloys
Hafnium Oxide (HFO2)	H	2200°C	2790°C	Excellent high temperature thermal conductivity and resistivity

Non MI-cable construction

In case Alumina or Hafnium is used in high temperature assemblies, the assembly is a non-MI cable construction. This means that the assemblies are not bendable, regardless of the sheath material that is used.

INSERT LENGTH



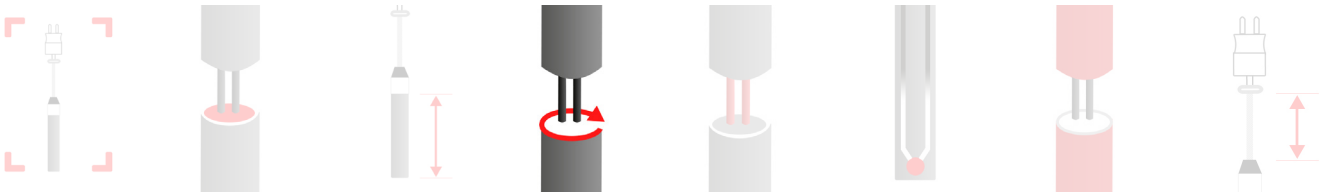
STYLE NUMBER	INSULATION MATERIAL	INSERT SHEATH LENGTH	SHEATH DIAMETER	THERMOCOUPLE WIRE TYPE	JUNCTION NUMBER CODE	SHEATH MATERIAL	LENGHT OF EXTENSION
T-107	N	**12**	B	AE	(8.1)	N	24

To calculate the length in inches, the standard calculation is:

Length in mm * 0.393701 = length in inches.

Please be informed that there is always a tolerance on the length. We indicate this tolerance in our quotations. If you require a special tolerance, please inform us in the quotation phase.

SHEATH DIAMETER

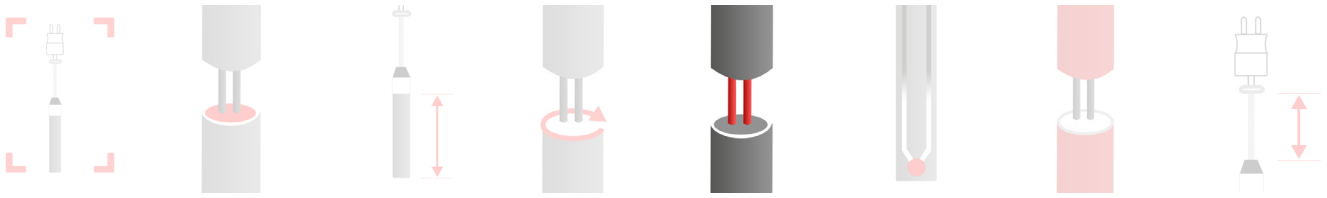


STYLE NUMBER	INSULATION MATERIAL	INSERT SHEATH LENGTH	SHEATH DIAMETER	THERMOCOUPLE WIRE TYPE	JUNCTION NUMBER CODE	SHEATH MATERIAL	LENGHT OF EXTENSION
T-107	N	12	**B**	AE	(8.1)	N	24

Symbols	(A)		(B)		(D)		(E)		(F)	
	Inches	*mm*	*Inches*	*mm*	*Inches*	*mm*	*Inches*	*mm*	*Inches*	*mm*
Standard sheath diameters	.040	1	.062	1.6	.125	3.2	.188	4.8	.250	6.4

For non-standard sheath diameters, the diameter will be indicated in inches. Example: .236 for 6 mm

THERMOCOUPLE WIRE TYPES



STYLE NUMBER	INSULATION MATERIAL	INSERT SHEATH LENGTH	SHEATH DIAMETER	THERMOCOUPLE WIRE TYPE	JUNCTION NUMBER CODE	SHEATH MATERIAL	LENGHT OF EXTENSION
T-107	N	12	B	**AE**	(8.1)	N	24

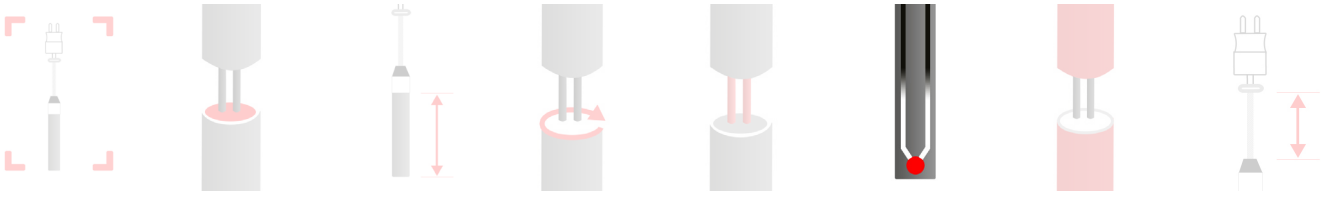
Thermocouple		Type	Symbol	Standard limits of error*	Recommended temperature range
+	-				Per ASTM E 230
Pt10%Rh	Pt	S	S	± 1.5°C or 0.25% per ASTM E 230	0-1450°C
Pt13%Rh	Pt	R	R	± 1.5°C or 0.25% per ASTM E 230	0-1450°C
Pt30%Rh	Pt6%Rh	B	B	± 0.5% per ASTM E 230	870-1700°C
W5%Re	W26%Re	C	AE	± 4.4°C (0-426°C) ± 1% (426-2315°C per ASTM E 988)	0-2200°C
W3%Re	W25%Re	D	AO	± 4.4°C (0-426°C) ± 1% (426-2315°C per ASTM E 988)	0-2200°C

From standard to special
Thermocouples with type S, R and B calibration made with mineral insulated construction can be supplied with special limits of error tolerance per ASTM E 230 or Class 1 per IEC 60584 (Class 1 is only available for S and R) to availability of material from stock. If the material is not in stock, special limits of error and Class 1 can be offered on best effort base.

Duplex element Construction
Most thermocouple combinations with an outside sheath diameter of 1/8" (3.2mm) or larger are available in duplex element construction. (2 separate measuring circuits in 1 sheath) To specify this option, add the suffix .4 after the style number. Repeat the junction code a second time and add parentheses.

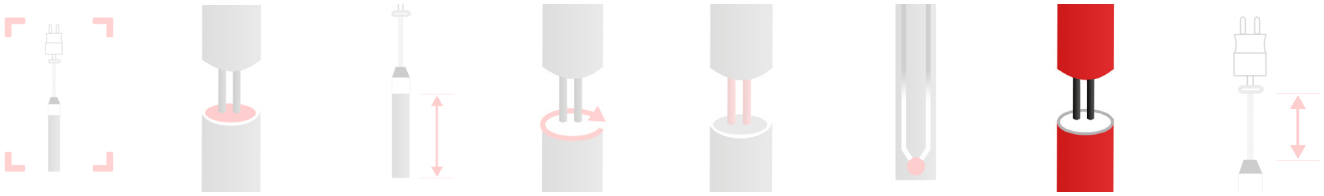
Example T-91.4N-12FR(9.9)B or T-91.4B-18DAE(9.3)(9.3)O

JUNCTION NUMBER CODES



Sheath type	Insulation Type (Letter Code)	Thermocouple type	Junction number code	
			Grounded	Ungrounded
Inconel 600	N	R, S & B	(8.1)	9
Pt10%Rh	N	R, S & B	8	9
Pt20%Rh	N	R, S & B	8	9
Tantalum	A	R, S & B	(8.1)	(9.4)
	N, H, B	R, S & B	(8.1)	(9.5)
	H, A	AE & AO	(8.1)	(9.3)
	N,B	AE & AO	(8.1)	(9.5)* or (9.3)
Molybdenum	A	R, S & B	N/A	(9.4)
	N, H, B	R, S & B	N/A	9
	N, H, B, A	AE & AO	N/A	(9.3)
Coated Molybdenum	N, H, B, A	R, S & B	N/A	(9.4)
	N, H, B, A	AE & AO	N/A	(9.3)

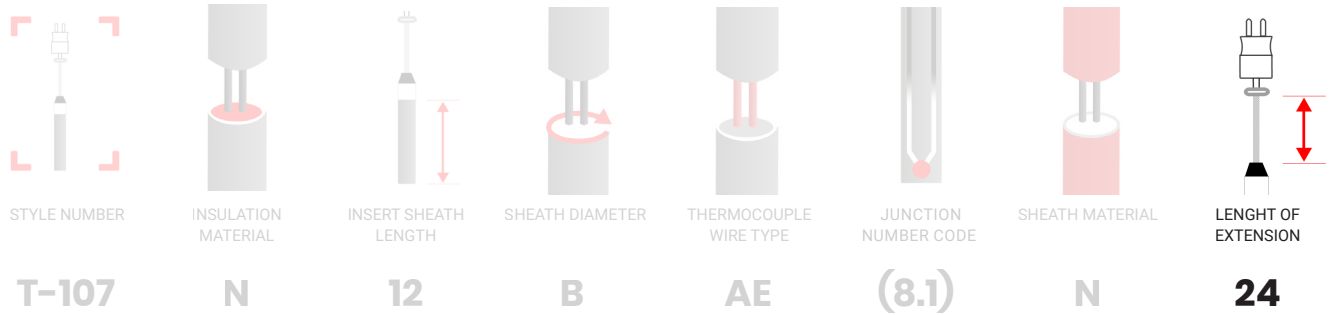
SHEATH MATERIAL



Sheath type	Symbol	Recommended maximum temperature	Melting temperature	Allowable environment	Standard sheath diameter in mm	Minimum bend
Inconel 600	B	1175°C	1345°C	Inert, vacuum, oxidizing	>1.0	5 x diameter
Pt10%Rh	AH	1550°C	1850°C	Inert, oxidizing	1, 1.5, 1.6, 2, 3, 3.2	5 x diameter
Pt20%Rh	AW	1550°C	1850°C	Inert, oxidizing	1, 1.5, 1.6, 2, 3, 3.2	5 x diameter
Tantalum	N	2200°C	2995°C	Inert, vacuum	1, 1.6, 3.2	10 x diameter
Molybdenum	O	2000°C	2620°C	Inert, vacuum, reducing	1,1.6, 3.2, 4.8, 6.4	Not bendable
Niobioum 1% Zirc	AV	2200°C	2495°C	Inert, vacuum	1.6, 3.2	10 x diameter
Coated Molybdenum	OCR	1600°C	2000°C	Inert, oxidizing	3.2, 6.4	Not bendable

Argon backfill
In order to minimize the effects of any residual oxidation remaining inside non-compacted sheath designs, for type C and D, ARi evacuates and backfills the sheath with inert Argon gas prior to sealing the cold end.

LENGHT OF EXTENSION



To calculate the length in inches, the standard calculation is:

Length in mm * 0.393701 = length in inches.

Please be informed that there is always a tolerance on the length. We indicate this tolerance in our quotations. If you require a special tolerance, please inform us in the quotation phase.

SPECIAL REFRACTORY SHEATHS

Sheath type	Symbol	Recommended maximum temperature	Melting temperature	Comments
Tungsten	BC	2300°C	3410°C	Very high melting point and low vapor pressure for vacuum applications
Molybdenum 50% Rhenium	BE	2300°C	2550°C	Easily weldable and ductile up to 2200°C. Suitable for inert, vacuum, hydrogen, nitrogen and amonia atmospheres
UCAR Metal ceramic LT-1 tubes	BV	1371°C	1538°C	Suitable for various molten metals and corrosive gases
Moly Disillicide	BW	1700°C	Varies	Can be used in air up to 1700°C. Suitable for heat treating, sintering and glass applications

In addition to the sheaths listed in the table above, ARi can also provide the below sheath coating on special order.

SPECIAL COATINGS FOR SHEATHS

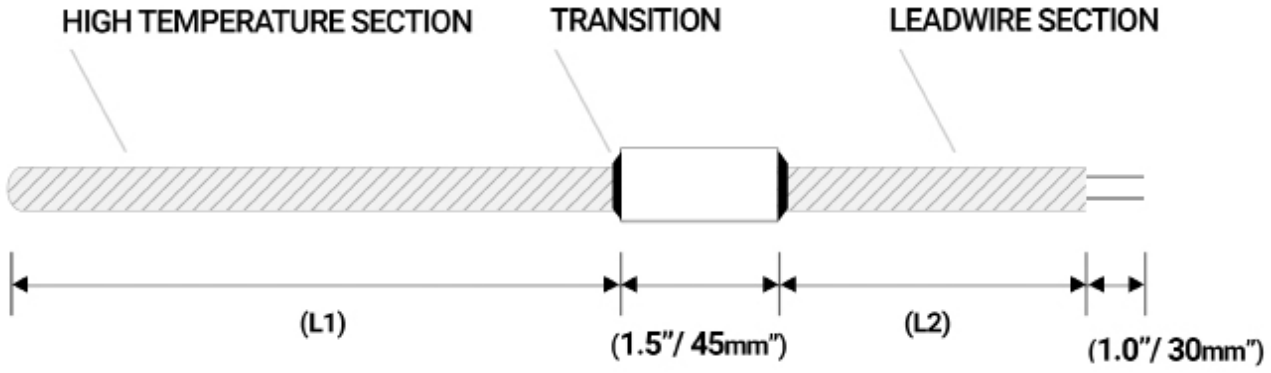
Coating type	Symbol	Maximum temperature	Comments
Thungsten plasma spray	TPL	2200°C	For resistance to graphite attack in vacuum applications. Applied to Molybdenum sheath
Boron Nitride	BN	1800°C	Non-wetting with most molten metals and slags. Use in oxidizing atmospheres to 1100°C

Please contact Kamet for dimensions and availability.

TRANSITION STYLE THERMOCOUPLES

When exotic applications require long thermocouples with expensive noble metal or refractory sheaths, ARi can supply custom made transition style thermocouples for substantial cost savings.
Thermocouples can be supplied with suitable high temperature "hot section" sheath and insulating materials long enough to reach a cooler zone in the furnace or reactor. At this point, a brazed transition can be made to a less expensive thermocouple or compensating material with Inconel 600 or stainless-steel sheath.

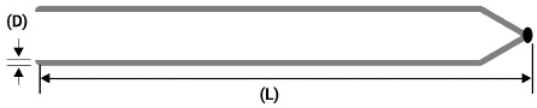
Contact Kamet for specific part numbers and specifications.



Bare wire thermocouple elements

We can supply un-sheathed bare wire thermocouple elements where quick response time and accurate easurements are critical.

Elements can be supplied in three (3) standard diameters, custom built to your length requirements.
Type S, R and B are supplied with a standard bead type junction, while tungsten rhenium types C and D (ARi type AE and AO) are supplied with our patented wire wound junction type (9.3)



Specify P/N	T-50994-(L)-(D)-Type
(L)	Length in inches
(D)	Diameter in inches
Type	S, R, B, C and D

The hot junction length for type C and D is included in the (L) total length in inches on your quotation.

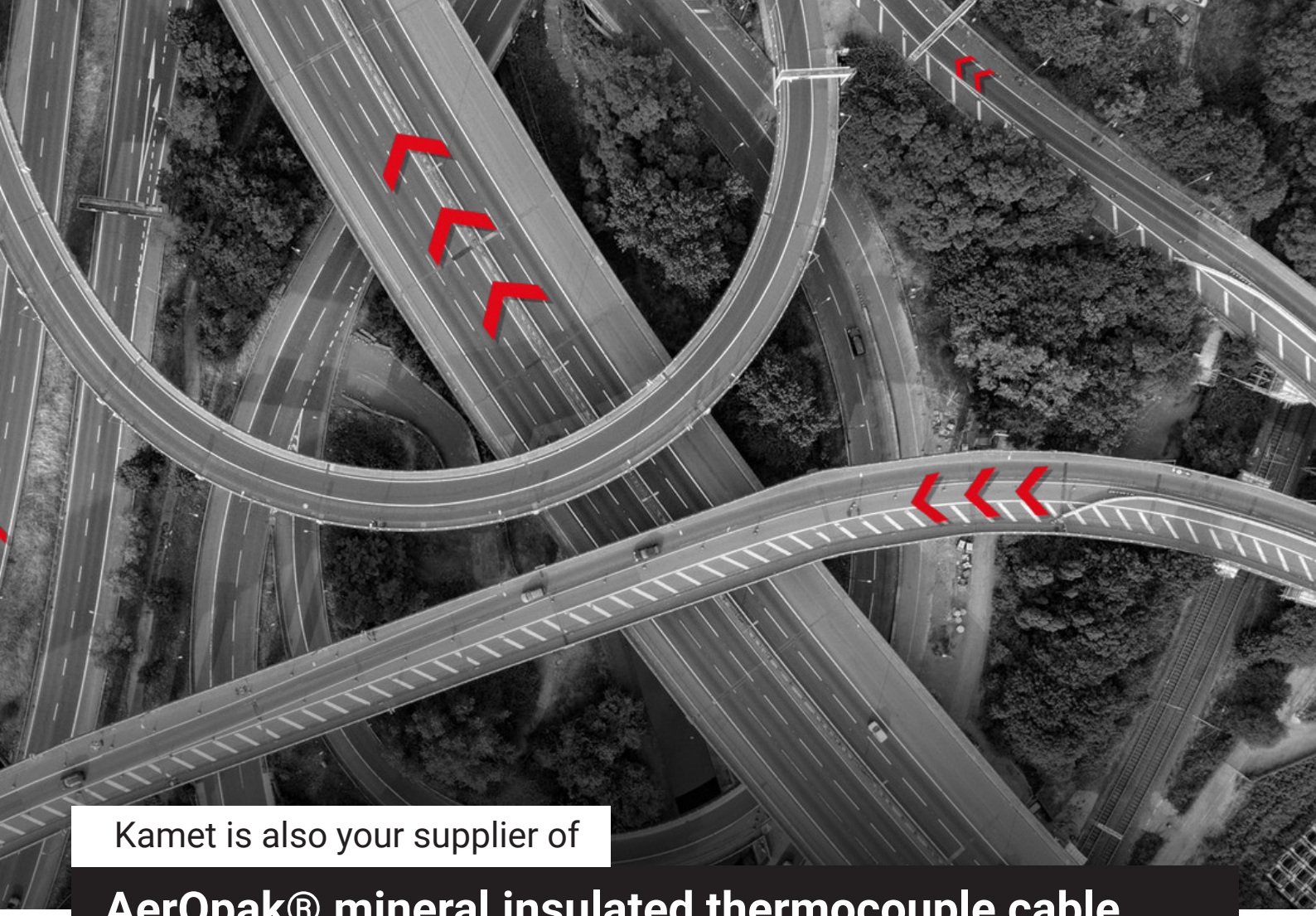
Special testing

Special non-destructive testing is available on in-process and finished thermocouple assemblies. For some assembly constructions, non-MI cable assemblies, ARi recommends to use the temperature calibration information from the supplier of the raw wires which can be supplied upon request. This is also especially advised when calibration over +1100°C is required.

Type of tests available include:

- **Temperature calibration, up to +1100°C** (temp vs. EMF)
- **Cryogenic calibration, Class 3 calibration, -196°C**
- **Radiography**
- **Liquid penetrant**
- **Helium leak**
- **Dimensional and Insulation resistance**
- **X-Ray**

All ARi standards are traceable to the National Institute of Standards and Technology (NIST). ARi's quality management system meets the requirements of ISO 9001, the certificate is available upon request or downloadable from our website.



Kamet is also your supplier of

AerOpak® mineral insulated thermocouple cable

AerOpak® is the trademark for our mineral insulated thermocouple cable. The construction of our MI cable consists of two conductors (sometimes even four, six or eight) of dissimilar alloys. These conductors are joined on the side on which temperature should be measured (hot junction). Properly joined, a voltage is produced that can be read to determine temperature (Seebeck effect). The conductors are insulated with high quality magnesium oxide and covered with a corrosion resistant sheath material, such as Inconel or Stainless steel. MI cables provide stable temperature measurement readings and are often used for high temperatures (up to 1250°C and even higher) in hazardous environments.

Do you have a question about MI Thermocouple Cable?

Check our website, email Kamet or call us on +31 (0) 85 040 27 00

Kamet

Kamet Trading B.V.
Tennesseedreef 6
NL-3565 CJ Utrecht
Netherlands