THORNE & DERRICK INTERNATIONAL
Thorne & Derrick
+44 (0) 191 490 1547
www.heatingandprocess.com

An introduction to the full range of services of the TRM Group including MICC Ltd and TET Ltd companies.

TRM GROUP

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TRM GROUP

Introduction

The TRM (Thermal Resources Management Ltd) Group of Companies including MICC Ltd and TET Ltd are manufacturers of the World's largest range Mineral Insulated heating, thermoelectric & fireproof wiring cables, along with CSA / ATEX approved Heating Elements, Temperature Measurement probes and assemblies and manufacturing equipment.

The TRM Group provide the unique 'all in one' solution of;

① Design ② Manufacture ③ Install

We can work with you on;

- Industrial Heating systems
- Temperature measurement solutions
- Enhanced Fire Survival wiring cable installations
- Special Mineral Insulated Cables
- Thermocouple manufacturing equipment

TRM GROUP

Introduction

We have the competitive advantage of being the UK's only full range manufacturer of mineral insulated cable.

We spend a great deal of time on new product development and have a special cell at our factory to focus on this category of work.

All our products are made in accordance with former BICC designs, specifications and we operate a typical common referencing system.

Our workforce comprises former BICC Senior Managers and technicians offering a wealth of experience in cable making and temperature application knowledge.

TRM GROUP

Introduction

We supply a wide range of industries including Oil & Gas, Petrochemical, Pharmaceutical, Refrigeration, Water, Food & Beverage, Transport, General Engineering, Chemical, Commercial Building and Power Generation.

We specialise in projects working in hazardous areas and supply to all UK Nuclear Power Station's.

We also supply to the Thermo-Solar Power Generation sector, partnering with market leaders in Europe and the United States.

On every production line, which can run 24hrs a day, you have up to 40 years experience on-hand at any one time, this guarantees that you receive the best quality products and the finest workmanship available.

TRM GROUP

Introduction

Offering optimum technical and economic solutions for the design, supply and installation of electrical trace heating systems. Our own specialist UK cable manufacturing plants support client needs for materials required to be installed on industrial projects.

From frost protection through to high temperature process applications our heating cables and temperature measurement products ensure client's needs are met and exceeded through each phase of the individual project.

TRM & MICC are directly approved to work on a multitude of major blue chip company sites and control numerous on site term contracts within the industries as described above.

TRM GROUP

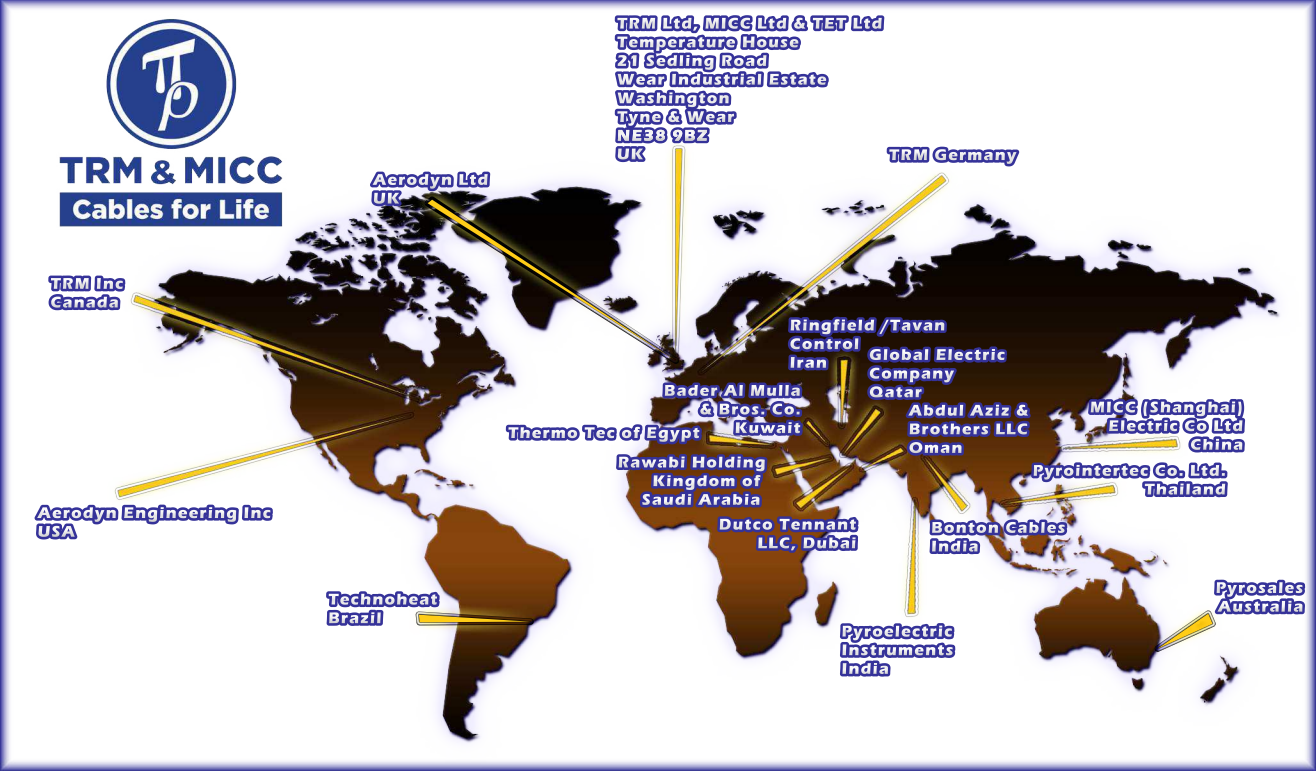
Introduction

Our services cover all aspects of a project from detailed design, manufacture, supply, installation and/or supervision through to annual audit and maintenance contracts.

Detailed as-built drawings and mechanical catalogues complement the installed system. To complete our comprehensive services portfolio we also design and supply custom built control systems.

Our Global Headquarters are based in Washington, Tyne & Wear, UK. We are proud to be a North East business and are North East England Ambassadors, helping promote and strengthen the regions image and supporting local businesses worldwide.

TRM GROUP


TRM & MICC
Cables for Life
TRM Ltd, MICC Ltd & TET Ltd
Temperature House
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
UK
TRM Germany
Aerodyn Ltd
UK
TRM Inc
Canada
Ringfield /Tavan
Control
Iran
Global Electric
Company
Qatar
Bader Al Mulla
& Bros. Co.
Kuwait
Abdul Aziz &
Brothers LLC
Oman
MICC (Shanghai)
Electric Co Ltd
China
Thermo Tec of Egypt
Rawabi Holding
Kingdom of
Saudi Arabia
Pyrointertec Co. Ltd.
Thailand
Aerodyn Engineering Inc
USA
Dutco Tennant
LLC, Dubai
Bonton Cables
India
Technoheat
Brazil
Pyrosales
Australia
Pyroelectric
Instruments
India

Company History

- TRM formed in Durham in November 2000
- MICC and TDI formed in July 2001
- Moved to Temperature House in October 2001
- TRM Germany established in October 2001
- MI Heat Sensors acquired in June 2003
- JV with Pyro Goa formed in May 2004
- TRM Inc formed in September 2004
- Gateshead plant opened in October 2005
- MI Cable projects Ltd formed in September 2006
- Aerodyn established in 2007
- TRM Shanghai established in 2008 (JV partner)

TRM GROUP

Company History

- Increased capacity and Nuclear product development & enhanced recovery projects 2009
- Formed TET Ltd through acquisition, industry leading thermocouple manufacturing equipment 2010
- Expanding operations into Oil Sands, Western Canada in 2010
- Expanding operations into new markets; Brazil and USA in 2011
- New product developments for Down-well and Automotive industry in 2011
- Expanded operations in Thermo-Solar Power Generation 2012
- Appointed Bader Al Mulla Bros, Kuwait & Global Electric Corp. Qatar in 2012
- Doubled output again in 2013 to satisfy global demand for our products!

TRM GROUP

Company History

- Largest MI Cable Plant in the world opens in June 2013.
- Appointed Dutco Tennant UAE 2013
- Won £1,200,000 Kuwait University Project for supply of MI Fire Survival Wiring Cable, 2014
- Appointed Rawabi Trading & Contracting. Saudi Arabia and Abdul Aziz & Brothers. Oman 2014
- Plan set in motion to double UK production output within 3 years, 2015.
- MICC Ltd gain KAHRAMAA project approval in Qatar, 2015.
- Plans undertaken to open a USA factory within 2 years, 2015.
- MICC Manufacturing Corporation (MMC) Founded in Ohio USA, 2016.

TRM GROUP

Standards and Approvals

- ISO 9001
- ISO 14001
- TS 16949
- CSA & ATEX

(Hazardous Area Approval for Heating elements and RTD's)

- LCPB (BS EN 60702-1 / BS 6387 / BS 5839-1)
- GDCD 16-3
- British Nuclear Group Technical Standard A.0359-10
- IEC 1515
- AMS2750 D

TRM GROUP

Power Generation

TRM and MICC are approved and established suppliers to the Nuclear and Power Generation industries, we have over 40 years of experience in design, manufacture and installation.

All our products are made in accordance with former BICC designs, specifications and operate a typical common referencing system. Our workforce comprises former BICC Senior Managers and technicians offering a wealth of experience in cable making and temperature application knowledge.

We are specialist suppliers of bespoke thermocouples and cables, harnesses, probes, heating cables & elements, for use in hazardous areas and complex high temperature situations.

TRM GROUP

Power Generation

TRM and MICC are members of;

- Nuclear Industry Association
- North East Chamber of Commerce
- North East Nuclear Supply Chain
- Institute of Measurement and Control

We can provide references of many successful projects including work for;

- British Nuclear Services Ltd
- Sellafield Ltd
- British Energy Ltd
- AMEC
- Strainstall UK Ltd
- Doosan Babcock Ltd

TRM GROUP

Power Generation

Typical temperature measurement applications

- Main water feed
- Emergency cooling water
- Pressure vessel cooling water
- Main steam header
- Performance rake – main steam
- Hot reheat header
- Cold reheat header
- Weld leakage monitors (collars)
- Primary header - main steam
- Secondary header - main steam
- Concrete surrounding outlet headers
- Steam valve metal and steam/valve passing
- Dump steam
- Start-up vessel
- De-aerator
- Steam trap passing

Power Generation

Further services

Leak Detection

⊙ Installation of unique small but durable and rugged modular sensing cables to the sub floor areas or following specific pipe routes in critical locations provides a cost effective and flexible system which in conjunction with microprocessor based alarm and locating modules enables leaks to be detected and accurately located immediately.

Benefits

⊙ Accurate location of water leaks, oil and other aqueous chemicals

⊙ Flexible and Adaptable

⊙ Prevention of damage to operating systems and infrastructure

⊙ Minimises business disruption and repair

⊙ Easy interface with BMS or main building alarm systems

⊙ Approved and Time proven products

TRM GROUP

Power Generation

Audit and Maintenance

⊙ All systems as described can require maintenance checks to ensure their optimum operational efficiently. We can devise an annual "Health Care Check" and alleviate pressures on plant operatives by taking care of a system maintenance program.

Hazardous Area

⊙ We specialise in the design, supply and installation of Hazardous Area Approved Trace Heating Systems.

System Efficiency

⊙ We work closely with you to design and install the most efficient system, saving capital costs, energy operating costs and whole of life term costs.

TRM GROUP

Mineral Insulated Cable

Mineral insulated (Magnesium Oxide insulant)

cable was first designed by Swiss Engineer Francois Borel in 1896.

The design was adopted by Pyrotenax France in 1932

and was acquired by BICC in 1947.

First plant built on the River Tyne manufactured MI cable for war ships - anti-mine applications.

In the 1950s it was further developed as a heating and thermocouple cable for the Nuclear Industry.

MI cables are still the only non-ageing fireproof cables and designed to transmit heat from the conductor to sheath.

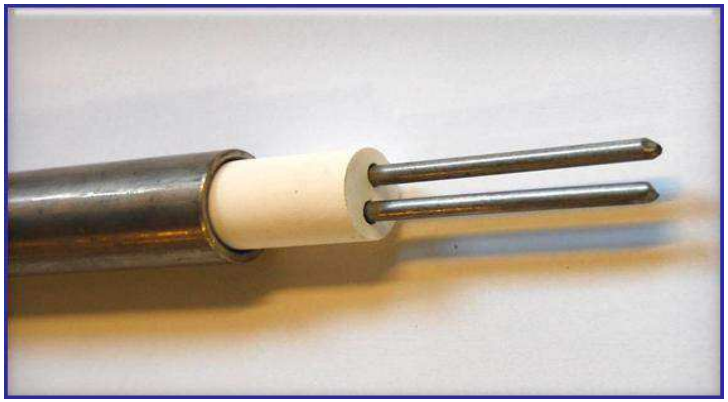
MICC Ltd

MICC Ltd specialises in the design and manufacture of metal sheathed, mineral insulated heating, transducer and thermocouple cables in our 45000 sq. ft. factory in Washington in the North East of the United Kingdom.

We can supply standard and special cable sizes and lengths to your requirements.

Our sister company TRM Ltd can manufacture finished units to your designs and requirements.

MICC Ltd is the UK's only manufacturer of Mineral Insulated Thermocouple, Heating, Transducer and Compensating cable.



TRM GROUP

MICC Ltd

MICC Ltd operates a large UK plant.

Temperature House in Washington.

Located in the North East of England.

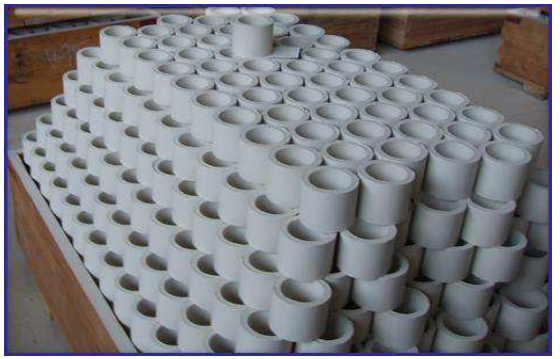
MICC Ltd are the worlds largest provider of stainless steel mineral insulated cable.

TRM GROUP

MICC Ltd

Since we supply thermocouples for installation in Nuclear power stations we are familiar with the need to use materials, especially powder, with very low levels of contaminant.

We understand the relative merits of powder-filling and block-filling cables – we do both.



TRM & MICC focus on solving specific customer problems, working closely with customer engineers.

TRM GROUP

MICC Ltd

Based on many years working at BICC, our highly experienced staff manufactures mineral insulated cables by a series of reductions from the original tube diameter. These reductions through a set of dies are lubricated in soap. No oil is used in the process of lubrication.

Cables manufactured using oil as a lubricant must be ‘pickled’ to remove the black surface finish or linished. Pickling requires a chemical process and chemicals that cannot be recycled. Linishing spreads cracks and risks weakness in the sheath.

The drawing process results in highly compacted insulant which in turn produces high thermal conductivity ensuring rapid thermal response.

MICC Ltd

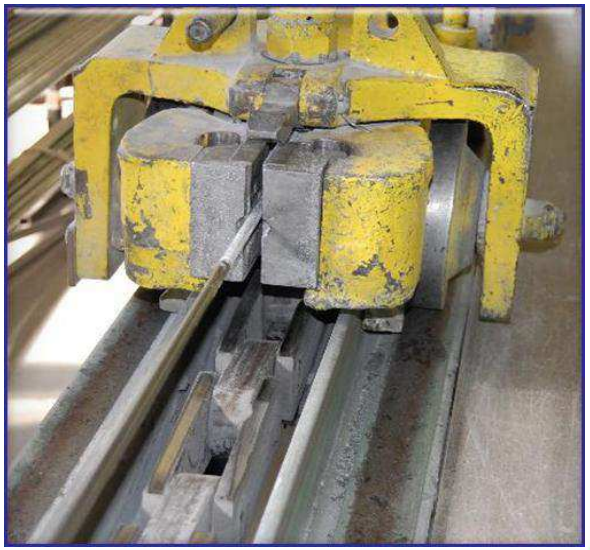
Our quality system ensures traceability of cable to sheath, conductor and insulant batches.

Coils are calibrated against standard thermocouples with a calibration record traceable back to the National Physical Laboratory.

Processing parameters have been developed and proven over many years.

In addition to EMF calibration each coil is tested for;

- Conductor integrity
- Sheath integrity
- Insulation resistance
- Conductor loop resistance
- Dimensions



TRM GROUP

MICC Ltd

Additional available tests include;

- Pressure tests to 400 psi
- X-ray
- Conductor ductility
- Sheath ductility

Our laboratory capacity meets the requirements of AMS 2750 D which requires calibration samples from both ends of a coil.

We can also provide an off-line production service for small batch production and trial works.

TRM GROUP

MICC Ltd

MICC Ltd, Washington, UK

MICC manufacture the World's largest range of Mineral Insulated heating, thermoelectric, compensating & Enhanced Fire Survival wiring cables along. TRM manufacture ATEX / CSA / IECEx approved Heating Elements, Temperature Measurement Probes & Assemblies. We are headquartered out of our Washington factory in the North East of the United Kingdom, with over 85 years manufacturing experience and many approvals including: ISO9001, ISO14001 and TS16949.

Cable Production:

Factory and office size:
= 45,000 sq. ft.

MI Cable Output capacity:

= Based on average to 3mm to 4mm cable diameter, the current production of cable is around 1 million meters.

Manufacturing Range:

Mineral Insulated Fire Survival Wiring Cable
Mineral Insulated Heating Cable
Mineral Insulated Thermocouple Cable

TRM GROUP

MICC Ltd

Standards / Approvals:
ISO9001
BSEN60702
LPCB
BS6387 / CWZ (On one cable)
ISO14001
TS16949

Experience:
85 years Ex-BICC Directors and staff using original BICC seamless tube design and manufacturing expertise

Final Test and Calibration Facilities:
High Voltage Test Cage > 2.5Kv
Water Immersion Test
Insulation Resistance Check
Diameter Check
Conductor Resistance Check
NPL traceable calibration equipment

TRM GROUP

Can TRM be a partner for your business?

Manufacturing the World's largest range of Mineral Insulated;

- Heating cable
- Thermoelectric cables
- Fireproof wiring cable
- CSA / ATEX approved Heating Elements and Temperature Measurement probes and assemblies.

TRM provide the unique 'all in one' solution of;

① Design ② Manufacture ③ Install

We can work with you on;

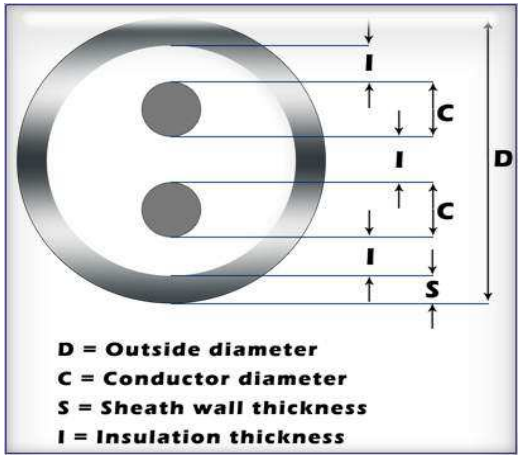
- Industrial Heating systems
- Temperature measurement solutions
- Enhanced Fire Survival wiring cable installations
- Special Mineral Insulated Cables

TRM GROUP

MI Thermocouple Cable

Cable Design

MICC Ltd UK Manufactures and supplies a comprehensive range of mineral insulated thermoelectric cables to meet the requirements and conditions of a wide range of temperature measurement applications.



Outside diameter of cable *(D)* Nominal ±tolerance mm	Sheath wall thickness *(S)* minimum mm	Diameter of conductor *(C)* minimum mm	Insulation thickness *(I)* minimum mm
0.5 ± 0.025	0.05	0.08	0.04
1.0 ± 0.025	0.10	0.15	0.08
1.5 ± 0.025	0.15	0.23	0.12
2.0 ± 0.025	0.20	0.30	0.16
3.0 ± 0.030	0.30	0.45	0.24
4.5 ± 0.045	0.45	0.68	0.36
6.0 ± 0.060	0.60	0.90	0.48
8.0 ± 0.080	0.80	1.20	0.64

MI Thermocouple Cable

MICC Ltd offers the best cable quality available, providing;

- High Purity MgO as Standard
- Fully Annealed and easy to use
- Fully Calibrated NOT batch calibration
- Oxide coated conductors to improve stability
- Made in the UK to original BICC designs, references, and specifications

MI Thermocouple Cable

Reference data

Cable Diameters	Inconel Range	AISI 310 Range	AISI 316 Range	AISI 321 Range	Nicrobell Range	446 Stainless Range	Hastalloy X Range	Alloy 825 Range
8	T2K-600-80	T2K-310-80	T2K-316L-80	T2K-321-80	T2K-NIC-80	T2K-446-80	T2K-HSX-80	T2K-825-80
6.4	T2K-600-64	T2K-310-64	T2K-316L-64	T2K-321-64	T2K-NIC-64			
6	T2K-600-60	T2K-310-60	T2K-316L-60	T2K-321-60	T2K-NIC-60	T2K-446-60	T2K-HSX-60	T2K-825-60
4.8	T2K-600-48	T2K-310-48	T2K-316L-48	T2K-321-48	T2K-NIC-48			
4.5	T2K-600-45	T2K-310-45	T2K-316L-45	T2K-321-45	T2K-NIC-45			
3.2	T2K-600-32	T2K-310-32	T2K-316L-32	T2K-321-32	T2K-NIC-32			
3	T2K-600-30	T2K-310-30	T2K-316L-30	T2K-321-30	T2K-NIC-30		T2K-HSX-30	T2K-825-30
2	T2K-600-20	T2K-310-20	T2K-316L-20	T2K-321-20	T2K-NIC-20			
1.6	T2K-600-16	T2K-310-16	T2K-316L-16	T2K-321-16	T2K-NIC-16			
1.5	T2K-600-15	T2K-310-15	T2K-316L-15	T2K-321-15	T2K-NIC-15			
1	T2K-600-10	T2K-310-10	T2K-316L-10	T2K-321-10	T2K-NIC-10			
The following duplex (4 core) cables are also available								
8	T4K-600-80	T4K-310-80	T4K-316L-80	T4K-321-80	T4K-NIC-80	T4K-446-80	T4K-HSX-80	T4K-825-80
6.4	T4K-600-64	T4K-310-64	T4K-316L-64	T4K-321-64	T4K-NIC-64			
6	T4K-600-60	T4K-310-60	T4K-316L-60	T4K-321-60	T4K-NIC-60	T4K-446-60	T4K-HSX-60	T4K-825-60
4.8	T4K-600-48	T4K-310-48	T4K-316L-48	T4K-321-48	T4K-NIC-48			
4.5	T4K-600-45	T4K-310-45	T4K-316L-45	T4K-321-45	T4K-NIC-45			
3.2	T4K-600-32	T4K-310-32	T4K-316L-32	T4K-321-32	T4K-NIC-32			
3	T4K-600-30	T4K-310-30	T4K-316L-30	T4K-321-30	T4K-NIC-30		T4K-HSX-30	T4K-825-30
2	T4K-600-20	T4K-310-20	T4K-316L-20	T4K-321-20	T4K-NIC-20			
1.6	T4K-600-16	T4K-310-16	T4K-316L-16	T4K-321-16	T4K-NIC-16			
1.5	T4K-600-15	T4K-310-15	T4K-316L-15	T4K-321-15	T4K-NIC-15			
1	T4K-600-10	T4K-310-10	T4K-316L-10	T4K-321-10	T4K-NIC-10			

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

RTD Data Sheet - Standard 3 & 4 Wire Assembly

To order please specify the following:

1. Part reference (see example below).
2. Design lengths usually specified in mm, including immersion or route length and tail length (see illustration).
3. Tail type (see table 3).
4. Seal type (see table 4).
5. Any accessories required e.g. Termination gland as illustrated.

Part Reference Example:

See table 1 for materials and specifications

P	T	D	4	T	60	B

Categorise Probe
Sheath Material
Conductor Material
Number of Conductors
RTD Category
Overall Cable Diameter x 10 (Metric)
Tolerance Class

Table 2 - Tolerance Class

Temperature °C	Class A		Class B	
	± °C	±Ω	± °C	±Ω
-200	0.55	0.24	1.3	0.56
-100	0.35	0.14	0.8	0.32
0	0.15	0.06	0.3	0.12
100	0.35	0.13	0.8	0.30
200	0.55	0.20	1.3	0.48
300	0.75	0.27	1.8	0.64
400	0.95	0.33	2.3	0.79
500	1.15	0.38	2.8	0.93
600	1.35	0.43	3.3	1.06
650	1.45	0.46	3.6	1.13
700	-	-	3.8	1.17
800	-	-	4.3	1.28
850	-	-	4.6	1.34

Table 1

Sheath Material	*Conductor Material*	*RTD Category*	*Cable Diameter*	*Tolerance Class*
C = Copper D = Cupro Nickel T = 316L S = 321	C = Copper D = Nickel R = Nickel-Chrome	R = Premium Grade T = Commercial Grade	4.5mm (45) 6.0mm (60)	A = Class A B = Class B

Table 3 Tail Type

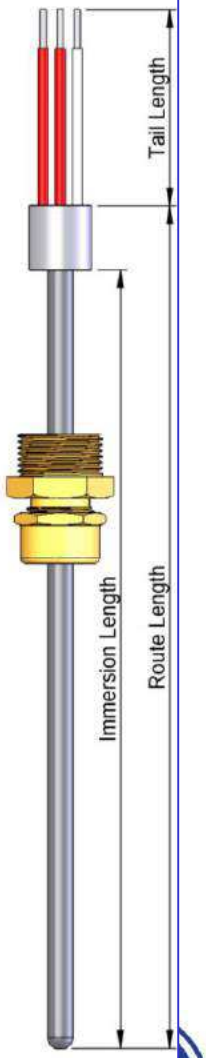
Type	Configuration	Colour Code
PTFE Insulated Flexible	3 Wire 4 Wire	2 Red & 1 White 2 Red & 2 White
PTFE Insulated Solid	3 Wire 4 Wire 3 Wire & Earth tail	2 Red & 1 White 2 Red & 2 White 2 Red, 1 White & 1 Green/Yellow

Table 4 Seal Type

Fitting	Type	Tail Type
Crimp	Plain	3 Wire flexible
Silver Solder	Plain	4 Wire flexible
	Plain	3 Wire solid 4 Wire solid
	Earth Tail	3 Wire & Earth tail solid

Table 5 Termination Fittings

Reference	Material	Tail Type
TGMV 45 16 TGMV 60 16	Brass	16mm ISO Metric
TGMV 45 20 TGMV 60 20	Brass	20mm ISO Metric
TGMVS 45 16 TGMVS 60 16	Stainless Steel	16mm ISO Metric
TGMVS 45 20 TGMVS 60 20	Stainless Steel	20mm ISO Metric
Pressure entry fittings e.g. BSPT are also available on request		



Notes.

RTD probes manufactured to IEC751.

Tolerance classes are to BS1904:1984-IEC751:1983.

Minimum immersion length = 100mm.

Standard tail length = 150mm

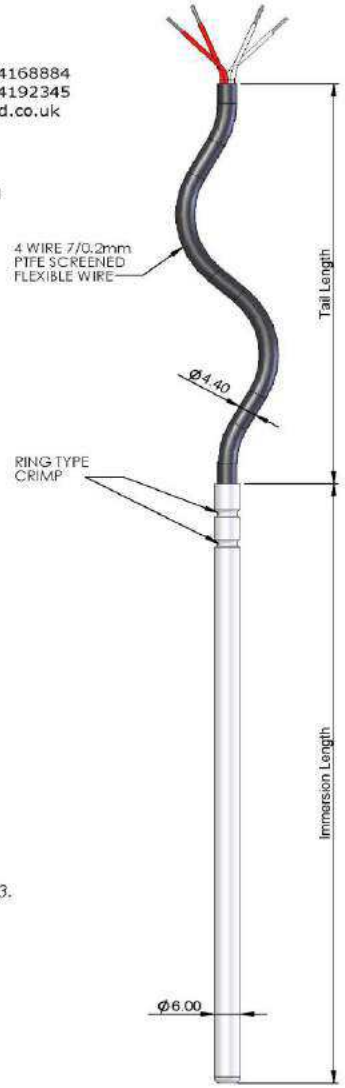
Maximum operating temperature = 550°C

Minimum operating temperature: Grade A = -196°C
Grade B = 0°C

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

RTD Data Sheet - Non MI Construction
RTD Assembly



Assembly Details:

Tube Material: 316 Stainless Steel.

Pt100 Detector: Thin Film Class 'A'

Part Reference: Pt100-Flexible

Table 1 - Tolerance Class

Temperature °C	Class A		Class B	
	±°C	±Ω	±°C	±Ω
-200	0.55	0.24	1.3	0.56
-100	0.35	0.14	0.8	0.32
0	0.15	0.06	0.3	0.12
100	0.35	0.13	0.8	0.30
200	0.55	0.20	1.3	0.48
300	0.75	0.27	1.8	0.64
400	0.95	0.33	2.3	0.79

Notes.

RTD probes manufactured to IEC751.

Tolerance classes are to BS1904:1984-IEC751:1983.

Minimum immersion length = 100mm.

Maximum immersion length = 300mm.

Standard tail length = 1000mm

Maximum operating temperature = 250°C

Minimum operating temperature = 0°C

 www.temperature-house.com

TRM GROUP

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
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Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

RTD Data Sheet - Standard 3 & 4 Wire Assembly

To order please specify the following:

1. Part reference (see example below).
2. Design lengths usually specified in mm, including immersion or route length and tail length (see illustration).
3. Tail type (see table 3).
4. Seal type (see table 4).
5. Any accessories required e.g. Termination gland as illustrated.

Part Reference Example:
See table 1 for cables and specifications

P 4 D - 316L - 60

- Categorise Probe
- Number of Conductors
- Conductor Material
- Sheath Material
- Overall Cable Diameter x 10 (Metric)

Table 2 - Tolerance Class

Temperature °C	Class A ±°C	Class A ±Ω	Class B ±°C	Class B ±Ω
-200	0.55	0.24	1.3	0.56
-100	0.35	0.14	0.8	0.32
0	0.15	0.06	0.3	0.12
100	0.35	0.13	0.8	0.30
200	0.55	0.20	1.3	0.48
300	0.75	0.27	1.8	0.64
400	0.95	0.33	2.3	0.79
500	1.15	0.38	2.8	0.93
600	1.35	0.43	3.3	1.06
650	1.45	0.46	3.6	1.13
700	-	-	3.8	1.17
800	-	-	4.3	1.28
850	-	-	4.6	1.34

Table 1

Sheath Material	*Conductor Material*	*RTD Category*	*Cable Diameter*	*Tolerance Class*
C = Copper D = Cupro Nickel T = 316L S = 321	C = Copper D = Nickel R = Nickel-Chrome	R = Premium Grade T = Commercial Grade	4.5mm (45) 6.0mm (60)	A = Class A B = Class B

Table 3 Tail Type

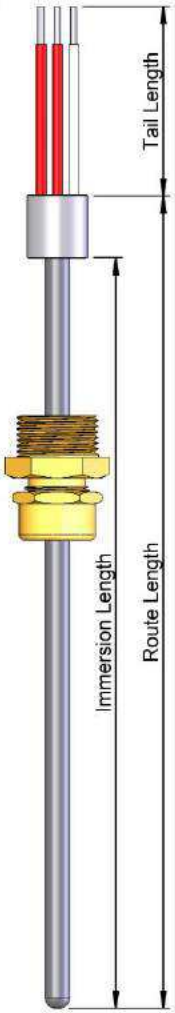
Type	Configuration	Colour Code
PTFE Insulated Flexible	3 Wire 4 Wire	2 Red & 1 White 2 Red & 2 White
PTFE Insulated Solid	3 Wire 4 Wire 3 Wire & Earth tail	2 Red & 1 White 2 Red & 2 White 2 Red, 1 White & 1 Green/Yellow

Table 4 Seal Type

Fitting	Type	Tail Type
Crimp	Plain	3 Wire flexible
Silver Solder	Plain	4 Wire flexible
	Plain	3 Wire solid 4 Wire solid
	Earth Tail	3 Wire & Earth tail solid

Table 5 Termination Fittings

Reference	Material	Tail Type
TGMV 45 16 TGMV 60 16	Brass	16mm ISO Metric
TGMV 45 20 TGMV 60 20	Brass	20mm ISO Metric
TGMVS 45 16 TGMVS 60 16	Stainless Steel	16mm ISO Metric
TGMVS 45 20 TGMVS 60 20	Stainless Steel	20mm ISO Metric
Pressure entry fittings e.g. BSPT are also available on request		



Notes.

RTD probes manufactured to IEC751.

Tolerance classes are to BS1904:1984-IEC751:1983.

Minimum immersion length = 100mm.

Standard tail length = 150mm

Maximum operating temperature = 550°C

Minimum operating temperature: Grade A = -196°C
Grade B = 0°C

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email:sales@trmltd.co.uk

Thermocouple Probe Data Sheet - 0.5 to 3.0mm Type K, J, T, E or N Thermocouples Terminated with Plain Seal

To order please specify the following:

1. Part reference (see example).
2. Design lengths specified in mm, including immersion length and tail length.
3. Type of junction -insulated (IJ) or bonded (BJ).
4. Any accessories required e.g. Lock nuts or termination glands.
5. Any special test requirements.

Part Reference Example:
See table 1 for cables and specifications

P 2 K - 321 - 15 S

- P — Categorise Probe
- 2 — Number of Conductors
- K — Conductor Material
- 321 — Sheath Material
- 15 — Overall Cable Diameter x 10 (Metric)
- S — EMF Tolerance

Junction Types.

IJ - Insulated junction. Conductors welded together and insulated from sheath.

BJ - Bonded Junction. Conductors and sheath welded together.

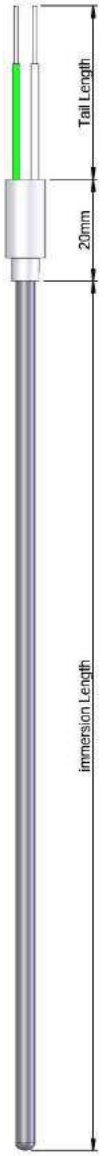


Table 1

Type K - Nickel Chromium/Nickel Aluminium Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Alloy 600 / AISI 310 — Maximum Operating Temperature: 800 / 1100 / 1100 — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
0.5	0.02	2	T2K-321-05S	T2K-600-05S	T2K-310-05S	126.00	0.10
1.0	0.02	2	T2K-321-10S	T2K-600-10S	T2K-310-10S	31.50	0.20
1.5	0.03	2	T2K-321-15S	T2K-600-15S	T2K-310-15S	14.00	0.30
2.0	0.03	2	T2K-321-20S	T2K-600-20S	T2K-310-20S	7.90	0.40
3.0	0.03	2	T2K-321-30S	T2K-600-30S	T2K-310-30S	3.50	0.60
3.0	0.03	4	T4K-321-30S	T4K-600-30S	T4K-310-30S	10.90	0.34

Type J - Iron/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Alloy 600 / - — Maximum Operating Temperature: 750 / 750 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.5	0.02	2	T2J-321-15S	T2J-600-15S	-	8.48	0.30
2.0	0.03	2	T2J-321-20S	T2J-600-20S	-	4.78	0.40
3.0	0.03	2	T2J-321-30S	T2J-600-30S	-	2.10	0.60
3.0	0.03	4	T4J-321-30S	T4J-600-30S	-	6.60	0.34

Type T - Copper/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Cupro Nickel / - — Maximum Operating Temperature: 400 / 400 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.5	0.02	2	T2T-321-15S	-	-	7.18	0.30
3.0	0.03	2	T2T-321-30S	-	-	1.80	0.60
1.5	0.02	2	-	T2T-400-15S	-	5.59	0.34
3.0	0.03	2	-	T2T-400-30S	-	1.15	0.75

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email:sales@trmltd.co.uk

Table 1 Cont.

Type E - Nickel Chromium/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / - / - — Maximum Operating Temperature: 800 / - / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.0	0.02	2	T2E-321-10S	-	-	37.90	0.20
1.5	0.03	2	T2E-321-15S	-	-	16.80	0.30
2.0	0.03	2	T2E-321-20S	-	-	9.50	0.40
3.0	0.03	2	T2E-321-30S	-	-	4.20	0.60

Type N - Nicrosil/Nsil Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: Alloy 600 / Nicrobell / - — Maximum Operating Temperature: 1100 / 1280 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.0	0.02	2	T2N-600-10S	T2N-NC-10S	-	43.48	0.20
1.5	0.03	2	T2N-600-15S	T2N-NC-15S	-	19.32	0.30
2.0	0.03	2	T2N-600-20S	T2N-NC-20S	-	10.90	0.40
3.0	0.03	2	T2N-600-30S	T2N-NC-30S	-	4.83	0.60
3.0	0.03	4	T4N-600-30S	T4N-NC-30S	-	15.05	0.34

Table 3 - Thermocouple EMF Tolerances

Cond. Config.	Tolerances: Class 1 (S*)	Class 2 (SS*)
K & N	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
J	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
T	±0.5°C from 40°C to 125°C ±0.4% above 125°C	±1.0°C from 40°C to 333°C ±0.75% above 183°C
E	±1.5°C from 40°C ±0.4% above 375°C	±2.5°C from 40°C ±0.75% above 333°C

**Where class 2 cable is required the final letter of cable/probe reference (nominally 'S') is replaced with 'SS'*

Table 2 - Insulation Colour Coding for Flexible Thermocouple Tails

Conductor Configuration		IEC 584		BS 1843		ANSI MC96		DIN 43714		NFC 42-324	
Type	Mat'l	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.
K	NiCR+ / NiAL-										
J	Iron+ / Con-										
T	Copper+ / Con-										
E	NiCR+ / Con-										
N	Nicrosil+ / Nisil-										

Notes

Minimum immersion length is 100mm

ISO termination is sealed with epoxy resin as standard. Maximum operating temperature of seal: Alternative resins available on request.

Flexible stranded tails are available with PVC or PTFE IEC colour coded insulation as standard. Other materials and colour coding available on request.

EMF Characteristic: B nominal EMF to IEC 584-3.

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TRM GROUP

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

Thermocouple Probe Data Sheet - 0.5 to 3.0mm Type K, J, T, E or N Thermocouples Terminated with 8mm ISO Seal

To order please specify the following:

1. Part reference (see example).
2. Design lengths specified in mm, including immersion length and tail length.
3. Type of junction -insulated (IJ) or bonded (BJ).
4. Any accessories required e.g. Lock nuts or termination glands.
5. Any special test requirements.

Part Reference Example:
See table 1 for cables and specifications

P 2 K - 321 - 15 S

- Categorise Probe
- Number of Conductors
- Conductor Material
- Sheath Material
- Overall Cable Diameter x 10 (Metric)
- EMF Tolerance

Junction Types.

IJ - Insulated junction. Conductors welded together and insulated from sheath.

BJ - Bonded Junction. Conductors and sheath welded together.

8mm ISO Lock nuts can be supplied to terminate the thermocouple as necessary

Table 1

Type K - Nickel Chromium/Nickel Aluminium Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Alloy 600 / AISI 310 — Maximum Operating Temperature: 800 / 1100 / 1100 — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
0.5	0.02	2	TZK-321-05S	TZK-600-05S	TZK-310-05S	126.00	0.10
1.0		2	TZK-321-10S	TZK-600-10S	TZK-310-10S	31.50	0.20
1.5		2	TZK-321-15S	TZK-600-15S	TZK-310-15S	14.00	0.30
2.0	0.03	2	TZK-321-20S	TZK-600-20S	TZK-310-20S	7.90	0.40
3.0		2	TZK-321-30S	TZK-600-30S	TZK-310-30S	3.50	0.60
3.0		4	T4K-321-30S	T4K-600-30S	T4K-310-30S	10.90	0.34

Type J - Iron/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Alloy 600 / - — Maximum Operating Temperature: 750 / 750 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.5	0.02	2	TZJ-321-15S	TZJ-600-15S	-	8.48	0.30
2.0		2	TZJ-321-20S	TZJ-600-20S	-	4.78	0.40
3.0	0.03	2	TZJ-321-30S	TZJ-600-30S	-	2.10	0.60
3.0		4	T4J-321-30S	T4J-600-30S	-	6.60	0.34

Type T - Copper/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Cupro Nickel / - — Maximum Operating Temperature: 400 / 400 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.5	0.02	2	TZT-321-15S	-	-	7.18	0.30
3.0	0.03	2	TZT-321-30S	-	-	1.80	0.60
1.5	0.02	2	-	TZT-400-15S	-	5.59	0.34
3.0	0.03	2	-	TZT-400-30S	-	1.15	0.75

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

Table 1 Cont.

Type E - Nickel Chromium/Constantan Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / - / - — Maximum Operating Temperature: 800 / - / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.0	0.02	2	TZE-321-10S	-	-	37.90	0.20
1.5		2	TZE-321-15S	-	-	16.80	0.30
2.0	0.03	2	TZE-321-20S	-	-	9.50	0.40
3.0		2	TZE-321-30S	-	-	4.20	0.60

Type N - Nicrosil/Nisil Conductors

Overall Diameter mm	±	Number of Conductors	Sheath Material: Alloy 600 / Nicrobell / - — Maximum Operating Temperature: 1100 / 1280 / - — Cable Ref.			Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
1.0	0.02	2	T2N-600-10S	T2N-NC-10S	-	43.48	0.20
1.5		2	T2N-600-15S	T2N-NC-15S	-	19.32	0.30
2.0	0.03	2	T2N-600-20S	T2N-NC-20S	-	10.90	0.40
3.0		2	T2N-600-30S	T2N-NC-30S	-	4.83	0.60
3.0		4	T4N-600-30S	T4N-NC-30S	-	15.05	0.34

Table 3 - Thermocouple EMF Tolerances

Cond. Config.	Tolerances: Class 1 (S*)	Class 2 (SS*)
K & N	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
J	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
T	±0.5°C from 40°C to 125°C ±0.4% above 125°C	±1.0°C from 40°C to 333°C ±0.75% above 183°C
E	±1.5°C from 40°C ±0.4% above 375°C	±2.5°C from 40°C ±0.75% above 333°C

**Where class 2 cable is required the final letter of cable/probe reference (nominally 'S') is replaced with 'SS'*

Table 2 - Insulation Colour Coding for Flexible Thermocouple Tails

Conductor Configuration		IEC 584		BS 1843		ANSI MC96		DIN 43714		NFC 42-324	
Type	Mat'l	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.
K	NiCR+										
	NiAL-										
J	Iron+										
	Con-										
T	Copper+										
	Con-										
E	NiCR+										
	Con-										
N	Nicrosil+										
	Nisil-										

Notes

Minimum immersion length is 100mm

ISO termination is sealed with epoxy resin as standard. Maximum operating temperature of seal: Alternative resins available on request.

Flexible stranded tails are available with PVC or PTFE IEC colour coded insulation as standard. Other materials and colour coding available on request.

EMF Characteristic: B nominal EMF to IEC 584-3.

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TRM GROUP

MI Thermocouple & RTD Units

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email:sales@trmltd.co.uk

Thermocouple Probe Data Sheet - 3.0mm, 4.5mm & 6.0mm Type K, J, T, E or N Thermocouples Terminated with Transmitter Mounting Plate

To order please specify the following:

1. Part reference (see example).
2. Design lengths specified in mm, including immersion length and tail length.
3. Type of junction -insulated (IJ) or bonded (BJ).
4. Any accessories required e.g. Lock nuts or termination glands.
5. Any special test requirements.

Part Reference Example:

See table 1 for cables and specifications

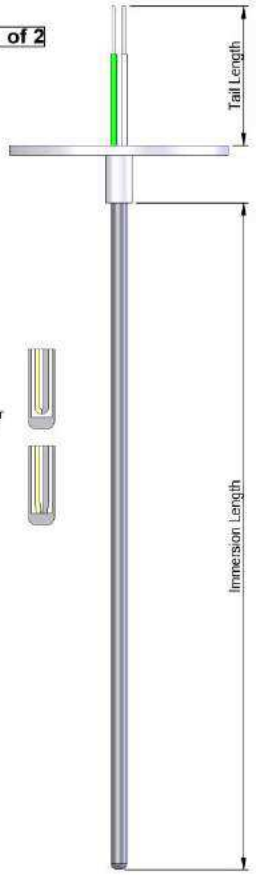
P 2 K - 321 - 60 S

- Categorise Probe
- Number of Conductors
- Conductor Material
- Sheath Material
- Overall Cable Diameter x 10 (Metric)
- EMF Tolerance

Junction Types.

IJ - Insulated junction. Conductors welded together and insulated from sheath.

BJ - Bonded Junction. Conductors and sheath welded together.



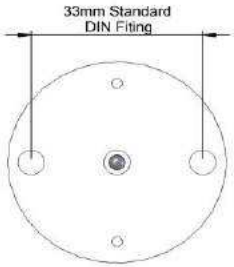


Table 1

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Maximum Operating Temperature 800 / Cable Ref.	Sheath Material: Alloy 600 / Maximum Operating Temperature 1100 / Cable Ref.	Sheath Material: AISI 310 / Maximum Operating Temperature 1100 / Cable Ref.	Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
Type K- Nickel Chromium/Nickel Aluminium Conductors							
3.0	0.03	2	T2K-321-30S	T2K-600-30S	T2K-310-30S	3.50	0.60
3.0		4	T4K-321-30S	T4K-600-30S	T4K-310-30S	10.90	0.34
4.5		2	T2K-321-45S	T2K-600-45S	T2K-310-45S	1.96	0.90
6.0		2	T2K-321-60S	T2K-600-60S	T2K-310-60S	0.88	1.20
6.0	0.05	4	T4K-321-60S	T4K-600-60S	T4K-310-60S	2.73	0.68
6.0		6	T6K-321-60S	T6K-600-60S	T6K-310-60S	10.90	0.68
Type J - Iron/Constantan Conductors							
3.0	0.03	2	T2J-321-30S	T2J-600-30S	-	2.10	0.60
3.0		4	T4J-321-30S	T4J-600-30S	-	6.60	0.34
4.5		2	T2J-321-45S	T2J-600-45S	-	0.94	0.90
4.5		4	T4J-321-45S	T4J-600-45S	-	2.94	0.51
6.0	0.05	2	T2J-321-60S	T2J-600-60S	-	0.53	1.20
6.0		4	T4J-321-60S	T4J-600-60S	-	1.65	0.68
Type T - Copper/Constantan Conductors							
3.0	0.03	2	T2T-321-30S	-	-	1.80	0.60
6.0	0.05	2	T2T-321-60S	-	-	0.45	1.20
3.0	0.03	2	-	T2T-400-30S	-	1.15	0.75
6.0	0.05	2	-	T2T-400-60S	-	0.29	1.50

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email:sales@trmltd.co.uk

Table 1 Cont.

Overall Diameter mm	±	Number of Conductors	Sheath Material: AISI 321 / Maximum Operating Temperature 800 / Cable Ref.	Sheath Material: Alloy 600 / Maximum Operating Temperature 1100 / Cable Ref.	Sheath Material: Nicrobell / Maximum Operating Temperature 1280 / Cable Ref.	Nominal Loop Resistance Ω/m@20°C	Nominal Conductor Diameter mm
Type E - Nickel Chromium/Constantan Conductors							
3.0	0.03	2	T2E-321-30S	-	-	4.20	0.60
4.5		2	T2E-321-45S	-	-	1.87	0.90
6.0	0.05	2	T2E-321-60S	-	-	1.05	1.20
Type N - Nicrosil/Nisil Conductors							
3.0	0.03	2	T2N-600-30S	T2N-NIC-30S	-	4.89	0.60
3.0		4	T4N-600-30S	T4N-NIC-30S	-	15.05	0.34
4.5		2	T2N-600-45S	T2N-NIC-45S	-	2.15	0.90
4.5		4	T4N-600-45S	T4N-NIC-45S	-	6.69	0.51
6.0	0.05	2	T2N-600-60S	T2N-NIC-60S	-	1.21	1.2
6.0		4	T4N-600-60S	T4N-NIC-60S	-	3.76	0.68

Table 3 - Thermocouple EMF Tolerances

Cond. Config.	Tolerances: Class 1 (S*)	Tolerances: Class 2 (SS*)
K & N	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
J	±1.5°C from 40°C to 375°C ±0.4% above 375°C	±2.5°C from 40°C to 333°C ±0.75% above 333°C
T	±0.5°C from 40°C to 125°C ±0.4% above 125°C	±1.0°C from 40°C to 333°C ±0.75% above 183°C
E	±1.5°C from 40°C ±0.4% above 375°C	±2.5°C from 40°C ±0.75% above 333°C

*Where class 2 cable is required the final letter of cable/probe reference (nominally 'S') is replaced with 'SS'

Table 2 - Insulation Colour Coding for Flexible Thermocouple Tails

Conductor Configuration		IEC 584		BS 1843		ANSI MC96		DIN 43714		NFC 42-324	
Type	Mat'l	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.	Sheath	Cond.
K	NiCR + NiAL-										
J	Iron + Con -										
T	Copper+ Con -										
E	NiCR+ Con -										
N	Nicrosil+ Nisil-										

Notes.

Minimum immersion length is 100mm

ISO termination is sealed with epoxy resin as standard. Maximum operating temperature of seal: Alternative resins available on request.

Flexible stranded tails are available with PVC or PTFE IEC colour coded insulation as standard. Other materials and colour coding available on request.

EMF Characteristic: B nominal EMF to IEC 584-3.

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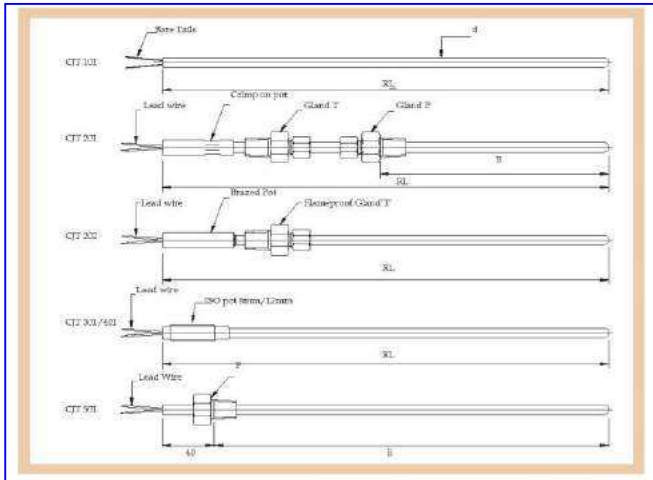
MI Thermocouple & RTD – 100 Series



100# Series

Thermocouple & Resistance Thermometer Inserts/probes

- Manufactured as per IEC 1515-1995
- Metal Sheathing and mineral insulation reduces overall size of inserts.
- Can be used at relatively higher temperatures.
- Pliable and can be routed through high temperature environment.
- Available with a choice of cold end termination (CJTs) and connectors.
- Certified for use in hazardous area.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia
1.5	1.5mm
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm
10	10.0mm
12	12.0mm

Code	Sheath Material
316	316SS
321	321SS
446	446SS
Inc	Inconel 600

Code	Options
0	None
15	Grounded Junction

Code	Mounting Threads
P/T	1/4", ½"NPT or M20x1.5
C	Not applicable

Code	Lead wire types
1	PTFE insulated
2	PTFE with SS over braid
3	PTFE with SS flexhose
4	PTFE + FG with SS over braid
5	PTFE + FG with SS Flexhose

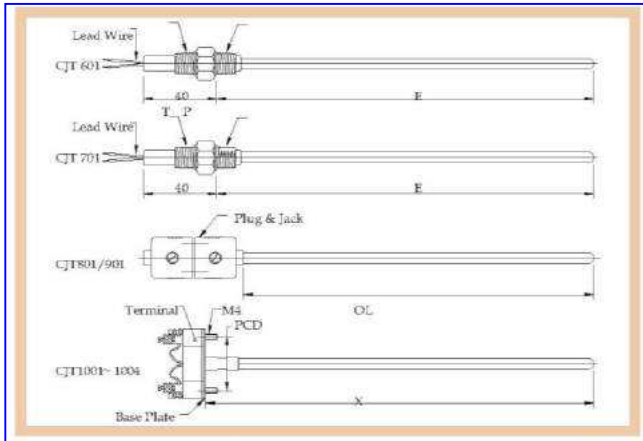
Code	Lead wire length
A	Standard length 150mm
B	Longer length (define)
C	None, bare tails

Code	Length of Insert/Probe
RL	Route length
'E'	Length inclusive of connector threads
'X'	Length below base plate of terminal Block

Code	CJT Details	Code	CJT Details
CJT 101	None, hot end junction made & baretails	CJT 701	Crimp-on pot + Spring loaded connector both sided
CJT 201	Crimp-on Pot with lead wire	CJT 801	Miniature Plug & Jack
CJT 301	Brazed pot with flameproof(EExd IIC) gland	CJT 901	Standard Plug and jack
CJT 401	12mm ISO pot with lead wire	CJT1001	Spring loaded Terminal block OD=41, PCD=33
CJT 501	Crimp-On pot + Fixed connector P on one side	CJT1001	SS Base plate OD=41, PCD=33
CJT801	Crimp-On pot + Fixed connector P&T on both side	CJT1001	SS Base plate OD=55, PCD=46

ORDERING EXAMPLE

100# SERIES 1-K-6-316-CJT101-RL-A-1-C-Op0



100# Series

Thermocouple & Resistance Thermometer Inserts/Probes

- Available in ANSI TC Types J,K,T,E,N,R,S & B (IEC- 584-Part 1,2, &3
- Pt100 RTDs to IEC 751- 1995
- Ungrounded Hot junction as a standard feature.
- Integral lead wires with PTFE or fiberglass insulation
- Special designs to suit Your applications.

Mi Thermocouple sensors employ a metal sheathed, Mineral insulated cable with matched Thermocouple conductors. The insulation is a compacted mass of MgO and this heterogencus cable, when converted into a Thermocouple sensor offers many unique advantages over the conventional ceramic bead insulated Thermocouples. Mi Thermocouple sensors are pliable, can be bent, coiled, routed through bends or intricate paths, bundled together to form a Multiple sensor assembly or welded to a tube or any surface to measure skin temperatures. The junction and Thermocouple conductors are not exposed to process fluids thus ensuring a longer usable life

Mi Thermocouples sensors are generally supplied with their hot junction isolated or ungrounded from the sheath. This enables the users to carry out periodical checking of the Thermocouple sensors. Bonded or grounded junction sensors are also supplied against request

Mi Resistance Thermometer sensor incorporates a wire wound element conforming to IEC 751 Class "A" or "B". The element leads are extended to the open end of the sensor by means of a Mi Transducer lead out cable employing Nickel conductors, compact mass of MgO as insulation and stainless steel sheath conforming to AISI 316. The standard overall sheath diameter available are 6mm, 4.8mm and 3.2mm.

Sensors, when built, are subject to all the routine tests as per IEC 751-1995. Type tests and any other special test can be carried out by mutual agreement.

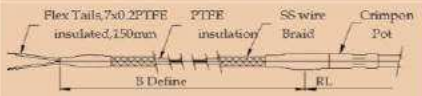
MI TC CABLE DETAILS (BASE METAL Tc's)

	ANSI Type	Sheath dia	Wire dia
SINGLE	J,K,T,E,N	3.0	0.6
		4.5	0.9
		6.0	1.2
		8.0	1.6
DUPLEX	J,K,T,E,N	3.0	0.5
		4.5	0.5
		6.0	0.9
		8.0	1.2

LEAD OUT CABLE DETAILS

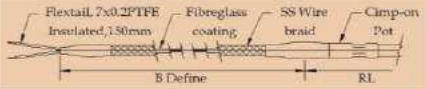
CODE 1: PTFE Insulated Lead wires

CODE 2: PTFE Insulated Lead wires with SS Over braid

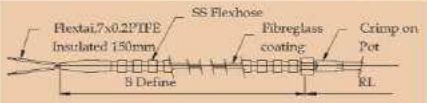


CODE 3: PTFE Insulated Lead wires with SS Flexhose

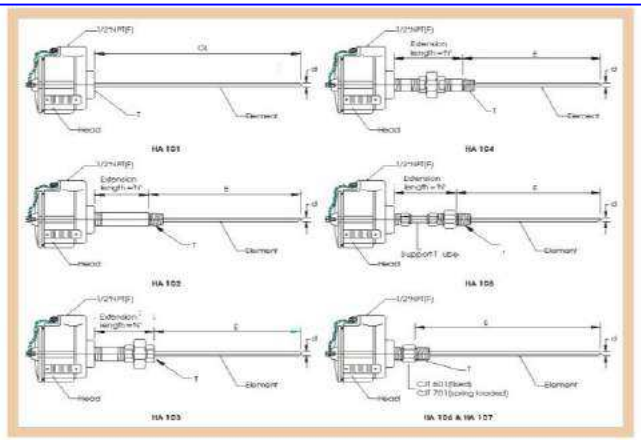
CODE 4: PTFE + FG With SS Over Braid



CODE 5: PTFE + FG With SS Flexhose



MI Thermocouple & RTD – 100 Series



110# Series

Thermocouple & Resistance Thermometer Assemblies less well

- Suitable for replacement for existing installations.
- Various head assembly types to choose from.
- Certified for use in hazardous area.
- Terminal head in die cast Aluminum or in 316SS.
- Available with "in-head" 2-wire Temperature Transmitter.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia
1.5	1.5mm
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm
10	10.0mm
12	12.0mm

Code	Sheath Material
316	316SS
321	321SS
446	446SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Mounting Threads
1	½"NPT(F)
2	½"NPT(M)
3	M20x1.5(F)
4	M20x1.5(M)
5	½"BSP(F)
6	½"BSP(M)
7	Other (Define)

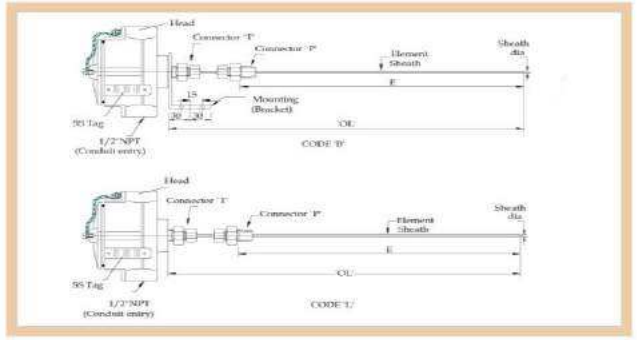
Code	Length 'N'
A	Standard length of 150mm
B	Define 'N'
C	None

Code	Length of insert / Probe
E	Length inclusive of threads 'T'
OL	Overall length

Code	Head Assembly
HA101	Head only with female threads 'T'
HA102	Head-Nipple with male threads 'T'
HA103	Head-Nipple-Union with female Threads 'T'
HA104	Head-Nipple-Union-Nipple with Male threads 'T'
HA105	Head with support Tube and Connector 'T'
HA106	Head with insert CJT 601
HA107	Head with insert CJT 701

ORDERING EXAMPLE

110# SERIES 1-Pt-6-316-D-1-HA105-E-N=75-3-Op0



120# Series

Thermocouple & Resistance Thermometer Assemblies less well

- With choice of adjustable connectors.
- Long Pliable MI lead out, where required for intricate installation and high temperature route.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature. Transmitter.

Mi Thermocouple or Resistance Thermometers can be provided with a long MI Lead out cable to enable its usage in intricate installations and in high temperature environment.

Typical application are, turbine casing, SH/RH and drum metal temperature measurements in power plants and measurement of temperature in high temperature application in Fertiliser and Petrochemical plants.

These thermocouples can be provided with suitable connectors, flame proof packing glands, weld pads and other accessories for particular use.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
Pt	Pt100 RTD

Code	Sheath Dia
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm

Code	Sheath Material
316	316SS
321	321SS
446	446SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
13	Weld pad
14	Weld clamps
15	Grounded junction

Code	Element length
E	Immersion
OL	Overall length

Code	Connector 'P'
1/4"N	1/4"NPT
½"N	½" NPT
M20	M20x1.5

Other sizes are also available. Please specify

Code	Connector 'T'
M20	M20x1.5
½"B	½" BSP
½" N	½" NPT

Other sizes are also available. Please specify

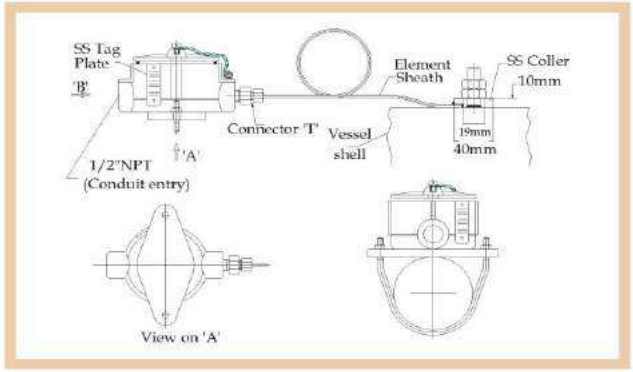
Code	Head Assembly
S	Surface Mounting for JB
B	Bracket mounting for Head
P	2"Nb Pipe Mounting
L	Local mounting without bracket.

ORDERING EXAMPLE

120# SERIES 2-K.6-316-D-2.B-1/2"B-1/2"N-OL=15M-Op13,14

TRM GROUP

MI Thermocouple & RTD – 100 Series



121# Series

Thermocouple & Resistance Thermometer Assemblies with

- Integral Coller.
- Long Pliable MI lead out, ideal for skin Temperature measurement.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.
- Bracket mounting or 2"Nb pipe mounting.

Mi Thermocouple or Resistance Thermometers can be provided with a long MI Lead out cable to enable its usage in intricate installations and in high temperature environment. An integral coller enables the Thermocouple to be fitted on the vessel/reactor surface.

Typical application are measurement of surface temperature of refractory lined vessels, columns, reactors in Petrochemicals plants and Oil Refineries.

These thermocouples are provided with a bracket for surface mounting or for mounting on 2" Nb Pipe.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
Pt	Pt100 RTD

Code	Sheath Dia
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm

Code	Sheath Material
316	316SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
15	Grounded junction

Code	Element length
OL	Define Overall length

Code	Coller Dimension
A	OD=30, ID=19, thick=10
B	OD=40, ID=19, thick=10
C	OD=50, ID=19, thick=10

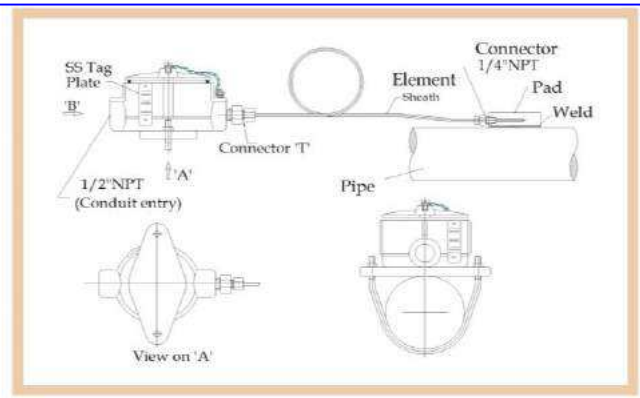
Other sizes are also available. Please specify

Code	Connector 'T'
1/4"N	1/4"NPT
½" N	½" NPT

Code	Head Assembly
S	Surface Mounting for JB
B	Bracket mounting for Head
P	2"Nb Pipe Mounting
L	Local mounting without bracket.

ORDERING EXAMPLE

121# SERIES 2-K-6-316-D-2-B-1/2"N-A-OL=15M-Op15



122# Series

Thermocouple & Resistance Thermometer Assemblies with

- Weld pad or "Strap on" pad.
- Long Pliable MI lead out, ideal for skin Temperature measurement of pipe or vessel surface.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.
- Bracket mounting or 2"Nb pipe mounting.

Mi Thermocouple or Resistance Thermometers can be provided with a long MI Lead out cable to enable its usage in intricate installations and in high temperature environment. A separate weld pad or "Strap-on" pad is provided for fixing the Thermocouple to vessel/reactor or on pipe surface.

Typical application are measurement of surface temperature of refractory lined vessels, columns, reactors in Petrochemicals plants, Oil Refineries and pipelines.

These thermocouples or RTD's are provided with a bracket for surface mounting or for mounting on 2" Nb Pipe.

Thermocouples are provided with ungrounded junction unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
Pt	Pt100 RTD

Code	Sheath Dia
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm

Code	Sheath Material
316	316SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
15	Grounded junction
28	SS Pipe Strap

Code	Element length
OL	Define Overall length

Code	Pad Dimension
A	25 x 15x 25
B	25 x 25 x 50
C	25 x 25 x 100

Other sizes are also available. Please specify

Code	Connector 'T'
1/4"N	1/4"NPT
½" N	½" NPT

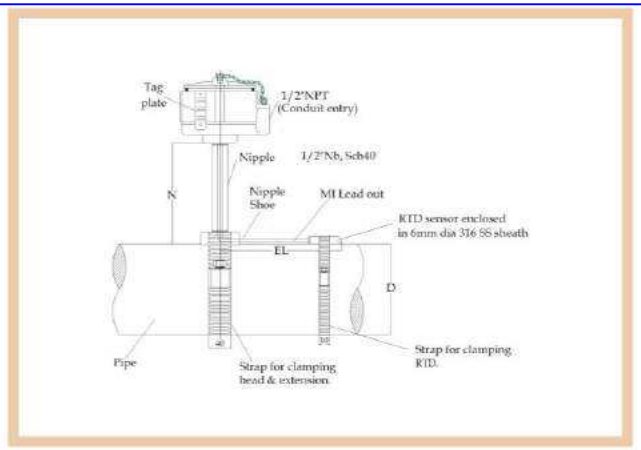
Code	Head Assembly
S	Surface Mounting for JB
B	Bracket mounting for Head
P	2"Nb Pipe Mounting
L	Local mounting without bracket.

ORDERING EXAMPLE

122# SERIES 2-Pt-6-316-D-2-B-1/2"N-C-OL=3M-Op28

TRM GROUP

MI Thermocouple & RTD – 100 Series



123# Series

Thermocouple & Resistance Thermometer Assemblies with

- "Strap on" for pipe surface measurement.
- Pliable MI lead out, ideal for skin Temperature measurement of pipe or vessel surface.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.
- Quick disconnect jack for using with hand held monitor

MI Thermocouple or Resistance Thermometers can be provided with a Pliable MI Lead out cable to enable its usage in intricate installations and for strapping on the pipe surface for skin temperature measurement of gas/oil pipelines or heat traced pipe lines.

These thermocouples or RTD's are provided with a stand out nipple for local mounting.

Thermocouples atre provided with ungrounded junction unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
Pt	Pt100 RTD

Code	Sheath Dia
3	3.0mm
4.5	4.5mm
6.0	6.0mm
8.0	8.0mm

Code	Sheath Material
316	316SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of Entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
15	Grounded junction
28	SS Pipe Strap
40	Quick Disconnect jack

Code	Element length along the pipe
EL	Define

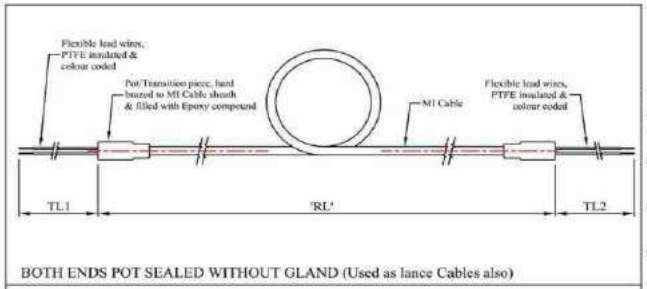
Code	Pipe Diameter
D	Define

Code	Extension length
N	Define

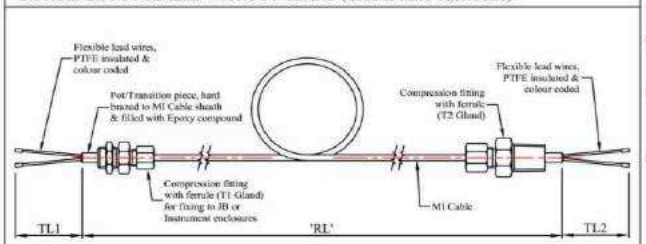
Code	Mounting
L	Local mounting with extension Nipple

ORDERING EXAMPLE

123# SERIES 1-Pt-6-316-D-1-L-N=200-D=32"-EL=200-Op28,40



BOTH ENDS POT SEALED WITHOUT GLAND (Used as lance Cables also)



BOTH ENDS POT SEALED & WITH GLANDS

150 Series

MI Thermocouple Extension & Compensating Cable Units

- Manufactured as per IEC 1515-1995
- Custom built units, ready for use
- Metal sheathing and mineral insulation reduces overall size of Cables
- Can be used at much higher temperatures
- Pliable and can be routed through high temperature enviroment
- Provided with PTFE insulated & colour coded flex tails for termination in Junction Box or instrument enclosures
- Available with a choice of glands & Flameproof Enclosures (Optional)

150# Series

Code	No of Pairs
1	One pair
2	Two pairs
3	Three pairs
4	Four pairs
6	Six pairs
9	Nine pairs

Code	Cable Type
KX	Chromel-Alumel
SX	PtRh-Pt (R or S)
BX	PtRh 30% - PtRh 6%

Code	Sheath Diameter
6	6 mm
8	8 mm
10	10 mm
12	12 mm
Other diameters also available	

Code	Sheath Material
C	Copper (for Sx & Bx)
S	321 SS

Code	CJT details
CJT 201	Both ends with crimp-on pot
CJT 201G	Crimp-on pot with glands

Code	Options
0	None
10	Special requirement

Code	T2 Gland Details
2	1/2"NPT(M)
4	M20 x 1.5(M)
6	1/2"BSP(M)
7	Other, define
X	None

Code	T1 Gland Details
2	1/2"NPT(M)
4	M20 x 1.5(M)
6	1/2"BSP(M)
7	Other, define
X	None
Add suffix 'N' if locknut is required	

Code	Lead wires Insulation
1	PTFE insulated
Define Colour Code (ANSI/IEC)	

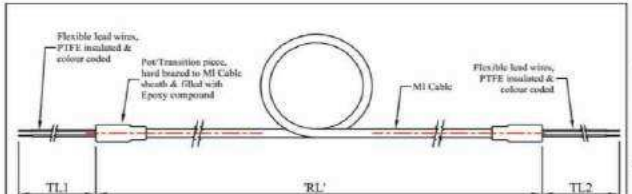
Code	Lead wire length
TL1/TL2	Define

Code	Length of cable
RL	Route length

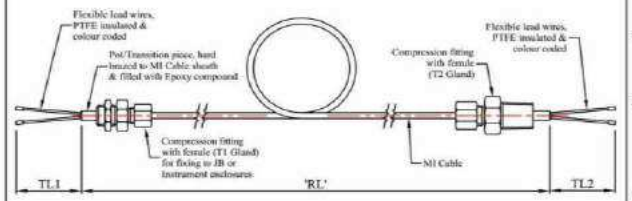
ORDERING EXAMPLE

150 SERIES 1-KX-6-S-CJT201G-RL=10M-TL1=150/TL2=200-1(ANSI)-6N-2-OPTION 0

MI Thermocouple & RTD – 100 Series



BOTH ENDS POT SEALED WITHOUT GLAND (Used as Lance Cables also)



BOTH ENDS POT SEALED & WITH GLANDS

151# Series

MI Transducer Leadout & Wiring Cable Units

- Custom built units, ready for use
- Metal sheathing and mineral insulation reduces overall size of Cables
- Can be used at much higher temperatures
- Pliable and can be routed through high temperature enviroment
- Provided with PTFE insulated & colour coded flex tails for termination in Junction Box or instrument enclosures
- Available with a choice of glands & Flameproof Enclosures (Optional)

151# Series

Code	No of Pairs
1	One pair
2	Two pairs
3	Three pairs

Code	Conductor Material
Cu	Copper
Ni	Nickel
CuNi	Constantan

Code	Sheath Diameter
3	3 mm
4.5	4.5 mm
6	6 mm
Other diameters also available	

Code	Sheath Material
C	Copper
D	Cupronickel
T	316 SS
S	321 SS
W	310 SS
I6	Inconel 600
I8	Incoloy 800

Code	Sheath Termination
CJT 201	Both ends with crimp-on pot
CJT 201G	Crimp-on pot with glands

Code	Options
0	None
10	Special requirement

Code	T2 Gland Details
2	1/2"NPT(M)
4	M20 x 1.5(M)
6	1/2"BSP(M)
7	Other, define
X	None

Code	T1 Gland Details
2	1/2"NPT(M)
4	M20 x 1.5(M)
6	1/2"BSP(M)
7	Other, define
X	None
Add suffix 'N' if locknut is required	

Code	Lead wires Insulation
1	PTFE insulated
Define Colour Code	

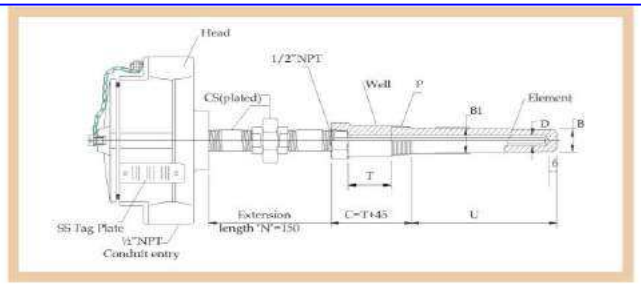
Code	Lead wire length
TL1/TL2	Define

Code	Length of cable
RL	Route length

ORDERING EXAMPLE

151# SERIES 1-Cu-6-T-CJT201G-RL=10M-TL1=150/TL2=200-1-6N-2-OPTION 0

MI Thermocouple & RTD – 300 Series



300# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Threaded tapered Thermowell.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wireTemperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

Various designs are available as standard products, few of which are illustrated in this leaflet. We can design and manufacture assemblies, single/duplex as well as multipoint to suit practically every process. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia 'd'	
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B1	B
½"NPT	17	12.5
3/4"NPT	22	16
1"NPT	25	19
M33x2	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

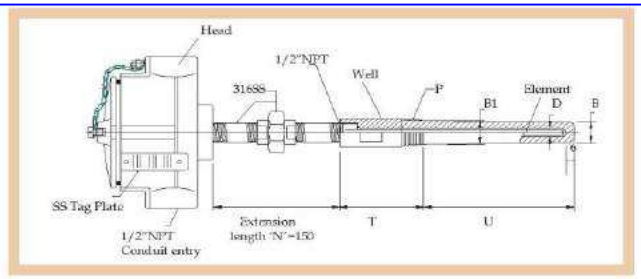
Code	Well Insertion
U	Define

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

300# SERIES 1-K-6-316-D-1-316-U=150-T=50-1"NPT-Op 3,8



310# Series

Thermocouple & Resistance Thermometer Assemblies with

- ENI Standard 0165.00 Threaded Thermowell.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell as per ENI standard 0165.00, is ideally suited for use in Fertiliser plants, Refineries and Petrochemical complexes.

The assembly can be supplied with 316SS terminal head and nipple-union-nipple in 316SS as a standard feature in weatherproof or flameproof execution. This will resist atmospheric corrosion and help in carrying out periodic maintenance with more ease.

Heavy Duty well with process connection 1.5"NPT and tapered shank tapering from 38mm to 33mm is offered as a standard design for use on very high pressure application such as syngas compressor discharge.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia 'd'	
6	6mm	7.0mm
8	8mm	8.0mm
10	10mm	10.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B1	B
½"NPT	17	12.5
3/4"NPT	22	16
1"NPT	25	19
M33x2	28	25
1½"NPT	38	33

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

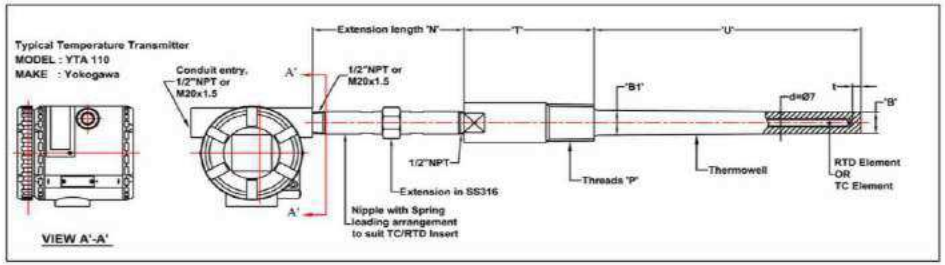
310# SERIES 1-K-6-316-D-1-316-U=150-T=75-1"NPT-Op 4

MI Thermocouple & RTD – 300 Series

TT310# Series (Y)

Temperature Transmitters with Thermocouple or RTD Assemblies

- Factory assembled, configured & callibrated units
- Transmitters to customer choice
- Various Thermowell options
- Safe design as per ASME PTC 19.3



Temperature Transmitters of various makes have standard features which has enabled us to develop assemblies to suit most of them. We offer Transmitter assemblies of make selected by customer, but do stock a wide range manufactured by "Yokogawa".

The assemblies are designed as per IEC 60079-1(2001)/IS:2148:2004 & complete assembly with Temperature Transmitter meet the requirement of these standards, for use in potentially flammable atmospheres. The design of the complete assembly depends on , various process parameters, such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

High velocity collar can be provided to reduce the suspended length of Thermowell and to meet ASME PTC 19.3 requirement. Thermowells are available in standard AISI 300 series stainless steels as well as, in exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy C276 & B3, and Flanges in ASTM grades A105, A182 and A 350 and in sizes 3/4" to 2" (DN 20 to DN 50).

TT310# Series(Y)

Code	No of Elements
1	Simplex
2	Duplex

Code	Element Type
K	Chromel-Alumel
E	Chromel-Constantan
Pt	Pt 100 RTD

Code	Sheath dia	'd'
6	6.0 mm	7.0 mm
8	8.0 mm	8.5 mm

Code	Sheath Material
316	SS 316
321	SS 321
Inc 6	Inconel 600

Code	TT Model	Make
YTA 110	YTA 110	Yokogawa
YTA 130	YTA 130	Yokogawa
STT 350	STT 350	Honeywell
STT 35F	STT 35F	Honeywell
644H	644H	EPM
3144P	3144P	EPM
653S	653S	ABB

Code	No. of Entries
1	One entry
2	Two entries

Define conduit entry

Code	Local Indication
Y	Provided
N	None

Code	Options
0	None
4	Extension in 316 SS
7	Brass cable gland
10	Special requirement

Process Conn. P	B1	B	T
3/4"NPT	22	16	100
1"NPT	25	19	100
1.5"NPT	38	33	150
M33x2	28	25	100

Other sizes and dimensions on request.

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
F316L	A182 F316L
F321	A182 F321
Hast C	Hastelloy C276

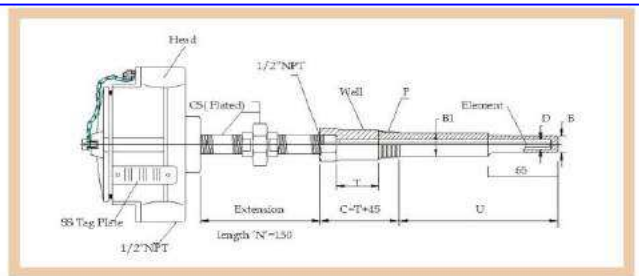
Other materials also available. Define grade

Code	Well Material
316L	SS 316L
321	SS 321
Hast C	Hastelloy C276

Other materials also available. Define grade

ORDERING EXAMPLE

TT 310# Series(Y) -1-K-6-316-YTA 110-1-N-316L-F316L-U=250-T=70-3/4"NPT(M)-Option 4



320# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Threaded stepped shank or straight shank well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for.

Various designs are available as standard products, few of which are illustrated in this leaflet. We can design and manufacture assemblies, single/duplex as well as multipoint to suit practically every application.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and stepped shank Thermowell. Specify Option 9 for thermowell with straight shank. The Thermocouple junctions are ungrounded unless otherwise specified.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
E	Chromel-Constantan
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.0mm
10	10mm	10.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
9	Straight shank
10	Special requirement

Process Conn P	B1	B
½"NPT	17	12.5
3/4"NPT	22	16
1"NPT	25	19
M33x2	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

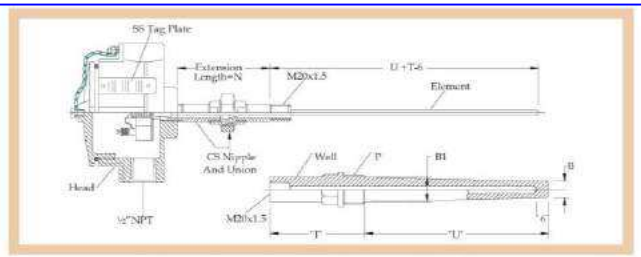
Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

320# SERIES 1-K-6-316-D-1-316-U=150-T=50-1"NPT-Op 3,8

MI Thermocouple & RTD – 300 Series



330 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Threaded tapered Thermowell.
- Certified for use in hazardous area. (Ex)
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

ASME performance Test code PTC 19.3 gives a basis for arriving at a design of thermowell for use on pipings carrying process fluids. We recommend that insertion lengths are checked for safe design as per ASME PTC19.3.

The assembly shown in this leaflet is typical for Power plants for use on steam and water services.

Thermowells are available in standard AISI 300 series Stainless Steel such as 316SS, 304SS and 321SS.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and well entry of M20x1.5. Assemblies with longer extension length to locate cold end termination away from installation can be supplied. Specify code 10 and requirement of extension length. The thermocouple junctions are ungrounded unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B1	B
½"NPT	17	12.5
3/4"NPT	22	16
1"NPT	25	19
M33x2	28	25

Other sizes and dimensions on request

Code	Head Extension
N	Define

Code	Well Extension
T	Define

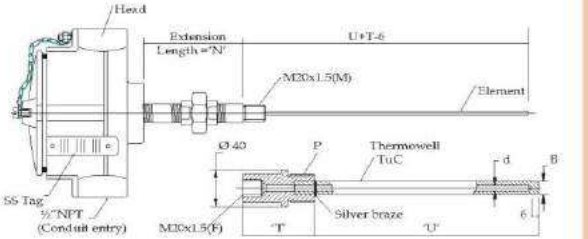
Code	Well Insertion
U	Define

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

330# SERIES 1-K-6-316-D-1-316-U=150-T=100-N=100-1"NPT-Op 3,8



340# Series

Thermocouple & Resistance Thermometer Assemblies with

- Solid Sintered Tungsten Carbide Thermowell for mill Classifier Outlet.
- Recystallized Silicon Carbide for use on high temperature and abrasive services.
- Certified for use in hazardous area (Ex)
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and solid sintered Tungsten carbide Thermowell would form typically, a complete assembly for use in Power Plants for highly abrasive services such as mill classifier outlet for temperature measurement of Coal + Air Mixture.

For use at relatively high temperatures we recommend re-crystallized Silicon Carbide, which also has a very high abrasion resistance characteristics. These are recommended for use in Flue gas application in power plants or for use on incinerators employed in modern day waste management systems of process plants. Standard well is available in diameter of 20mm; and is cemented into stainless steel bushing.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and well entry of M20x1.5.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	110mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	d	B
1"NPT	7	16
M33x2	7	16

Other sizes and dimensions are d=9, B=19
For SiC well d=10,B=20

Code	Head Extension
N	Define

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

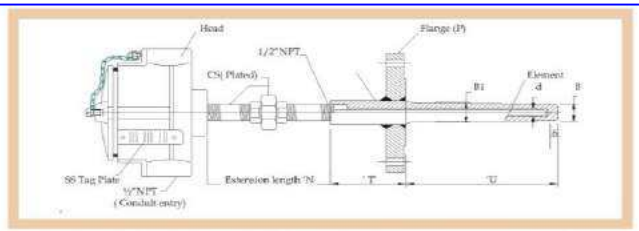
Code	Well Material
TuC	Tungsten Carbide
SiC	Silicon Carbide

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

340# SERIES 1-K-6-316-D-1-TuC-U=150-T=100-N=100-M33x2-Op 1,7

MI Thermocouple & RTD – 400 Series



400 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Flanged tapered Thermowell.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Flanged Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

High Velocity collar can be provided to reduce the suspended length of thermowell and to meet ASME PTC19.3 requirement. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B and flanges in ASTM grades A105, A182 and A350 and in sizes 3/4" to 2" (Dn20 to DN50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B	B
3/4"ANSI or DN20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
A105	ASTM A105 (CS)
F316	A182 F316
F304	A182 F304
F321	A182 F321
F5	A182 F5
LF2	A350 LF2

Other materials also available. Define grade

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

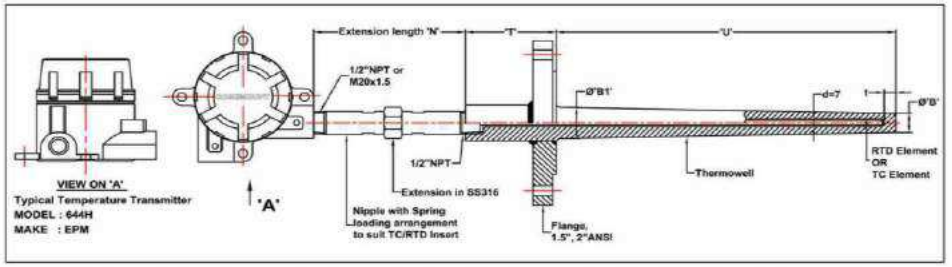
ORDERING EXAMPLE

400# SERIES 1-K-6-316-D-1-316-F316-U=150-T=70-1"150#RF-Op0

TT400# Series

Temperature Transmitters with Thermocouple or RTD Assemblies

- *Factory assembled, configured & callibrated units*
- *Transmitters to customer choice*
- *Various Thermowell options*
- *Safe design as per ASME PTC 19.3*



Temperature Transmitters of various makes have standard features which has enabled us to develop assemblies to suit most of them. We offer Transmitter assemblies of make selected by customer, but do stock a wide range manufactured by "Emerson process".

The assemblies are designed as per IEC 60079-1(2001)/IS:2148:2004 & complete assembly with Temperature Transmitter meet the requirement of these standards, for use in potentially flammable atmospheres. The design of the complete assembly depends on , various process parameters, such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

High velocity collar can be provided to reduce the suspended length of Thermowell and to meet ASME PTC 19.3 requirement. Thermowells are available in standard AISI 300 series stainless steels as well as, in exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy C276 & B3, and Flanges in ASTM grades A105, A182 and A 350 and in sizes 3/4" to 2" (DN 20 to DN 50).

TT400# Series

Code	No of Elements
1	Simplex
2	Duplex

Code	Element Type
K	Chromel-Alumel
E	Chromel-Constantan
Pt	Pt 100 RTD

Code	Sheath dia	'd'
6	6.0 mm	7.0 mm
8	8.0 mm	8.5 mm

Code	Sheath Material
316	SS 316
321	SS 321
Inc 6	Inconel 600

Code	TT Model	Make
644H	644H	EPM
3144P	3144P	EPM
653S	653S	ABB
YTA 110	YTA 110	Yokogawa
YTA 130	YTA 130	Yokogawa
STT 350	STT 350	Honeywell
STT 35F	STT 35F	Honeywell

Code	No. of Entries
1	One entry
2	Two entries

Define conduit entry

Code	Local Indication
Y	Provided
N	None

Code	Options
0	None
4	Extension in 316 SS
7	Brass cable gland
10	Special requirement

Flange 'P'	'B1'	'B'
3/4"ANSI or DN 20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Define flange rating and facing.

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
F316L	A182 F316L
F321	A182 F321
Hast C	Hastelloy C276

Other materials also available. Define grade

Code	Well Material
316L	SS 316L
321	SS 321
Hast C	Hastelloy C276

Other materials also available. Define grade

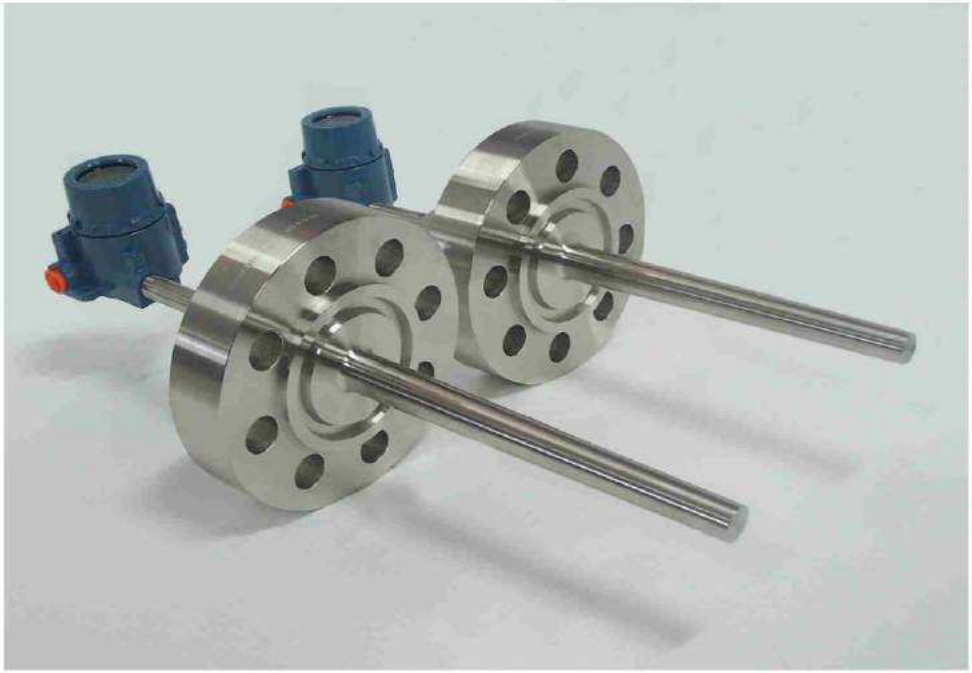
ORDERING EXAMPLE

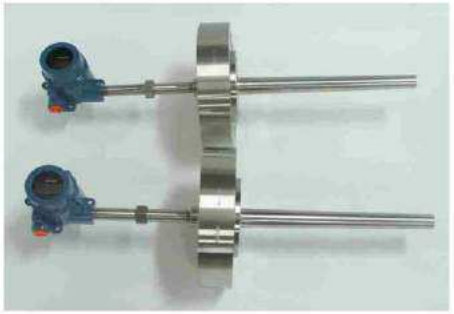
TT 400# Series 1-K-6-316-644H-1-N-316L-F316L-U=250-T=70-1.5"150#RF- Option 4

MI Thermocouple & RTD – 400 Series

TT400# Series

Temperature Transmitter with Thermocouple or RTD Assemblies

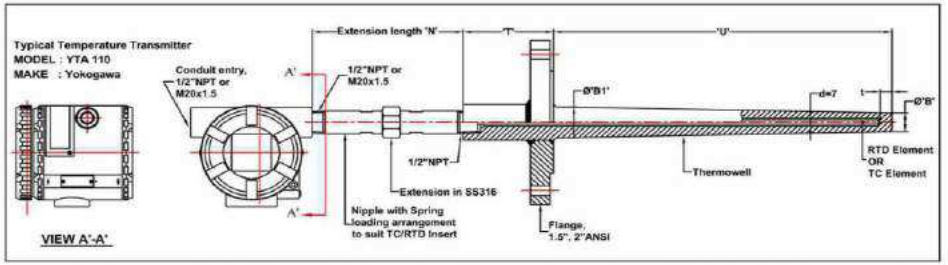




TT400# Series (Y)

Temperature Transmitters with Thermocouple or RTD Assemblies

- Factory assembled, configured & callibrated units
- Transmitters to customer choice
- Various Thermowell options
- Safe design as per ASME PTC 19.3



Temperature Transmitters of various makes have standard features which has enabled us to develop assemblies to suit most of them. We offer Transmitter assemblies of make selected by customer, but do stock a wide range manufactured by "Yokogawa".

The assemblies are designed as per IEC 60079-1(2001)/IS:2148:2004 & complete assembly with Temperature Transmitter meet the requirement of these standards, for use in potentially flammable atmospheres. The design of the complete assembly depends on , various process parameters, such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

High velocity collar can be provided to reduce the suspended length of Thermowell and to meet ASME PTC 19.3 requirement. Thermowells are available in standard AISI 300 series stainless steels as well as, in exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy C276 & B3, and Flanges in ASTM grades A105, A182 and A 350 and in sizes 3/4" to 2" (DN 20 to DN 50).

TT400# Series(Y)

Code	No of Elements
1	Simplex
2	Duplex

Code	Element Type
K	Chromel-Alumel
E	Chromel-Constantan
Pt	Pt 100 RTD

Code	Sheath dia	'd'
6	6.0 mm	7.0 mm
8	8.0 mm	8.5 mm

Code	Sheath Material
316	SS 316
321	SS 321
Inc 6	Inconel 600

Code	TT Model	Make
YTA 110	YTA 110	Yokogawa
YTA 130	YTA 130	Yokogawa
STT 350	STT 350	Honeywell
STT 35F	STT 35F	Honeywell
644H	644H	EPM
3144P	3144P	EPM
653S	653S	ABB

Code	No. of Entries
1	One entry
2	Two entries
Define conduit entry	

Code	Local Indication
Y	Provided
N	None

Code	Options
0	None
4	Extension in 316 SS
7	Brass cable gland
10	Special requirement

Flange 'P'	'B1'	'B'
3/4"ANSI or DN 20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25
Define flange rating and facing		

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
F316L	A182 F316L
F321	A182 F321
Hast C	Hastelloy C276
Other materials also available. Define grade	

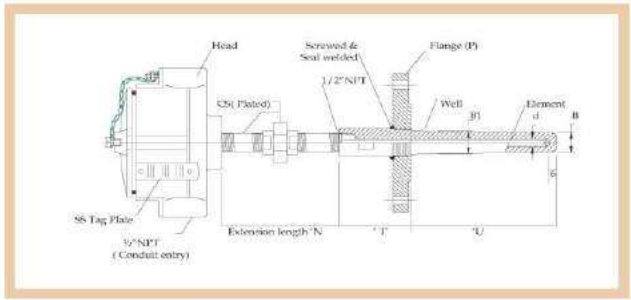
Code	Well Material
316L	SS 316L
321	SS 321
Hast C	Hastelloy C276
Other materials also available. Define grade	

ISO 9001

ORDERING EXAMPLE

TT 400# Series(Y) -1-K-6-316-YTA 110-1-N-316L-F316L-U=250-T=70-1.5"150#RF- Option 4

MI Thermocouple & RTD – 400 Series



410 Series

Thermocouple & Resistance Thermometer Assemblies with

- ENI Standard 0165.00Flanged Thermowell.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell as per ENI standard 0165.00, is ideally suited for use in Fertiliser plants, Refineries and Petrochemical complexes.

The assembly can be supplied with 316SS terminal head and nipple-union-nipple in 316SS as a standard feature in weatherproof or flameproof execution. This will resist atmospheric corrossion and help in carrying out periodic maintenance with more ease.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B and flanges in ASTM grades A105, A182 and A350 and in sizes 3/4" to 2" (Dn20 to Dn50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B1	B
3/4"ANSI or DN20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

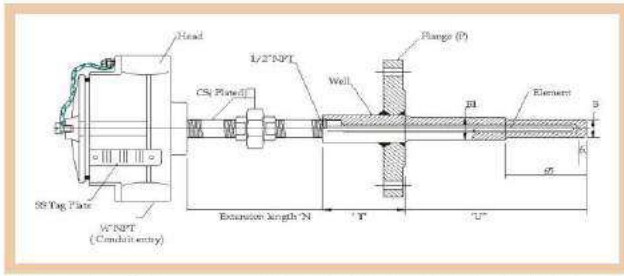
Code	Flange Material
A105	ASTM A105 (CS)
F316	A182 F316
F304	A182 F304
F321	A182 F321
F5	A182 F5
Lf2	A350 Lf2

Other materials also available. Define grade

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

410# SERIES 1-K-6-316-D-1-316-F316-U=150-T=70-1"150#RF-Op4



420 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Flanged stepped shank or straight shank well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for.

Heavy Velocity collar can be provided to reduce the suspended length of thermowell and to meet ASME PTC19.3 requirement.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B and flanges in ASTM grades A105, A182 and A350 and in sizes 3/4" to 2" (Dn20 to Dn50).Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and stepped shank Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	B1	B
3/4"ANSI or DN20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
A105	ASTM A105 (CS)
F316	A182 F316
F304	A182 F304
F321	A182 F321
F5	A182 F5
Lf2	A350 Lf2

Other materials also available. Define grade

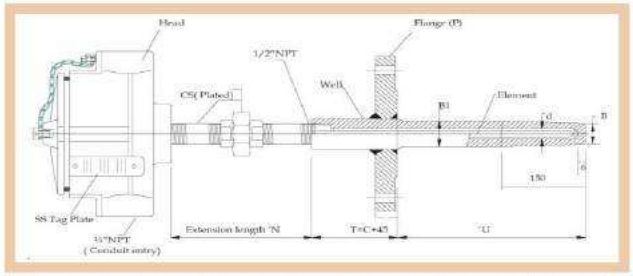
Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

420# SERIES 1-K-6-316-D-1-316-F316-U=150-T=70-1"150#RF-Op4

TRM GROUP

MI Thermocouple & RTD – 400 Series



430 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Flanged straight and tapered shank Thermowell.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

The Thermocouple or Resistance Thermometer Sensor illustrated in this leaflet is a typical design specified by M/s Engineers India Ltd. A drilled bar stock Thermowell is welded to suitably drilled blind flange by employing a groove and fillet TIG weld joint. For pressure rating 900# and above a full penetration weld is carried out.

Heavy Velocity collar can be provided to reduce the suspended length of thermowell and to meet ASME PTC19.3 requirement .Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B and flanges in ASTM grades A105, A182 and A350 and in sizes 3/4" to 2" (Dn20 to Dn50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and straight and tapered Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
11	Full penetration weld

Process Conn P	B1	B
3/4"ANSI or DN20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

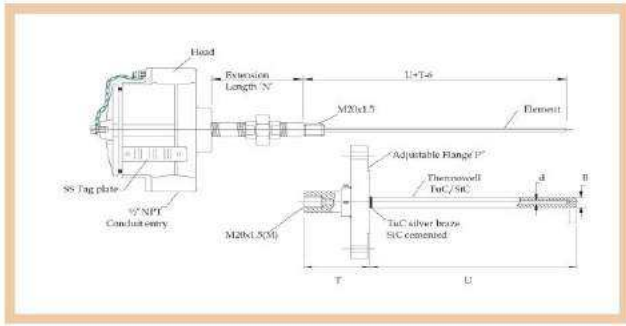
Code	Flange Material
A105	ASTM A105 (CS)
F316	A182 F316
F304	A182 F304
F321	A182 F321
F5	A182 F5
Lf2	A350 Lf2

Other materials also available. Define grade

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

430# SERIES 1-K-6-316-D-1-316-F316-U=150-T=70-1"150#RF-Op4



440 Series

Thermocouple & Resistance Thermometer Assemblies with

- Solid Sintered Tungsten Carbide Thermowell for mill Classifier Outlet.
- Recystallized Silicon Carbide for use on high temperature and abrasive services.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and solid sintered Tungsten carbide Thermowell would form typically, a complete assembly for use in Power Plants for highly abrasive services such as mill classifier outlet for temperature measurement of Coal + Air Mixture.

For use at relatively high temperatures we recommend re-crystallized Silicon Carbide, which also has a very high abrasion resistance characteristics. These are recommended for use in Flue gas application in power plants or for use on incinerators employed in mordern day waste management systems of process plants. Standard well is available in diameter of 20mm; and is cemented into stainless steel bushing.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and well entry of M20x1.5 and ungrounded Thermocouple.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	9.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	d	B
1"ASA	7	16
1.25" ASA	7	16
1.5" ASA	7	16

Other sizes and dimensions are d=9, B=19
For SiC well d=10,B=20

Define Flange Rating and facing

Code	Head Extension
N	Define

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
A105	ASTM A105 (CS)
F316	ASTM A182 F316

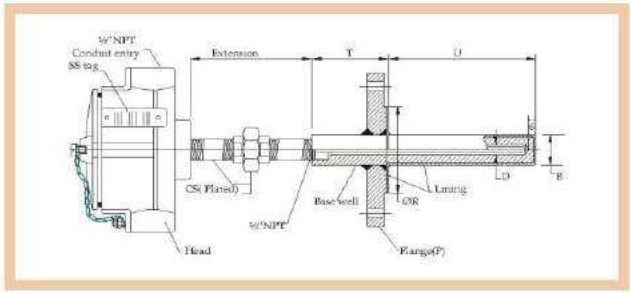
Code	Well Material
TuC	Tungsten Carbide
SiC	Silicon Carbide

ORDERING EXAMPLE

440# SERIES 1-K-6-316-D-1-TuC-A105-U=150-T=50-N=150-1.5"150#RF-Op 1,3

TRM GROUP

MI Thermocouple & RTD – 400 Series



450 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Flanged well with Lining
- Lining in Ta,Ti, Ni, Hast C.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

Thermocouples or resistance Thermometers are often required with Thermowells which can withstand corrosion caused by the process medium. It is expensive to manufacture bar stock thermowells in materials which can withstand the corrosion. An effective and less expensivealternative is to manufacture the thermowells from 300 seriesStainless steel barstocks and provide a sleeve or loose lining over the entire wetted portionof the well including the raised face of the flange, which can withstand the corrosive attack from process medium.

Thermowells can be provided with lining in various materials such as Tantalum(Ta), Titanium(Ti), Nickel(Ni), Hastelloy 'C', Hastelloy'B", Silver (Ag) and Platinum - Rhodium alloy (PtRh)

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and well entry of M20x1.5 and ungrounded Thermocouple.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	D	B
3/4"ANSI or DN20	43	12.5
1"ANSI or DN 25	51	16
1.5"ANSI or DN 40	73	19
2"ANSI or DN 50	92	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

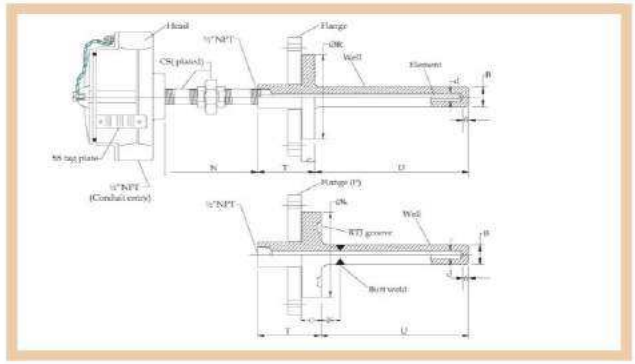
Code	Flange Material
A105	ASTM A105 (CS)
F316	ASTM A182 F316

Code	Lining Material	Lining Thickness
Ta	Tantalum	0.4mm
Ti	Titanium	1.0mm
Ni	Nickel	1.0mm
Hc	Hastelloy C	1.0mm

Code	Well Material
316	316SS
304	304SS

ORDERING EXAMPLE

450# SERIES 1-K-6-316-D-1-316-Ti-F316-U=150-T=50-1.5"150#RF-Op 1,3



460 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Van Stone Thermowell with or without weld joints.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.
- Raised face or RTJ facing.
- Mounting flange in A105 or A182 F316
- 100% Radiography for weld joints.
- PWHT
- Hardness to NACE MR-01-75
- Ferrite Number between 3 and 10

For Highly corrosive services, Thermowells without a weld joint are recommended. If weld joints cannot be avoided, full penetration weld is carried out and checked by 100% radiography test.

The design shown in this leaflet fulfills this criteria. Thermowells can also be offered with PWHT of weld joint, hardness check as per NACE MR-01-75, DP test, hydro test and ferrite number test.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.0mm
10	10mm	10.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 304SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
11	Full penetration weld

Process Conn P	B1	B
3/4"ANSI or DN20	17	12.5
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	25	19
2"ANSI or DN 50	28	25

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange Material
A105	ASTM A105 (CS)
F316	A182 F316
F304	A182 F304
F321	A182 F321
F5	A182 F5
Lf2	A350 Lf2

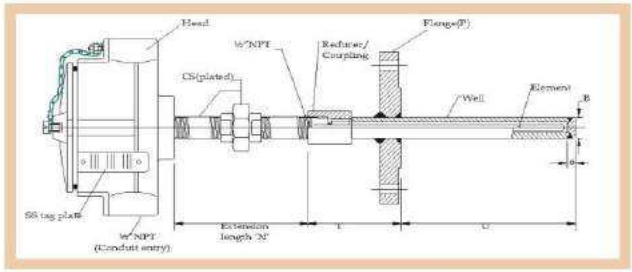
Other materials also available. Define grade

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

460# SERIES 1-K-6-316-D-1-316-F316-U=150-T=70-1"150#RF-Op4

MI Thermocouple & RTD – 400 Series



470 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Protecting Tube.
- Built up from seamless tubes, fixed or adjustable.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire
- Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with or without head extension and a protecting tube would form a typical complete assembly ready for use in the application where flow and pressure are not a major concern.

Protecting tubes are built from seamless tubes with hot end plugged and TIG welded and a blind flange is drilled to suit the outer diameter of the tube and TIG welded to it. These thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, 446SS and flanges in ASTM grades A105, A182 and A350 in sizes 3/4" to 2" (DN20 to DN50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia
6	6mm
8	8mm
10	10mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Well Material
316	316SS
304	304SS
321	321SS
Inc6	Inconel 600

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Process Conn P	Max B	Min B
3/4"ANSI or DN20	16	10
1"ANSI or DN 25	22	16
1.5"ANSI or DN 40	26	19
2"ANSI or DN 50	33	26

Other sizes and dimensions on request

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Flange material
A105	ASTM A105 (CS)
F316	ASTM A182 F316
F304	ASTM A182 F304

Other materials are also available. Define grade.

Code	Tube Dimensions OD x W/t
1/8"Sch80	10.29x2.41
1/4"Sch80	13.72x3.02
3/8"Sch80	17.15x3.18
½"Sch80	21.30x3.73
½"Sch160	21.30x4.75
3/4"Sch80	26.60x3.91
3/4"Sch160	26.60x5.53

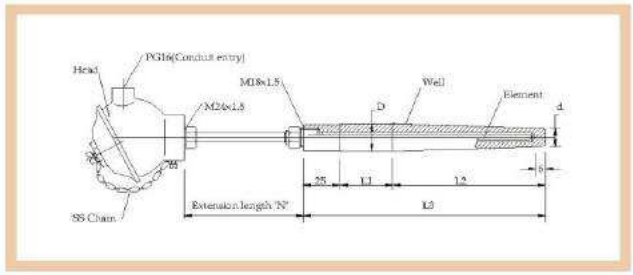
Other dimensions are also available.

ORDERING EXAMPLE

470# SERIES 1-K-6-316-D-1-316-1/2"Sch80-F316-U=640-T=60-1.5"150-Op0

TRM GROUP

MI Thermocouple & RTD – 500 Series



500# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Weld in Thermowell.
- Form D as per DIN 43763.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

Various designs are available as standard products, few of which are illustrated in this leaflet. We can design and manufacture assemblies, single/duplex as well as multipoint to suit practically every process. Thermowells are available in standard AISI 300 series Stainless Steel as well as in ferritic steels such as 13CrMo44 or 10CrMo910.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box
KB	DIN 'B' W/P
KA	DIN 'A' W/P

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	L3	L2	D	d
D1	140	65	24	12.5
D2	200	125	24	12.5
D3	200	125	30	16
D4	260	65	24	12.5
D5	260	125	24	12.5
D6	255	125	30	16

Note : Type D3 and D6 are for 8 dia inserts. All other types are 6 dia inserts

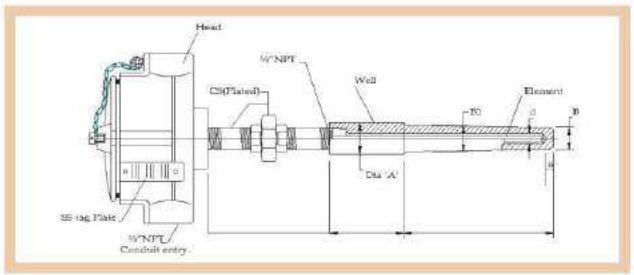
Code	Well Type
W	Weld-in

Code	Well Material
316	316SS
321	321SS
316Ti	316SS Ti stabilised
F11	13CrMo44
F22	10CrMo910

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE

500# SERIES 1-Pt-6-316-KB-1-F11-W-D1-Op7



510# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Bar stock Weld-In tapered well for use in socket weld or straight through socket.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

Weld-in wells are provided with a cylindrical head suitable for welding into a socket weld or straight through socket. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Socket	A	B1	B
20	20mm	26.6	22	16
25	25mm	33.4	25	19
32	32mm	42.1	33	25
40	40mm	48.3	42	30
00	Define A, B1, B			

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Well Type
W	Weld-in

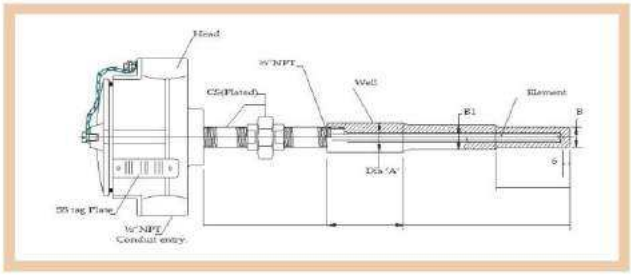
Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS
Inc8	Incoloy 800
Inc6	Inconel 600

ORDERING EXAMPLE

510# SERIES 1-K-6-316-D-1-316-W-U=250-T=70-25-Op0

TRM GROUP

MI Thermocouple & RTD – 500 Series



520 Series

Thermocouple & Resistance Thermometer Assemblies with

- A Weld-In Stepped shank well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

Mi Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. Weld in wells are provided with a cylindrical head for welding into a socket weld or a straight through socket.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Socket	A	B1	B
20	20mm	26.6	22	16
25	25mm	33.4	25	19
32	32mm	42.1	33	25
40	40mm	48.3	42	30
00	Define A, B1, B			

Code	Well Extension
T	Define

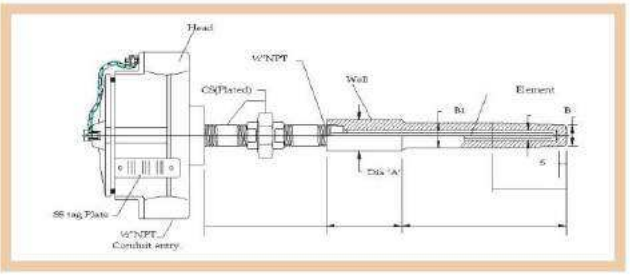
Code	Well Insertion
U	Define

Code	Well Type
W	Weld-in

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS
Inc8	Incoloy 800
Inc6	Inconel 600

ORDERING EXAMPLE

520# SERIES 1-K-6-316-D-1-316-W-U=250-T=70-25-Op0



530# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Weld-In Straight and tapered shank well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

The Thermocouple or RTD assembly illustrated in this leaflet is with a weld in well having straight shank with a tapered tail. These wells are provided with a cylindrical head for welding into a socket weld or a straight through socket.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise. Define dimensions B1 same as Dimension B, when a fully straight shank well is required.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
P1	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Socket	A	B1	B
20	20mm	26.6	22	16
25	25mm	33.4	25	19
32	32mm	42.1	33	25
40	40mm	48.3	42	30
00	Define A, B1, B			

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

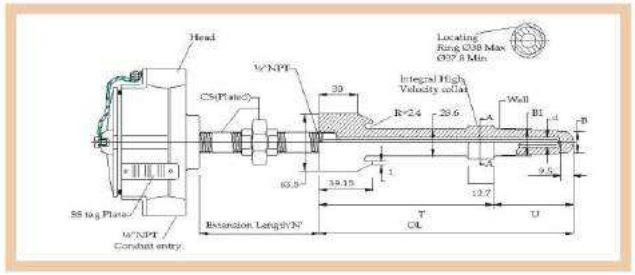
Code	Well Type
W	Weld-in

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS
Inc8	Incoloy 800
Inc6	Inconel 600

ORDERING EXAMPLE

530# SERIES 1-K-6-316-D-1-316-W-U=250-T=70-32-Op1

MI Thermocouple & RTD – 500 Series



540# Series

Thermocouple & Resistance Thermometer Assemblies with

- A High Pressure weld in well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wireTemperature Transmitter.

The assembly shown in this leaflet is with a weld in Thermowell manufactured from bar stock as per ASTM A276 grade 321SS or 316SS, duly tested prior to manufacture as per agreed QA plan. These assemblies are used for temperature measurement of high pressure and high velocity steam lines and are largely used in performance testing of utility boilers.

The Thermowell is butt welded on the weldolet provided on the pipings and the collar provided on thermowell fits snugly in the pipe wall, thus reducing the suspended length of the thermowell, and thereby meeting the ASME PTC19.3 code requirement.

Thermowells are provided with IBR certification, material integrity test certificates and are also subjected to a heat treatment of 950 Deg C prior to final finishing. A plug and chain is provided, when thermowells are supplied as "Test Wells".

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Weldolet size	A	B1	B
BW2'XXS	2'XXS	63.5	25.4	19

Code	Well Extension
T	Define

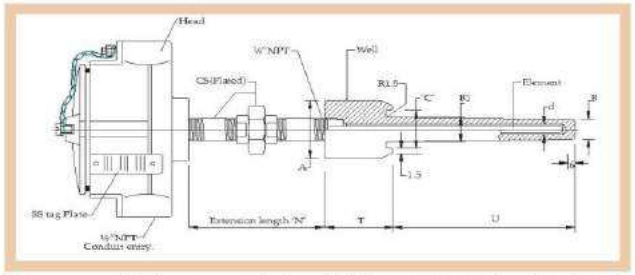
Code	Well Insertion
U	Define

Code	Well Type
W	Weld-in

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

540# SERIES 1-K-6-316-D-1-316-W-U=84.1-T=206.4-BW2'SchXXS-Op0



550# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Butt weld design tapered well.
- Certified for use in hazardous area.
- Safe design as per ASME PTC19.3.
- Available with "in-head" 2-wire Temperature Transmitter.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and drilled bar stock Thermowell would form a typical complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressure, flow velocity, abrasive nature of process fluid, intricate nature of installation and insertion lengths required.

High velocity collar can be provided to reduce the suspended length of thermowell and to meet ASME PTC19.3 requirement. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy alloys C and B.

The Thermowell illustrated in this leaflet is for butt welding to a weldolet and well dimensions given are suitable for weldolet size of 1.5" and 2" and schedule 40 to schedule XXS.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	8.5mm
10	10mm	11.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
3	Extension in 316SS
4	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Weldolet size	A	B1	B
BW1.5'40	1.5'Sch40	48	41	16
BW1.5'80	1.5'Sch80	48	38	16
BW1.5'160	1.5'Sch160	48	34	16
BW1.5'XXS	1.5'SchXXS	48	28	16
BW2'40	2'Sch40	60	52	16
BW2'80	2'Sch80	60	49	16
BW2'160	2'Sch160	60	43	16
BW2'XXS	2'SchXXS	60	38	16

Note:'B' will be 19mm for sheath dia of 8mm And 22mm for sheath dia of 10mm. 'B1' will be B+3

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Well Type
W	Weld-in

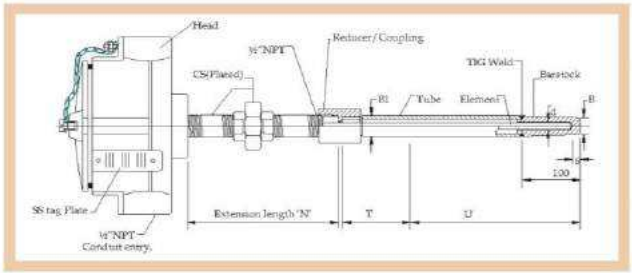
Code	Well Material
316	316SS
304	304SS
321	321SS
inc6	Inconel 600

ORDERING EXAMPLE

550# SERIES 1-K-6-316-D-1-316-W-U=250-T=70-BW1.5'40-Op0

TRM GROUP

MI Thermocouple & RTD – 500 Series



560# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Built up Weld -in well with tail portion in bar stock.
- Built up from seamless tubes.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire
- Temperature Transmitter.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal Head, and provided with head extension and built up Weld in Thermowell would form a typical complete assembly ready for use in the application designed for.

Thermowells are built up from seamless tubes with tail portion of 100mm made from bar stock and TIG welded. These wells are suitable for welding onto a straight through socket. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Incoloy 800, Inconel 600, 446SS.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of ½"NPT and ungrounded Junction for Thermocouples unless specified otherwise.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constanton
E	Chromel-Constanton
N	Nicrosil-Nisil
Pt	Pt100 RTD

Code	Sheath Dia	'd'
6	6mm	7.0mm
8	8mm	9.0mm
10	10mm	10.0mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Extension in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Well Type
W	Weld-in

Code	Well Extension
T	Define

Code	Well Insertion
U	Define

Code	Well Dimensions B1 x Wt	B
3/8" Sch80	17.15 x 3.18	12.7
½" Sch80	21.30 x 3.73	16.0
3/4" Sch80	26.60 x 3.91	22.0

Other Dimensions also available.

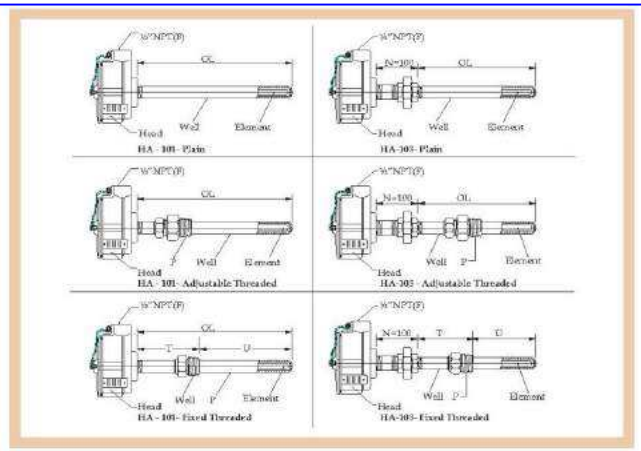
Code	Well Material
316	316SS
304	304SS
321	321SS
Inc6	Inconel 600

ORDERING EXAMPLE

560# SERIES 1-K-6-316-D-1-316-1/2"Sch80-U=640-T=30-W-Op0

TRM GROUP

MI Thermocouple & RTD – 600 Series



600# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Protecting Tube.
- Built up from seamless tubes, plain or threaded connection.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
E	Chromel-Constantan
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia
6	6mm
8	8mm
10	10mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Head Assembly
HA101	Head only
Ha103	Head with Nipple & Union

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	'P'
FT	Fixed Threaded
AT	Adjustable Threaded
PL	Plain(None)
	Define Thread details

Code	Well Extension
T	Define
X	Not Applicable

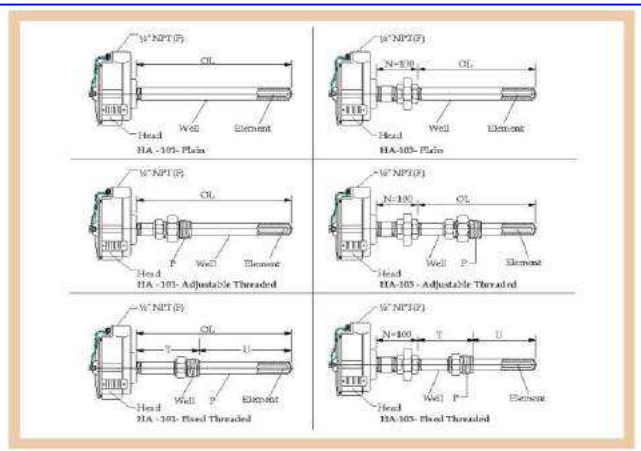
Code	Well Insertion
U	Define
OL	Define Overall length

Code	Tube Dimensions OD x Wt
1/8"Sch80	10.29x2.41
1/4"Sch80	13.72x3.02
3/8"Sch80	17.15x3.18
½"Sch80	21.30x3.73
½"Sch160	21.30x4.75
3/4"Sch80	26.60x3.91
3/4"Sch160	26.60x5.53
	Other Dimensions also available.

Code	Well Material
304	316SS
316	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

600# SERIES 1-K-6-316-D-1-HA101-316-1/2"Sch160-U=640-T=30-FT-1"NPT-Op0



601# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Solid, closed end Protecting Tube.
- Made from drilled bar stock, plain or adjustable or welded(Fixed) threaded connection.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

Code	No of Elements
1	Simplex
2	Duplex
3	Triplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
E	Chromel-Constantan
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%
Pt	Pt100 RTD

Code	Sheath Dia
6	6mm
8	8mm
10	10mm

Code	Sheath Material
316	316SS
321	321SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Head Assembly
HA101	Head only
Ha103	Head with Nipple & Union

Code	Options
0	None
1	Head in 304 SS
2	Head in 316SS
3	Extension in 304SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	'P'
FT	Fixed Threaded
AT	Adjustable Threaded
PL	Plain(None)
	Define Thread details

Code	Well Extension
T	Define
X	Not Applicable.

Code	Well Insertion
U	Define
OL	Define Overall length

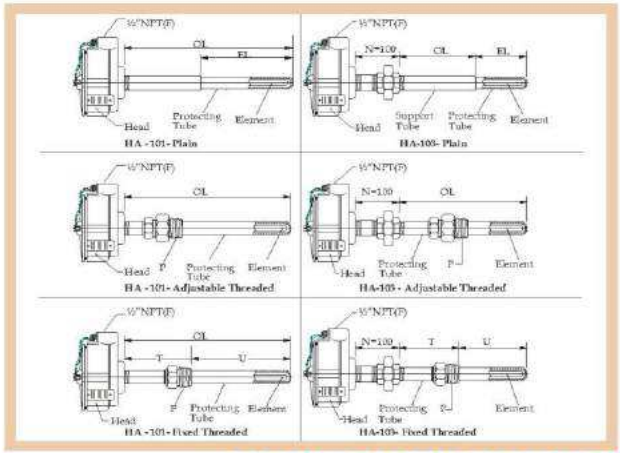
Code	Well 'OD'
01	10
02	14
03	17
04	19
05	22
06	26
07	33
	Other Dimensions are also available.

Code	Well Material
316	316SS
304	304SS
321	321SS
446	446SS

ORDERING EXAMPLE

601# SERIES 1-K-6-316-D-1-HA101-316-05-U=640-T=30-FT-1"NPT-Op3

MI Thermocouple & RTD – 600 Series



602# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Twin, closed end Protective Tubes.
- Plain or adjustable or welded(Fixed) threaded connection.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

Code	Thermocouple Type
MI	Mineral Insulated & Metal Sheathed.
BE	Thermocouple element insulated With ceramic Tube(beaded type)

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
K	Chromel-Alumel
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%

Code	Sheath Dia for MI	Code	Wire Dia For BE
3	3.0mm	24	24AWG
4.5	4.5mm	20	20AWG
6.0	6.0mm	18	18AWG
8.0	8.0mm	16	16AWG
10	10mm	14	14AWG
12	12mm	08	8AWG

Code	Sheath Material
Inc	Inconel 600
X	None

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Head Assembly
HA101	Head only
He103	Head with Nipple & Union

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	'P'
FT	Fixed Threaded
AT	Adjustable Threaded
PL	Plain(None)

Define Thread details

Code	Well Extension
T	Define
X	Not Applicable

Code	Well Insertion
U	Define
OL	Define Overall length

Code	Outer Protecting Tube
710	Recrystallized Alumina
610	Pythagoras
AF	Kanthal AF
APM	Kanthal APM
446	SS446

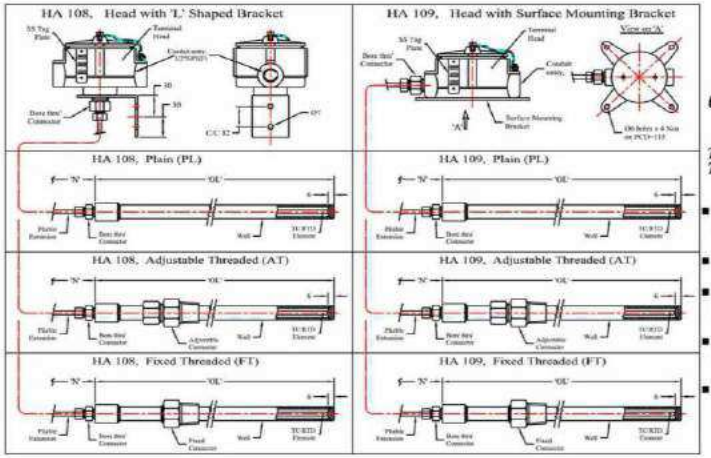
Define dimensions

Code	Inner Protecting Tube
Ker 710	Recrystallised Alumina
Ker 610	Pythagoras

Dimension 15x2.5 or 12x2

ORDERING EXAMPLE

602# SERIES BE-1-S-24-X-F-1-HA101-KER710(12x8)-446(21.3x2.65)-OL=1500-X-AT(1'NPT)-Op2



605# Series

Thermocouple & Resistance Thermometer Assemblies,with

- A Remote Mounted Head or Junction Box
- A Protective Tube.
- Built up from seamless tubes, plain or threaded connection.
- Flameproof or weatherproof execution in 316SS or Al
- Available with "in head" 2-wire Temperature Transmitter.

605 Series

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
E	Chromel-Constantan
N	Nicrosil-Nisil
Pt	Pt 100 RTD

Code	Sheath Dia
6	6mm
8	8mm
10	10mm

Code	Sheath Material
316	316 SS
321	321 SS
310	310 SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of Entries
1	One Entry
2	Two Entry

Code	Head Assembly
HA108	Remote mounted with 'L' Shaped bracket
HA109	Remote mounted with surface mounting bracket

Code	Head Extension
N	Define

Code	Options
0	None
1	Head in 304 SS
2	Head in 316 SS
3	Extension in 304 SS
4	Extension in 316 SS
5	Other Conduit entry
6	In head Transmitter
10	Special requirement

Code	'P'
FT	Fixed Threaded
AT	Adjustable threaded
PL	Plain (None)

Define thread details

Code	Well Extension
T	Define
X	Not applicable

Code	Length
U	Define insertion
OL	Define overall length

Code	Tube Dimensions OD x W/t (Nearest)
1/8"Sch80	10 x 2.5
1/4"Sch80	14 x 3
3/8"Sch80	17 x 3
1/2"Sch80	21 x 4
1/2"Sch160	21 x 5
3/4"Sch80	27 x 4
3/4"Sch160	27 x 5.5

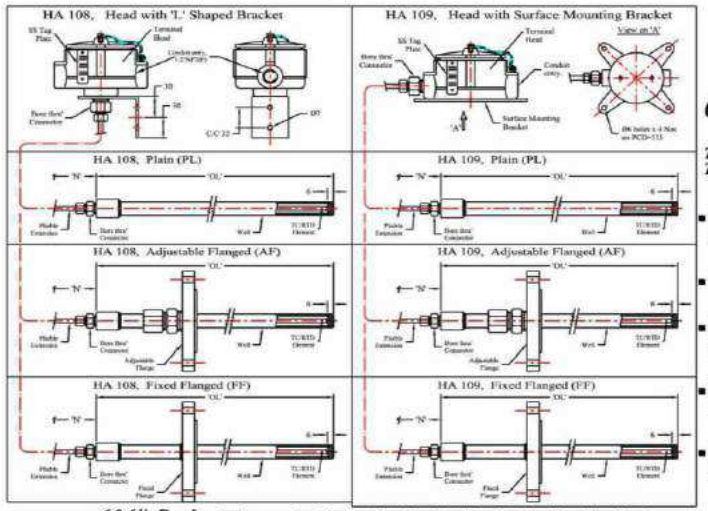
Other dimensions also available.

Code	Well Material
A106	CS to A106 GrB
316	316 SS
304	304 SS
321	321 SS
446	446 SS
310	310 SS
Inc 6	Incoloy 600
Inc 8	Incoloy 800
253 MA	253MA

ORDERING EXAMPLE

605 SERIES 1-K-6-316-D-1-HA 108-N=1500-316-1/2"Sch 80-U=650-T=30-FT(1"NPT)-OPTION 3

MI Thermocouple & RTD – 600 Series



606# Series

Thermocouple & Resistance Thermometer Assemblies,with

- A Remote Mounted Head or Junction Box
- A Protective Tube.
- Built up from seamless tubes, plain or Flanged connection.
- Flameproof or weatherproof execution in 316SS or Al
- Available with "in head" 2-wire Temperature Transmitter.

606# Series

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
E	Chromel-Constantan
N	Nicrosil-Nisil
Pt	Pt 100 RTD

Code	Sheath Dia
6	6mm
8	8mm
10	10mm

Code	Sheath Material
316	316 SS
321	321 SS
310	310 SS
Inc	Inconel 600

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of Entries
1	One Entry
2	Two Entry

Code	Head Assembly
HA108	Remote mounted with 'L' Shaped bracket
HA109	Remote mounted with surface mounting bracket

Code	Head Extension
N	Define

Code	Options
0	None
1	Head in 304 SS
2	Head in 316 SS
3	Extension in 304 SS
4	Extension in 316 SS
5	Other Conduit entry
6	In head Transmitter
10	Special requirement

Code	'P'
FF	Fixed Flange
AF	Adjustable Flange
PL	Plain (None)

Define Flange details & MoC

Code	Well Extension
T	Define
X	Not applicable

Code	Length
U	Define insertion
OL	Define overall length

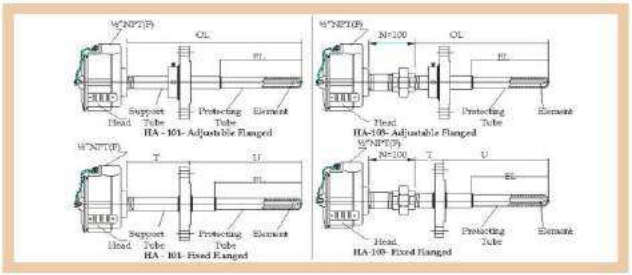
Code	Tube Dimensions OD x W/t (Nearest)
1/8"Sch80	10 x 2.5
1/4"Sch80	14 x 3
3/8"Sch80	17 x 3
1/2"Sch80	21 x 4
1/2"Sch160	21 x 5
3/4"Sch80	27 x 4
3/4"Sch160	27 x 5.5

Other dimensions also available.

Code	Well Material
A106	CS to A106 GrB
316	316 SS
304	304 SS
321	321 SS
446	446 SS
310	310 SS
Inc 6	Incoloy 600
Inc 8	Incoloy 800
253 MA	253MA

ORDERING EXAMPLE

606# SERIES 1-K-6-316-D-1-HA 108-N=1500-316-1/2"Sch 80-U=650-T=70-FF(1"150#RF)-OPTION 3



611# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Protecting tube of ceramic.
- Metallic support tube with fixed or adjustable flange.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

611# series thermocouple assemblies are employed for temperature measurements of furnaces, combustion chambers, recuperators and similar applications.

The closed end Protecting tube normally employed is re-crystallized Alumina Type 710 containing 99.7% Aluminium oxide & conforming to Type 799 as per DIN VDE 0335 & can be used for temperatures upto 1700 Deg C. These tubes are impervious and are fixed to metallic support tube by means of ceramic to metal cement.

The Thermocouple wire size when used as a beaded thermocouple is 24 AWG (0.51mm) for type 'R', 'S' and 'B' & 14AWG for all base metal Thermocouples.

Code	Thermocouple Type
MI	Mineral Insulated & Metal Sheathed
BE	Thermocouple element insulated With ceramic Tube(beaded type)

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
K	Chromel-Alumel
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%

Code	Sheath Dia for MI	Code	Wire Dia For BE
3	3.0mm	24	24AWG
4.5	4.5mm	20	20AWG
6.0	6.0mm	18	18AWG
6.0	8.0mm	16	16AWG
10	10mm	14	14AWG
12	12mm	08	8AWG

Code	Sheath Material
Inc	Inconel 600
X	None

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Head Assembly
HA101	Head only
Ha103	Head with Nipple & Union

Code	Support Tube
Inc8	Incoloy 800
446	446SS
Inc6	Inconel 600
310	310SS

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Flange details
FF	Fixed Flanged
AF	Adjustable Flanged

Define Flange size, rating and facing

Code	Extension Length
T	Define
X	Not Applicable

Code	Overall/Insertion/exposed length
U/EL	Define insertion & exposed length
OL/EL	Define Overall & exposed length.

Code	Flange Material
A105	ASTM A105 (CS)
F316	ASTM A182 F316

Other materials are also available. Define grades

Code	Tube Dimension (ODxw/t)
8	8 x 1.0
8	8 x 1.5
10	10 x 2.0
12	12 x 2.0
15	15 x 2.5
20	20 x 2.5
24	24 x 3.0

Code	Protecting Tube
Ker 710	Recrystalised Alumina
Ker 610	Pythagoras

Standard dimension 15x2.5 or 12x2

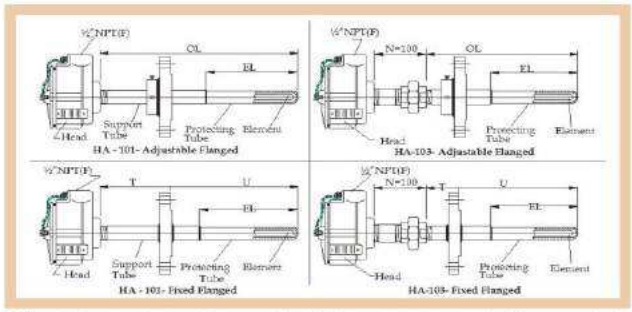
ISO 9001

ORDERING EXAMPLE

611# SERIES MI-2-R-6-Inc-D-2-310-KER710(15x2.5)-APM(26x2.9)-U=760-T=60-FF(1.5"150#RF)-Op4,10

TRM GROUP

MI Thermocouple & RTD – 600 Series



612# Series

Thermocouple & Resistance Thermometer Assemblies with

- A Twin, closed end Protective Tubes.
- Metallic support tube with fixed or adjustable flange.
- Certified for use in hazardous area.
- Available with "in-head" 2-wire Temperature Transmitter.

612# series thermocouple assemblies are employed for temperature measurements of furnaces, combustion chambers, recuperators and similar applications. These are provided with twin protecting tubes.

The closed end Protecting tube normally employed is re-crystallized Alumina Type 710 containing 99.7% Aluminium oxide & conforming to Type 799 as per DIN VDE 0335 & can be used for temperatures upto 1700 Deg C. These tubes are impervious and are fixed to metallic support tube by means of ceramic to metal cement.

The Thermocouple wire size when used as a beaded thermocouple is 24AWG (0.51mm) for type 'R', 'S' and 'B' & 14AWG for all base metal Thermocouples.

Code	Thermocouple Type
MI	Mineral Insulated & Metal Sheathed
BE	Thermocouple element insulated

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
K	Chromel-Alumel
N	Nicrosil-Nisil
R	PtRh 13%-Pt
S	PtRh 10%-Pt
B	PtRh30%-PtRh6%

Code	Sheath Dia for MI	Code	Wire Dia For BE
3	3.0mm	24	24AWG
4.5	4.5mm	20	20AWG
6.0	6.0mm	18	18AWG
8.0	8.0mm	16	16AWG
10	10mm	14	14AWG
12	12mm	08	8AWG

Code	Sheath Material
Inc	Inconel 600
X	None

Code	Head Type
D	Weatherproof
F	Flameproof IIA/ B
C	Flameproof IIC
JB	Junction Box

Code	No of entries
1	One entry
2	Two entries

Code	Head Assembly
HA101	Head only
Ha103	Head with Nipple & Union

Code	Support Tube
Inc8	Incoloy 800
446	446SS
Inc6	Inconel 600
310	310SS

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
3	Extension in 304SS
4	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement

Code	Flange details
FF	Fixed Flanged
AF	Adjustable Flanged

Define Flange size, rating and facing

Code	Extension Length
T	Define
X	Not Applicable

Code	Overall/insertion/exposed length
U/EL	Define Insertion length
OL/EL	Define Overall length.

Code	Flange Material
A105	ASTM A105 (CS)
F316	ASTM A182 F316

Other materials are also available. Define grades

Code	Outer Protecting Tube
710	Recrystallized Alumina
610	Pythagoras
AF	Kanthal AF
APM	Kanthal APM
446	SS446

Define dimensions

Code	Protecting Tube
Ker 710	Recrystallised Alumina
Ker 610	Pythagoras

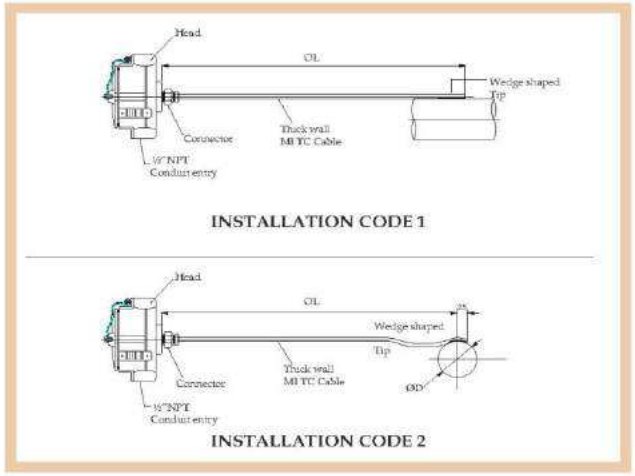
Dimension 15x2.5 or 12x2

ORDERING EXAMPLE

612# SERIES MI-2-R-6-Inc-D-2-310-KER710(15x2.5)-APM(26x2.9)-U=760-T=60-FF(1.5"150#RF)-Dp4.10

TRM GROUP

MI Thermocouple & RTD – 800 Series



800# Series

Wedge Shaped (Knife Edge)

Skin Thermocouples

- Almost accurate temperature measurement of :
  Fired Heater tubes
  Boiler Tubes
  Reformer tubes
- Thick wall for longer usage life.
- Grounded hot junction in a "Wedge Shaped" tip for direct welding to tube surface.
- Certified for use in hazardous area.
- Many Thermocouple Types and sheath materials to choose from.

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
E	Chromel-Constanton
N	Nicrosil Nisil

Code	Sheath Dia	Nominal wire gauge (S)	(D)
12.7	12.7mm	14AWG	16AWG
10.0	10.0mm	16AWG	18AWG

Code	Sheath Material
446	446SS
310	310SS
Inc 6	Inconel 600
Inc 8	Incoloy 800

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	JunctionBox

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
31	Spring loaded cover
32	UnGrounded junction

Code	Tube OD
D	Define

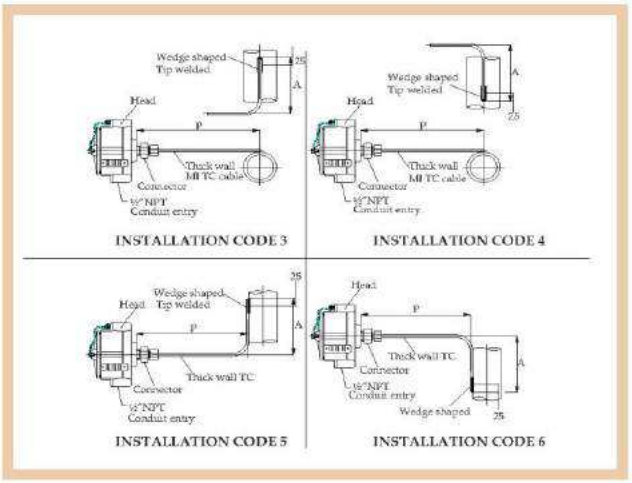
Code	Overall Length
OL	Define OL=U+T+95

Code	Expansion Loop
N	None

Code	Installation Type
1	Axial with tube
2	Perpendicular to tube axis

Code	No of entries
1	One entry
2	Two entries

ORDERING EXAMPLE
800# SERIES 1-K-12.7-446-D-1-1-N-OL-D-Op0



810# Series

Wedge Shaped (Knife Edge)

Skin Thermocouples

- Almost accurate temperature measurements of :
  Fired Heater tubes
  Boiler Tubes
  Reformer tubes
- Thick wall for longer usage life.
- Grounded hot junction in a "Wedge Shaped" tip for direct welding to tube surface.
- Certified for use in hazardous area.
- Retaining Clamp furnished.
- Many Thermocouple Types and sheath materials to choose from.

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
E	Chromel-Constanton
N	Nicrosil Nisil

Code	Sheath Dia	Nominal wire gauge (S)	(D)
12.7	12.7mm	14AWG	16AWG
10.0	10.0mm	16AWG	18AWG

Code	Sheath Material
446	446SS
310	310SS
Inc 6	Inconel 600
Inc 8	Incoloy 800

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC
JB	Junction Box

Code	No of Entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
31	Spring loaded cover
32	UnGrounded junction

Code	Tube OD
D	Define

Code	Axial Length
A	Define A

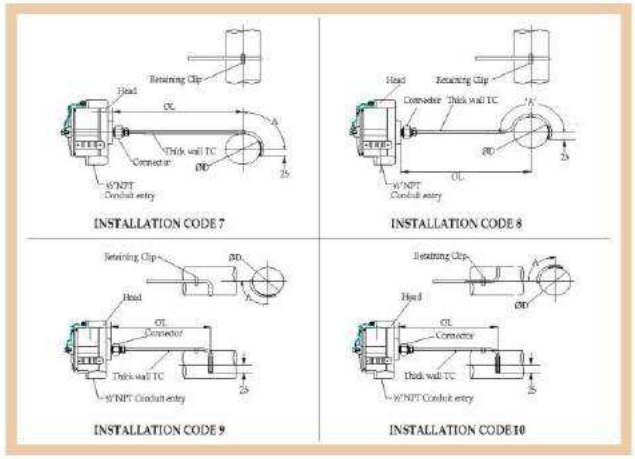
Code	Perpendicular Length
P	Define P=U+T+95

Code	Expansion Loop
N	None

Code	Installation Type
3	Perpendicular to tube axis & 90° left Coaxial bend.
4	Perpendicular to tube axis & 90° right Coaxial bend.
5	Perpendicular to tube axis & 90° left 'side' bend.
6	Perpendicular to tube axis & 90° right 'side' bend.

ORDERING EXAMPLE
810# SERIES 1-K-12.7-446-D-1-1-N-P--A-D-Op0

MI Thermocouple & RTD – 800 Series



820# Series

Wedge Shaped (Knife Edge)

Skin Thermocouples

- Almost accurate temperature measurements of :
  Fired Heater tubes
  Boiler Tubes
  Reformer tubes
- Thick wall for longer usage life.
- Grounded hot junction in a "Wedge Shaped" tip for direct welding to tube surface.
- Certified for use in hazardous area.
- Hot end designed tow rap round the tube.
- Many Thermocouple Types and Sheath materials to choose from.

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
E	Chromel-Constanton
N	Nicrosil Nisil

Code	Sheath Dia	Nominal wire gauge (S)	Nominal wire gauge (D)
12.7	12.7mm	14AWG	16AWG
10.0	10.0mm	16AWG	18AWG

Code	Sheath Material
446	446SS
310	310SS
Inc 6	Inconel 600
Inc 8	Incoloy 800

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	No of Entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
31	Spring loaded cover
32	UnGrounded junction

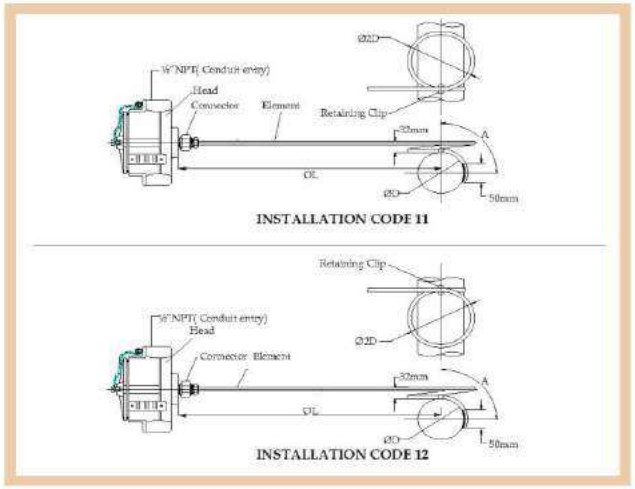
Code	Tube OD
D	Define

Code	Overall Length
OL	Define OL=U+T+95

Code	Expansion Loop
N	None

Code	Installation Type
7	Perpendicular to tube axis & with wrap around angle A=90°
8	Perpendicular to tube axis & with wrap around angle A=180°
9	Axial with tube with wrap around angle A=90° on right side of tube
10	Axial with tube with wrap around angle A=90° on left side of tube

ORDERING EXAMPLE
820# SERIES 1-K-12.7-446-D-1-8-N-OL-D-Op0



830# Series

Wedge Shaped (Knife Edge)

Skin Thermocouples

- Almost accurate temperature measurements of :
  Fired Heater tubes
  Boiler Tubes
  Reformer tubes
- Thick wall for longer usage life.
- Grounded hot junction in a "Wedge Shaped" tip for direct welding to tube surface.
- Certified for use in hazardous area.
- Expansion loop furnished.
- Hot end designed to wrap round the tube
- Many Thermocouple Types and sheath materials to choose from.
- Retaining Clamp furnished.
  Hot end designed to wrap round the tube

Code	No of Elements
1	Simplex
2	Duplex

Code	Elements
J	Iron-Constantan
K	Chromel-Alumel
E	Chromel-Constanton
N	Nicrosil Nisil

Code	Sheath Dia	Nominal wire gauge (S)	Nominal wire gauge (D)
12.7	12.7mm	14AWG	16AWG
10.0	10.0mm	16AWG	18AWG

Code	Sheath Material
446	446SS
310	310SS
Inc 6	Inconel 600
Inc 8	Incoloy 800

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IB
C	Flameproof IIC
JB	Junction Box

Code	Options
0	None
1	Head in 304SS
2	Head in 316SS
5	Other Conduit entry
6	In Head Transmitter
7	Brass Cable Gland
8	SS Cable Gland
10	Special requirement
31	Spring loaded cover
32	UnGrounded junction

Code	Tube OD
D	Define

Code	Overall Length
OL	Define OL=U+T+95

Code	Expansion Loop
Y	2 times the dia 'D'

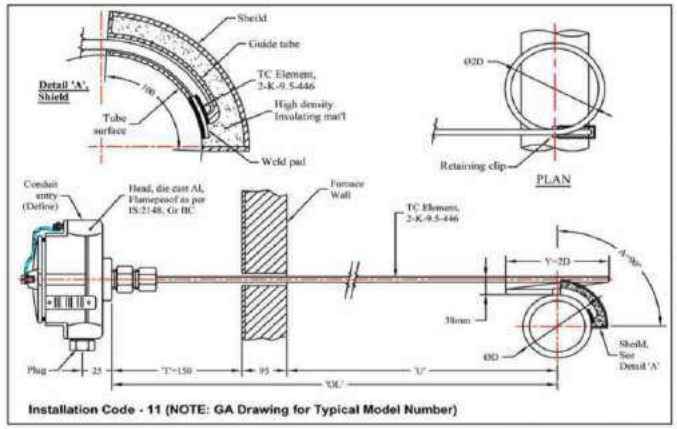
Code	Installation Type
11	Perpendicular to tube axis with left loop and wrap around angle A=90°
12	Perpendicular to tube axis with right loop and wrap around angle A=90°

Code	No of Entries
1	One entry
2	Two entries

ORDERING EXAMPLE
830# SERIES 1-K-12.7-446-D-1-12-Y-OL-D-Op0

TRM GROUP

MI Thermocouple & RTD – 800 Series



Installation Code - 11 (NOTE: GA Drawing for Typical Model Number)

830E# Series "Replaceable" Skin Thermocouples

- Almost accurate temperature measurements of :-
  - Fired heater tubes
  - Boiler tubes
  - Reformer tubes
- Provided with a Shield & densely packed insulation
- Replaceable in existing guide tube & welded pad, eliminating another weld joint
- Flameproof or weatherproof execution

Measurement of surface temperature of Refinery fired heater tubes is difficult because of high temperature gases and fumes which surrounds these tubes. These gases are 300°C to 400°C hotter than the heater tube at that point of measurement. This aspect and the heat transfer along the length of Thermocouple sheath to its point of attachment on the heater tube tends to cause the Thermocouple to show relatively higher temperature than the desired wall temperature. This problem can get aggravated if there is direct flame impingement at the point of attachment of Thermocouple to the heater tube.

Best results can be obtained by providing a shield over the hot junction which would prevent effect of higher temperature of surrounding gases.

In the event the Thermocouple needs to be replaced during shut down, another welding for weld pad need not be carried out. The new Thermocouple can be installed in the existing weld pad, through its guide tube. This is the distinct advantage of this design of Thermocouple.

830E# Series

Code	No of Elements
1	Simplex(S)
2	Duplex(D)

Code	Type of Element
K	Chromel-Alumel
N	Nicrosil-Nisil

Code	Sheath dia	Nominal wire gauge (S)
6.35	6.35	16 AWG
9.50	9.50	14 AWG

Code	Sheath Material
446	446 SS
310	310 SS
Inc 6	Inconel 600
Alloy TD	Alloy TD

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC

Code	No of Entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in SS304
2	Head in SS316
10	Special requirement
15	Grounded junction

Code	Tube 'OD'
D	Define 'D'

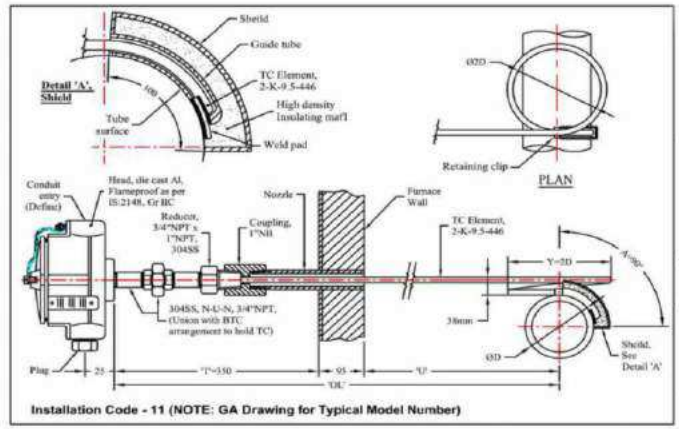
Code	Overall Length
OL	Define

Code	Expansion loop
Y	2 times the dia 'D'

Code	Installation Type
11	Perpendicular to tube axis with left loop and wrap around angle A=90°.
12	Perpendicular to tube axis with right loop and wrap around angle A=90°.

ORDERING EXAMPLE

830E# SERIES 2-K-9.5-446-D-2-11-Y-OL-D-OPTION 15



Installation Code - 11 (NOTE: GA Drawing for Typical Model Number)

830F# Series "Replaceable" Skin Thermocouples

- Almost accurate temperature measurements of :-
  - Fired heater tubes
  - Boiler tubes
  - Reformer tubes
- Provided with a Shield & densely packed insulation
- Replaceable in existing guide tube & welded pad, eliminating another weld joint
- Flameproof or weatherproof execution

Measurement of surface temperature of Refinery fired heater tubes is difficult because of high temperature gases and fumes which surrounds these tubes. These gases are 300°C to 400°C hotter than the heater tube at that point of measurement. This aspect and the heat transfer along the length of Thermocouple sheath to its point of attachment on the heater tube tends to cause the Thermocouple to show relatively higher temperature than the desired wall temperature. This problem can get aggravated if there is direct flame impingement at the point of attachment of Thermocouple to the heater tube.

Best results can be obtained by providing a shield over the hot junction which would prevent effect of higher temperature of surrounding gases.

In the event the Thermocouple needs to be replaced during shut down, another welding for weld pad need not be carried out. The new Thermocouple can be installed in the existing weld pad, through its guide tube. This is the distinct advantage of this design of Thermocouple.

830F# Series

Code	No of Elements
1	Simplex(S)
2	Duplex(D)

Code	Type of Element
K	Chromel-Alumel
N	Nicrosil-Nisil

Code	Sheath dia	Nominal wire gauge (S)
6.35	6.35	16 AWG
9.50	9.50	14 AWG

Code	Sheath Material
446	446 SS
310	310 SS
Inc 6	Inconel 600
Alloy TD	Alloy TD

Code	Head Type
D	Weatherproof
F	Flameproof IIA/IIB
C	Flameproof IIC

Code	No of Entries
1	One entry
2	Two entries

Code	Options
0	None
1	Head in SS304
2	Head in SS316
10	Special requirement
15	Grounded junction

Code	Tube 'OD'
D	Define 'D'

Code	Overall Length
OL	Define

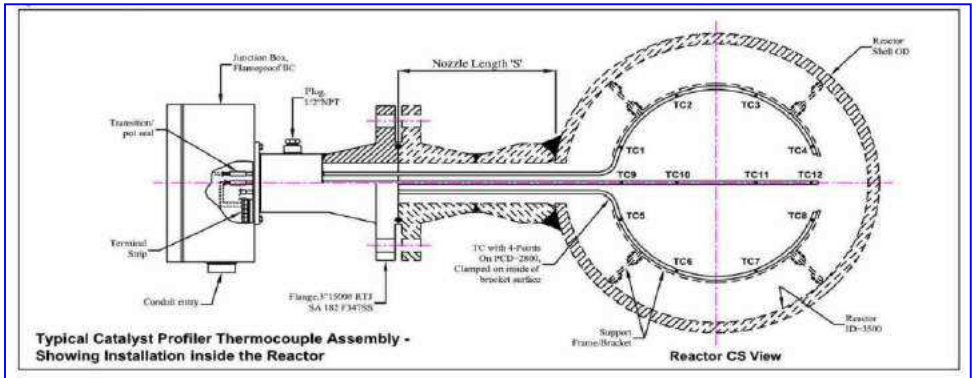
Code	Expansion loop
Y	2 times the dia 'D'

Code	Installation Type
11	Perpendicular to tube axis with left loop and wrap around angle A=90°.
12	Perpendicular to tube axis with right loop and wrap around angle A=90°.

ORDERING EXAMPLE

830F# SERIES 2-K-9.5-446-D-2-11-Y-OL-D-OPTION 10, 15

MI Thermocouple & RTD – 900 Series



Typical Catalyst Profiler Thermocouple Assembly - Showing Installation inside the Reactor

Reactor CS View

- **Catalyst profiler Thermocouple Assembly triumph over regular Multipoint Thermocouple Assembly**
  - ***Catalyst profiler Multipoint Thermocouple assembly comprises of one or more mineral insulated Thermocouple cable with several hot junctions along the length.***
  - ***Assembly can be designed to provide several sensing points to measure the Temperature inside the vessel.***
  - ***Each sensing point is independent & isolated from one another & ungrounded from sheath.***
  - ***Seamless sheath along the entire length ensures usage at very high operating pressures. The welded end of the sheath is checked by N2 pressure test at 100 Bar.***
  - ***Welded to mounting flange & provided with secondary containment chamber to ensure safe & reliable operation for use in high pressure vessels.***
  - ***Sensing points can be placed anywhere inside the vessel or catalyst bed, with minimum mounting hardware.***
  - ***Catalyst profiler Multipoint Thermocouple assembly can be designed for use on Retrofit vessel or on Reactor or on any other hydrocarbon storage equipment & our scope could also include design, supply, installation & commissioning of the temperature profiling system.***
  - ***Can be supplied with 2-Wire Temperature Transmitter of reputed Make with HART ®, Fieldbus ® or Profibus ® protocol.***

965# Series

Code	No of TC Points
2	Two
3	Three
4	Four
6	Six
9	Nine

Code	Each TC Element
1	Simplex

Code	Element Type
K	Chromel-Alumel
E	Chromel-Constantan
As per IEC 584 / ANSI MC 96.1	

Code	Sheath diameter
6.0	6.0 mm
8.0	8.0 mm
9.5	9.5 mm
12.7	12.7 mm

Code	Sheath Material
316	SS 316
321	SS 321
347	SS 347
Inc 6	Inconel 600

Code	Junction Box
JC	Flameproof IIC

Code	Options
0	None
6	JB with Temperature Transmitter
10	Special requirement

Code	Extension length
N	Define

Code	TC Location
'U1' to 'U9'	Refer Drg or Model No.

Code	Process Connection
P	3"1500#RTJ, A182 F347

Code	Secondary Seal
CC	Containment Chamber
X	None

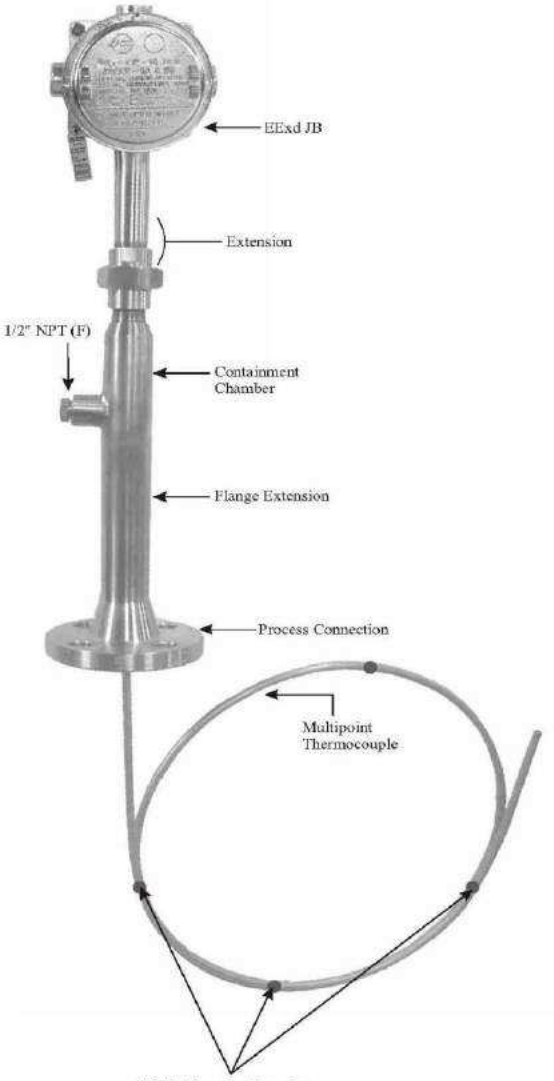
Code	Primary Seal
PGS	Packing gland with SS Ferrule
PGL	Packing gland with Lava Seal
W	Welded to Flange

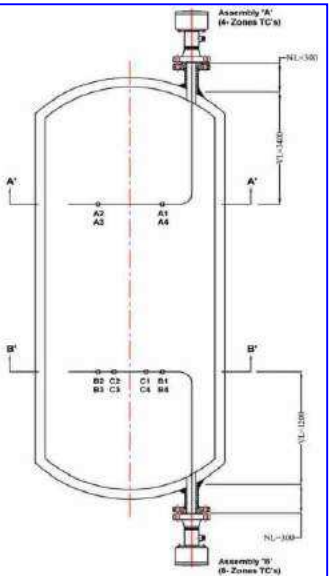
Code	No. conduit entries
2	Two (1.5"NPT)

ISO 9001

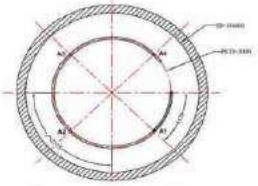
ORDERING EXAMPLE

965# Series -9-1-K-9.5-347-JC-2-X-X-P=3"1500#RTJ(F347)-'U1' to 'U9'-N=3M-Option 10

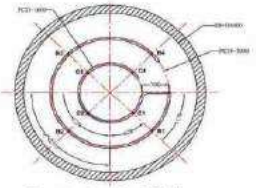




Reactor Elevation Showing Nozzles for Multipoint Thermocouples



Reactor Section A'-A' Showing HJ Locations A1 to A4



Reactor Section B'-B' Showing HJ Locations B1 to B4 and C1 to C4

TRM GROUP

Thermocouple Manufacturing Equipment by TET Ltd

1. INTRODUCTION

THERMOCOUPLE EQUIPMENT TECHNOLOGY (TET) LTD IS THE LATEST ADDITION TO THE TRM GROUP OF COMPANIES.

Led by the Mineral Insulated Cable Company (MICC) Ltd, TET was formed by acquisition of the award winning TET Ltd – A global supplier of thermocouple manufacturing equipment.

TET Ltd will support MICC Ltd in strengthening its position of one of the worlds leading mineral insulated cable manufacturing companies.

This new partnership will give MICC the unique competitive advantage of being able to offer a total 'end to end solution' to the global temperature sensor manufacturing industry.

We are proud to be a North East business and as we are part of the TRM Group we are North East England Ambassadors, helping strengthen the regions image and supporting local global business relationships.

With over 250 machines sold worldwide the TET and MICC partnership provides many unique business advantages;

- Consultancy / Technical advice service
- Industry standard machinery or bespoke design, we have the solution for;
  - o Welding machines
  - o Drilling machines
  - o Cable striping machines
  - o Calibration solutions
- A wide range of associated accessories
- World widest range of MI cable and accessories
- Save time and money;
  - o Innovative technologies make manufacture faster & easier!
  - o Don't waste time searching the market what you need.
  - o Benefit from 'valued' customer multi-buy discounts.

Passionate about temperature

north east england

2. WELDING MACHINE

The New revised version of the TET MI Thermocouple welding machine incorporates a new weld torch assembly and a new vice jaw arrangement for easier changing of thermocouple sizes.

ISO 9001 Registered Company

sira CERTIFICATION SERVICE

UKAS QUALITY MANAGEMENT 011

A comprehensive tool kit and extended manual is provided with all Welders. Key features include;

- Welds all Mineral Insulated thermocouples from 1.0mm to 6.0mm
- Fully automatic weld cycle under microprocessor control
- Both conductors and sheath closure weld carried out on one machine
- Removable Microscope included with optical light guide for maximum visibility
- Separate weld actions for conductors and sheath closure (CD & TIG)
- Automatic recharge on CD ready for next weld
- TIG weld has slope-up and slope-down functions for accurate weld control envelope
- Bench mounted
- Single phase supply

This machine is specifically designed for welding the hot junctions of mineral insulated thermocouples. Either Earthed (Bonded) Junction or Insulated Junction welds can be accommodated. The machine will weld thermocouples from1.0mm to 6.0 mm outside diameter. The welder is divided into two sections to accommodate the two welding processes associated with the junction of an MI thermocouple.

TRM GROUP

Thermocouple Manufacturing Equipment by TET Ltd

3. ULTRASONIC WELDING MACHINE

New products in development include an Ultrasonic Welding machine designed to attach flexible wire strands to the conductors of MI thermocouples.

Ultrasonics' are good at this type of welding and have several advantages over traditional methods.

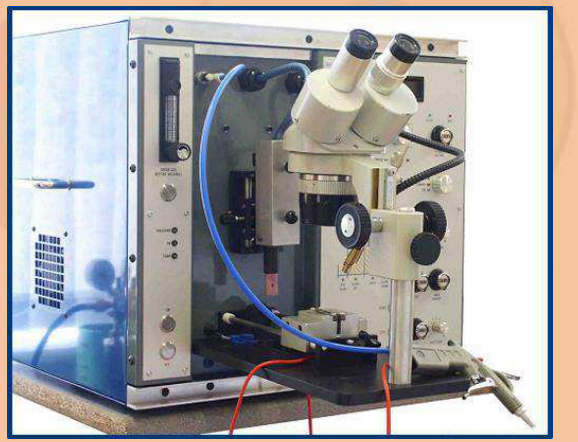
In comparison with electrical spot welding there is;

1. No burning,
2. No heat affected zone,
3. No embrittlement
4. And materials hard to weld electrically will readily weld ultrasonically.

In comparison with soldering there is;

1. No flux residue
2. And no flame required so the weld can be much closer to the wire insulation.

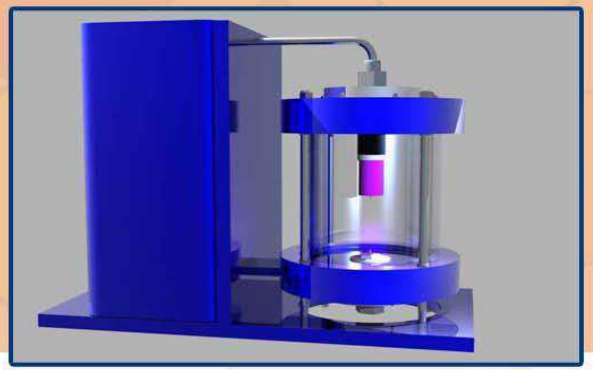
The new design will weld both conductor to their respective flex wires in one operation which will improve not only the quality and repeatability of the actual welds but will reduce the time needed for this operation.



4. ION PULSE WELDER

Welding sub 1mm MI Thermocouples using Ion Pulse Technology

This revolutionary new welding machine uses Ion pulse technology to create a controlled clean weld on sub-millimetre MI Thermocouples. The basic principle utilises a cross between TIG welding and vacuum plasma welding but unlike costly vacuum plasma welders the heat energy source components are simple and require very little maintenance.



- Low Cost alternative to Laser Welding
- Consistent Weld quality
- Conductor and sheath closure welding
- Quick turnaround
- No alignment problems
- Clean Oxide free Welds
- Long cables accommodated
- Automatic Weld control
- Low running costs
- Reduced strip down

Thermocouple Manufacturing Equipment by TET Ltd

5. PRECISION DRILLING MACHINE

This new Drilling Machine is designed to remove the insulation from the end of a prepared sample of M.I. cable in order to facilitate a complete welded measurement junction.

The insulation is removed along with a section of conductor by drilling the end of the cable precisely to the required depth. The machine cleanly cuts away the conductors without twisting them together at the same time as removing the insulation.

- Sizes from 1.0mm to 6.0mm MI cables
- Precise alignment even at 1mm
- Reduces preparation time
- Selectable footswitch Control option
- Selectable speeds up to 4000rpm
- Comprehensive accessories
- All drills, guides and collets supplied
- Bench fixing kit
- Full printed instruction manual (pdf also available on CD or via e-mail)

6. ULTRASONIC STRIPPING

The New TET UCES-400 uses powerful pulses of Ultrasonic energy to strip the sheath from mineral insulated cable.

The ultrasonic energy transfers to the insulation on contact and de-compacts and liquefies the powder, which escapes from the end of the cable.

The result is that all the powder in the stripped section is cleanly removed leaving the conductors completely untouched.

The whole action is completed in seconds (in the case of small cables in a fraction of a second).

All cable sizes can be accommodated from 1.0mm (0.04") to 6.0mm (or ¼")

The only preparation needed prior to stripping is to ring through the sheath at the break point (up to 25mm from the cable end).
The machine is supplied with a ringing tool and a pair of electronic side cutting pliers for the smaller sizes.

There are four mechanisms affecting the stripping action;
1. Cable size
2. The length being stripped
3. Powder density (Supplier dependant)
4. 'Grip'

Thermocouple Manufacturing Equipment by TET Ltd

7. CABLE END HEATER

When making the Measuring (hot) junction of MI Thermocouples and RTD's it is advisable to keep the open end of the cable warm.

This avoids the slow ingress of moisture into the cable insulation, which would lower the Insulation Resistance. This parameter is important for high measurement integrity.

Keeping the cable warm also has a beneficial effect on the welding process.

1. Moisture in the insulation lowers both the resistance and the capacitance. If these two parameters become too low the high frequency component used to start the weld becomes corrupted. In extreme cases the spark will travel across the surface of the insulation and create weld spots and melting of the cable sheath. This is more prevalent with smaller cables which, although they have the same capacitance as their larger family members have increased voltage stress across the powder surface.

2. When making a sheath closure weld any moisture inside the cable begins to expand as the cable heats up. This affects the weld as the water vapour mixes in with the weld gas restricting the ionising process. In the extreme the expanding moisture creates a pressure differential within the weld causing the molten metal to rise up. (blown weld)

3. For both conductor welds and sheath closure welds the starting process is improved if the cable sheath or conductors are hot. This seems to affect the initial breakdown of the argon gas allowing a smoother more rapid start and less spluttering.

Most MI Thermocouple manufacturers properly store their cable prior to welding in large ovens. However when it comes to a warming facility close to the welding machine, there are no proprietary ovens on the market. Subsequently users have adopted a variety of ingenious and novel approaches, from hair dryers to domestic plate warmers.

8. CALIBRATION SYSTEM

In Response to the 2006 revision of the Aerospace Material Specification AMS2750D TET Limited has designed a purpose built Automatic emf Calibration System.

AMS2750D Specification Covers pyrometric requirements for thermal processing equipment. The specification is used as a basis for the NADCAP certification programme.

The specification covers the following;

- Temperature sensors
- Instrumentation
- Thermal processing equipment
- System accuracy tests
- Temperature uniformity surveys

Many First Class MI thermocouple manufacturers are seeking inclusion on the Qualified Manufacturers List (QML) within the NADCAP programme.

In order to do this company's have to increase their calibration facility at least fourfold and seek to improve the relevance, accuracy and delivery of calibration data and to improve the archiving and retrieval of relevant data for analytical purposes.

AMS2750D requires suppliers to show evidence of conformity and accuracy of material. For MI Cable manufacturers this is achieved by sampling coils of cable prior to conversion into thermocouple sensors and producing calibration evidence for a number of stated reference points across the temperature range.

The TET Automatic Calibration System uses four furnaces fixed at four different temperatures and each furnace can accommodate up to 8 samples and a Reference Standard.

The four furnaces are controlled using Industry Standard temperature controllers. Each incorporates an EIA-485 interface allowing individual addressing and adjustment under computer control. The Temperature controller protocol ensures safe and secure digital communication.

The calibration system uses an individual Type R Standard Thermocouple in each furnace. For traceability this thermocouple requires its own calibration to National Standards, which must be carried out at predetermined intervals. The program therefore allows for entry of the calibration curve for each Standard thermocouple during the time it is being used in the furnace.

Thermocouple Manufacturing Equipment by TET Ltd

9. MINERAL INSULATED CABLE

MICC Ltd specialises in the design and manufacture of metal sheathed, mineral insulated heating, transducer and thermocouple cables in our 14000 sq. ft. factory in Washington in the North East of the United Kingdom.

We can supply standard and special cable sizes and lengths to your requirements.

MICC Ltd is the UK's only manufacturer of Mineral Insulated Thermocouple, Heating, Transducer and Compensating cable.

MICC Ltd operates 2 UK plants:

- Temperature House in Washington
- Gateshead Plant in Gateshead

Both located in the North East of England.

MICC Ltd is Europe's largest provider of stainless steel mineral insulated cable.

Since we supply thermocouple cable for installation in Nuclear power stations we are familiar with the need to use materials, especially powder, with very low levels of contaminant.

We understand the relative merits of powder-filling and block-filling cables – we do both.

TET & MICC focus on solving specific customer problems, working closely with customer engineers.

Based on many years working at BICC, our highly experienced staff manufactures mineral insulated cables by a series of reductions from the original tube diameter. These reductions through a set of dies are lubricated in soap. No oil is used in the process of lubrication.

Cables manufactured using oil as a lubricant must be 'pickled' to remove the black surface finish or linished. Pickling requires a chemical process and chemicals that cannot be recycled. Linishing spreads cracks and risks weakness in the sheath.

The drawing process results in highly compacted insulant which in turn produces high thermal conductivity ensuring rapid thermal response.

Our quality system ensures traceability of cable to sheath, conductor and insulant batches.

Coils are calibrated against standard thermocouples with a calibration record traceable back to the National Physical Laboratory.

Processing parameters have been developed and proven over many years.

In addition to EMF calibration each coil is tested for;

- Conductor integrity
- Sheath integrity
- Insulation resistance
- Conductor loop resistance
- Dimensions

Additional available tests include;

- Pressure tests to 400 psi
- X-ray
- Conductor ductility
- Sheath ductility

Our laboratory capacity meets the requirements of AMS 2750 D which requires calibration samples from both ends of a coil.

To provide an off-line production for small batch production and trial works.

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UKAS QUALITY MANAGEMENT 011

Thermocouple Manufacturing Equipment by TET Ltd

Cable Design

MICC Ltd UK Manufactures and supplies a comprehensive range of mineral insulated thermoelectric cables to meet the requirements and conditions of a wide range of temperature measurement applications.

Outside diameter of cable (D) Nominal ±tolerance mm	Sheath wall thickness (S) minimum mm	Diameter of conductor (C) minimum mm	Insulation thickness (I) minimum mm
0.5 ± 0.025	0.05	0.08	0.04
1.0 ± 0.025	0.10	0.15	0.08
1.5 ± 0.025	0.15	0.23	0.12
2.0 ± 0.025	0.20	0.30	0.16
3.0 ± 0.030	0.30	0.45	0.24
4.5 ± 0.045	0.45	0.68	0.36
6.0 ± 0.060	0.60	0.90	0.48
8.0 ± 0.080	0.80	1.20	0.64

MICC Ltd offers the best cable quality available, providing;

- High Purity MgO as Standard
- Fully Annealed and easy to use
- Fully Calibrated NOT batch calibration
- Oxide coated conductors to improve stability
- Made in the UK to original BICC designs, references, and specifications

Cable Diameters	Inconel Range	AISI 310 Range	AISI 316 Range	AISI 321 Range	Nicrobell Range	446 Stainless Range	Hastalloy X Range	Alloy 825 Range
8	T2K-600-80	T2K-310-80	T2K-316L-80	T2K-321-80	T2K-NIC-80	T2K-446-80	T2K-HSX-80	T2K-825-80
6.4	T2K-600-64	T2K-310-64	T2K-316L-64	T2K-321-64	T2K-NIC-64			
6	T2K-600-60	T2K-310-60	T2K-316L-60	T2K-321-60	T2K-NIC-60	T2K-446-60	T2K-HSX-60	T2K-825-60
4.8	T2K-600-48	T2K-310-48	T2K-316L-48	T2K-321-48	T2K-NIC-48			
4.5	T2K-600-45	T2K-310-45	T2K-316L-45	T2K-321-45	T2K-NIC-45			
3.2	T2K-600-32	T2K-310-32	T2K-316L-32	T2K-321-32	T2K-NIC-32			
3	T2K-600-30	T2K-310-30	T2K-316L-30	T2K-321-30	T2K-NIC-30		T2K-HSX-30	T2K-825-30
2	T2K-600-20	T2K-310-20	T2K-316L-20	T2K-321-20	T2K-NIC-20			
1.6	T2K-600-16	T2K-310-16	T2K-316L-16	T2K-321-16	T2K-NIC-16			
1.5	T2K-600-15	T2K-310-15	T2K-316L-15	T2K-321-15	T2K-NIC-15			
1	T2K-600-10	T2K-310-10	T2K-316L-10	T2K-321-10	T2K-NIC-10			
The following duplex (4 core) cables are also available								
8	T4K-600-80	T4K-310-80	T4K-316L-80	T4K-321-80	T4K-NIC-80	T4K-446-80	T4K-HSX-80	T4K-825-80
6.4	T4K-600-64	T4K-310-64	T4K-316L-64	T4K-321-64	T4K-NIC-64			
6	T4K-600-60	T4K-310-60	T4K-316L-60	T4K-321-60	T4K-NIC-60	T4K-446-60	T4K-HSX-60	T4K-825-60
4.8	T4K-600-48	T4K-310-48	T4K-316L-48	T4K-321-48	T4K-NIC-48			
4.5	T4K-600-45	T4K-310-45	T4K-316L-45	T4K-321-45	T4K-NIC-45			
3.2	T4K-600-32	T4K-310-32	T4K-316L-32	T4K-321-32	T4K-NIC-32			
3	T4K-600-30	T4K-310-30	T4K-316L-30	T4K-321-30	T4K-NIC-30		T4K-HSX-30	T4K-825-30
2	T4K-600-20	T4K-310-20	T4K-316L-20	T4K-321-20	T4K-NIC-20			
1.6	T4K-600-16	T4K-310-16	T4K-316L-16	T4K-321-16	T4K-NIC-16			

MI Trace Heating

TRM Ltd has established an enviable reputation within industrial and commercial sectors for its ability to handle complete electric trace heating projects effectively and efficiently. Our dedication to electrical trace heating, allows the company to ***independently*** design and install the most suitable trace heating system to match the requirement, without technology or manufacturing bias.

Products are supplied and installed **worldwide** for both Hazardous and non hazardous area use.

Our services cover all aspects of a project, including:

- Detailed front end design, (minimise number of electrical circuits, advice on most efficient operational design).
- Front end product specification.
- Supply of all Trace Heating materials.
- Installation of Trace Heating materials.
- Supervision (where required) of 3rd party installations.
- Annual audit and maintenance contracts.
- Detailed as-built drawings.
- Mechanical catalogues to complement the installed system.
- Design and supply custom built control systems.

TRM GROUP

MI Trace Heating

All trace heating systems designed and installed by TRM are to BS6351 parts 2 and 3 and meet the special requirements of the electrical Installation regulations 'sixteenth edition'.

All installation personnel carry Safety Passports.

The typical applications we specialise in:

Trace Heating - Frost Protection
Trace Heating – Process Temperature Maintenance
Trace Heating - Hot Water Temperature Maintenance
Leak Detection Systems
Audit and Maintenance Services

The core industries we serve:

⇨Oil & Gas
⇨Petrochemical
⇨Waste – Incineration Plants
⇨Pharmaceutical
⇨Nuclear
⇨Power Generation
⇨Refrigeration
⇨Transport
⇨General Engineering
⇨Chemical
⇨Commercial Building.
⇨Water

TRM GROUP

MI Trace Heating

Trace Heating – Frost Protection

Frost or Freeze protection of process water pipe work is a necessity for all critical water services and exposed pipe work.

Thermal insulation alone is no guarantee against water or water based products freezing during winter.

Efficient and controllable frost protection can generally be best achieved using electric trace heating cables in conjunction with simple ambient or line sensing thermostats.

Whether Copper, Stainless, Composite or Plastic pipe work, feeding Water Services, Sprinkler Systems, Fire hoses or other services - Electrical Frost Protection provides the reliable solution.

Benefits

- Reliability of Services
- Minimum 25 Year Life Expectancy
- Automatically and easily controlled
- No collateral damage as result of burst pipes
- Energy Efficient
- Approved and Time proven products

TRM GROUP

MI Trace Heating

Trace Heating – Process Maintenance

Many products require heating to maintain their desired condition during processing, whether in pipes, tanks, storage vessels or hoppers.

It is essential that the materials and equipment to be installed meet both the design and environment requirements in which they are required to work.

Efficient and accurate control of the medium to be heated can be performed by line sensing thermostats. Optional monitoring facilities can be installed to give plant operatives further enhanced information about the systems operational performance.

A few factors to consider when designing process maintenance systems include, length of heating circuit, temperature to be maintained, cable withstand temperature, operational environment, supply voltage, hazardous area classification (if appropriate) and thermal insulation type.

Typical trace heating cables installed to meet these requirements are; Self Regulating, Mineral Insulated (MI), Constant Output and Polymer Insulated.

MI Trace Heating

Benefits of Trace Heating – Process Maintenance

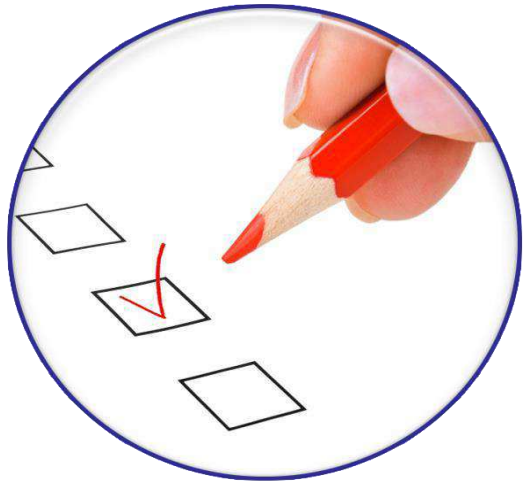
- Reliability of Services
- Energy Efficient
- Hazardous Area Approved
- Long Line Systems
- Systems for the harshest of environments
- Process Temperature Maintained
- Time proven products
- High / Low Temperature Applications

MI Trace Heating

Expert Trace Heating Services

We provide an expert Trace Heating Service that can supply you with the following support;

1. Design Services - Enquiry evaluation
2. Design Services - Engineering (Detailed design)
3. Site Survey
4. Project Management (Office based)
5. Project Management (Site based)
6. Training (Theoretical)
7. Training (Practical)



We can provide assistance with the whole project or any particular area you need support on. Please contact us for a detailed guide on how we manage this all-in-one solution.

TRM GROUP

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
Wimpey	BP Chemicals	184,000	Over 26 Week Period	Heat up and maintain acetic acid line in highly corrosive atmosphere zone 1
Foster Wheeler	BP Espana Tenerife	175,000	26	Internal traced pipelines with heat-up facility
Carless Exploration	Lasham Oilfield	100,000	6 Week Deadline 'Penalty Clause'	ETH system inc. intercabling against tight time schedule
WE Mannin	Dover Docks	87,000	2 Stages Over 29 Weeks	Ice/Snow protection on access ramps including auto control systems
Foster Wheeler	BP Espana Gran Canaria	400,000	26	Internally traced pipelines – zone 1 area
Matthew Hall	BP Isle of Grain	400,000	40	Raise/maintain temp. 12" NB. bitumen pipes approx. 2km long, part in zone 1 area

TRM GROUP

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
Badger Catalytic	Monsanto Newport	90,000	8	Raise/maintain temp of various bore pipelines inc. complete monitoring system – zone 2 hazardous area
Broughtons	South Quay	104,000	30	Frost protection of essential water supplies
Badger Catalytic	CIBA Geigy Pyewipe	300,000	40	Maintain temp. of pipelines and vessels in zone 1 hazardous area complete with computerised control system
BP	Salt End Hull	110,000	On Going Term Contract	Temperature maintenance of acid lines in zone 1 hazardous area T3
Kitsons Insulation	Brigg CCGT	120,000	22	Frost protection of water and steam pipe work withstanding temps of 520°C
Fluor Daniel	Eastman Chemicals Hartlepool	40,000	2 – Deadline	Upgrading of existing trace heating from non-hazardous to zone 1 area

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
Hertel (UK) Ltd	Little Barford 'C' Power Station	100,000	8	Frost protection of water and steam pipe work withstanding temps up to 538°C
How Fire	Keadby Power Station	32,000	8	Frost protection of fire fighting pipe work
Kitsons Insulation	Little Barford Power Station	63,000	20	Frost protection instrument pipe work
KR Insulation	Barking Reach CCGT	70,000	20	Boiler pipe work frost protection
GEC	Barking Reach CCGT	410,000	24	Trace heating and control/monitoring
Air Products	Gas Plant Holland	31,000	4	Process/Frost protection
BP	Hull	15,000	4	Acetic acid plant
Carrs	Mobil Oil	18,000	3	New CHP plant frost protection

TRM GROUP

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
EWE	Hydro Polymers	162,000	24	Frost protection of essential water pipes in zone 1 area plus cable schedules
Balfour Beatty	Iggesund Board CHP	80,000	12	Frost protect water and boiler pipe work
AMEC Lurgi	Crossness STW	44,000	20	Temperature maintenance of hoppers and ducting
AMEC Lurgi	Beckton STW	72,000	20	Temperature maintenance of hoppers and ducting
Zarafshan Newmont	Uzbekestan	52,000	4	Frost protection of water pipe work
BP Oil	Belfast	25,000	6	Trace heating fuel oil pipe work in zone 1 hazardous area
CGB Humbertherm	Didcot CCGT	36,000	-	Steam pipe work boilers and power cabling
Lodge Sturtevant	China	40,000	6	Supply of 72 sets of hopper heating equipment

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
Technical Absorbents	Courtaulds	110,000	2 – Window	Process heating project including high tech computer interlocked control system – overall management of all sub-contract disciplines
Simon Storage	Immingham	26,000	2	Acetic acid turnkey contract
Simon Storage	Immingham	32,000	2	Acetic acid turnkey contract
Nooter Eriksen	Conoco	27,000	6	CHP Plant – Boiler pipe work and power cabling
Wm Lee	Dronfield Sand Plant	20,000	2	Frost protection of CW pipe work and thermal insulation
AMEC Lurgi	Beckton	72,000	20	Temperature maintenance (160°C) of hoppers, cyclones, conveyors and ducting

MI Trace Heating

A SELECTION OF TRACE HEATING PROJECTS COMPLETED

Customer	Site	Approx. Value (£)	Duration (weeks)	Details
Powertherm	Rolls Royce Derby	180,000	10	CHP plant boiler and balance of plant pipe work
BP Chemicals	Salt End Hull	160,000	4	Trace heating for temperature maintenance in zone 1 hazardous area
Jas Scott	Sutton Bridge CHP	150,000	10	CHP plant boiler and balance of plant pipe work
Kvaerner Process Engineering	VAM/ETAC Project BP Chemicals	250,000	16	Trace heating in zone 1 hazardous area
Hertel (UK) Ltd	Coryton CHP	320,000	20	CHP plant boiler and balance of plant pipe work

Please contact us for a full guide on how to successfully install Mineral Insulated Trace Heating on pipelines.

MI Trace Heating Cable Datasheets

Stainless Steel, Alloy 825 & Inconel Sheathed Single Core Heating Cables						
Cable Reference S/S 316	Cable Reference Alloy 825	Cable Reference Inconel	Overall Diameter mm	Conductor Resistance Ω/m @20°C	Recommended Cold lead-in	
					Reference	OD mm
H321A10K	H825A10K	H600A10k	3.2	10.00	W321-C2.5-750V	5.3
H321A6300	H825A6300	H600A6300	3.2	6.30	W321-C2.5-750V	5.3
H321A4000	H825A4000	H600A4000	3.2	4.00	W321-C2.5-750V	5.3
H321A2500	H825A2500	H600A2500	3.4	2.50	W321-C2.5-750V	5.3
H321A1600	H825A1600	H600A1600	3.6	1.60	W321-C2.5-750V	5.3
H321A1000	H825A1000	H600A1000	3.9	1.00	W321-C2.5-750V	5.3
H321A630	H825A630	H600A630	4.3	0.63	W321-C2.5-750V	5.3
H321A400	H825A400	H600A400	4.7	0.40	W321-C2.5-750V	5.3
H321A250	H825A250	H600A250	5.3	0.25	W321-C6.0-750V	6.4
H321A160	H825A160	H600A160	6.5	0.16	W321-C6.0-750V	6.4

Stainless Steel Cables provide increased upper temperature operation to 600°C as well as increased corrosion resistance.

MI Trace Heating Cable Datasheets

Cupro-Nickel (70:30) Sheathed Heating Cables		
Reference	**Overall Diameter mm**	**Conductor Resistance Ω/m @20°C**
H400B1600	3.2	1.60
H400B1000	3.4	1.00
H400B630	3.7	0.63
H400B400	4.0	0.40
H400B250	4.4	0.25
H400B160	4.9	0.16
H400C63	3.2	0.063
H400C40	3.4	0.040
H400C25	3.7	0.025
H400C17	4.6	0.017
H400C11	4.9	0.011
H400C7	5.3	0.007
H400C4	5.9	0.004
Conductor Resistance Tolerance +/-10% - 600v single conductor		

Cupro- Nickel Cables are designed to provide increased corrosion protection especially in most conditions. The conductor is copper allowing long lengths to be used in applications such as long line pipe tracing.

Sheath temperatures can be as high as 400°C and resistances are from 0.004 ohms/m upto 1.6 ohms/m.

TRM GROUP

MI Trace Heating Cable Datasheets

Copper Sheathed Single Core Heating Cables – Bare and HDPE Covered					
Cable Reference Bare	Cable Reference HDPE Covered	Overall Diameter mm	Conductor Resistance Ω/m @20°C	Recommended Cold lead-in	
				Reference	OD mm
H122D2000	H122D2000HDPE	2.8	2.000	W122-C2.5-750V	5.3
H122D1250	H122D1250HDPE	2.8	1.250	W122-C2.5-750V	5.3
H122D800	H122D800HDPE	3.5	0.800	W122-C2.5-750V	5.3
H122D630	H122D630HDPE	4.0	0.630	W122-C2.5-750V	5.3
H122D450	H122D450HDPE	4.0	0.450	W122-C2.5-750V	5.3
H122D315	H122D315HDPE	4.3	0.315	W122-C2.5-750V	5.3
H122D220	H122D220HDPE	4.5	0.220	W122-C2.5-750V	5.3
H122D140	H122D140HDPE	4.9	0.140	W122-C2.5-750V	5.3
H122D100	H122D100HDPE	5.2	0.100	W122-C2.5-750V	5.3
H122C63	H122C63HDPE	3.2	0.063	W122-C2.5-750V	5.3
H122C40	H122C40HDPE	3.4	0.040	W122-C2.5-750V	5.3
H122C25	H122C25HDPE	3.7	0.025	W122-C6.0-750V	6.4
H122C17	H122C17HDPE	4.6	0.017	W122-C6.0-750V	6.4
H122C11	H122C11HDPE	4.9	0.011	W122-C6.0-750V	6.4
H122C7	H122C7HDPE	5.3	0.007	W122-C10.0-750V	7.3
H122C4	H122C4HDPE	5.9	0.004	W122-C16.0-750V	8.3
Conductor Resistance Tolerance +/-10% - 600v single conductor					

BS Range of MI Heating Cables; These cables are available for onsite manufacture of heating elements. A comprehensive range of accessories is available to assist with assembly.

Served Cables;
Are protected with High Density Polyethylene (HDPE) suitable for applications including burial in soil or concrete and for low temperature pipe tracing applications.

TRM GROUP

MI Heating Element Datasheets

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

Heating Element Data Sheet - Standard Stainless Steel or Cupro Nickel Single Conductor Element

To order please specify the following:

1. Part reference (see example).
2. Design lengths usually specified in metres, including heating cable length,lead-in cable length and tail length in mm.
3. Lead-In cable sheath material.
4. Any accesories required e.g. thread adaptors.

Part Reference Example:
See table 1 for cables and specifications

E 321 - A 1600
- Categorise Element
- Sheath Material
- Conductor Material
- Cable Resistance in Ohms/km

Table 1

Cable Reference	Cable Diameter (mm)	Conductor Resistance Ω/m@20°C	Lead-In Cable* Size	Dia. (mm)	Seal Ref.**	Gland Ref.
H321-A10K	3.2	10.00	C2.5	5.30	TYP1/1H2.520	RGM1H2.520
H321-A6300	3.2	6.30				
H321-A4000	3.2	4.00				
H321-A2500	3.4	2.50				
H321-A1600	3.6	1.60				
H321-A1000	3.9	1.00				
H321-A630	4.3	0.63				
H321-A400	4.7	0.40				
H321-A250	5.3	0.25	C6.0	6.40	TYP1/1H620	RGM1H620
H321-A160	6.5	0.16				
H400-B1600	3.2	1.60	C2.5	5.30	TYP1/1H2.520	RGM1H2.520
H400-B1000	3.4	1.00				
H400-B630	3.7	0.63				
H400-B400	4.0	0.40				
H400-B250	4.4	0.25				
H400-B160	4.9	0.16	C6.0	6.40	TYP1/1H620	RGM1H620

Sheath materials: 321 = 321 St.Stl
400 = Cupro Nickel
600 = Inconel 600
(Subtitute 321 with 600 for Inconel 600 cables, e.g. H600-A10K)

Full Lead-in cable ref.: W321*-C2.5-750V
*Sheath materials: 321 = 321St.Stl
400 = Cupro Nickel
122 = Copper
(HDPE served copper also available, add -HDPE to lead-in cable reference)

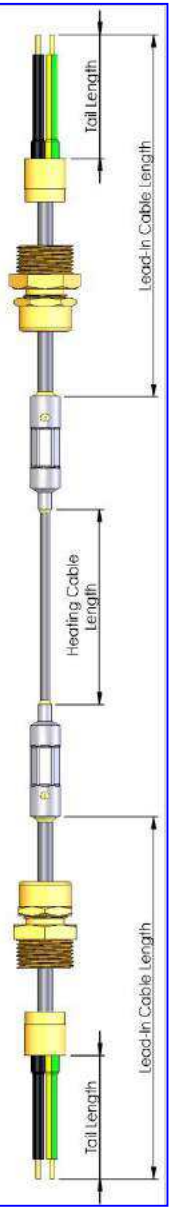
For details of termination seals available see DS0005.
**Substitute TYP1 with either TYP2 or TYP3 depending on seal type required.

Notes.

Maximum sheath temperatures: *Stainless Steel = 600°C*
Cupro Nickel = 400°C

Conductor resistance tolerance ± 10%

Standard tail lengths: 150mm, 300mm & 450mm.



Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

Heating Element Data Sheet - Standard Copper or Copper HDPE served Single Conductor Element

To order please specify the following:

1. Part reference (see example).
2. Design lengths usually specified in metres, including heating cable length,lead-in cable length and tail length in mm.
3. Lead-In cable sheath material.
4. Any accesories required e.g. thread adaptors.

Part Reference Example:
See table 1 for cables and specifications

E 122 - D 1250
- Categorise Element
- Sheath Material
- Conductor Material
- Cable Resistance in Ohms/km

Table 1

Cable Reference	Cable Diameter (mm)		Conductor Resistance Ω/m@20°C	Lead-In Cable*			
H122-D2000	2.8	4.6	2.000	C2.5	5.30	TYP1/1H2.520	RGM1H2.520
H122-D1250	2.8	4.6	1.250				
H122-D800	3.5	5.3	0.800				
H122-D630	4.0	5.8	0.630				
H122-D450	4.0	5.8	0.450				
H122-D315	4.3	6.1	0.315				
H122-D220	4.5	6.3	0.220				
H122-D140	4.9	6.7	0.140				
H122-D100	5.2	7.0	0.100				
H122-C63	3.2	5.0	0.063				
H122-C40	3.4	5.2	0.040				
H122-C25	3.7	5.5	0.025	C6.0	6.40	TYP1/1H620	RGM1H620
H122-C17	4.6	6.4	0.017				
H122-C11	4.9	6.7	0.011				
H122-C7	5.3	7.1	0.007	C10.0	7.30	TYP1/1H1025	RGM1H1025
H122-C4	5.9	7.7	0.004	C16.0	8.30	TYP1/1H1625	RGM1H1625

* Lead-In cable is available with HDPE served copper and bare copper sheath

** Heating cables available with HDPE serving, if required add '-HDPE' to the end of the cable reference

For details of termination seals available see DS0005

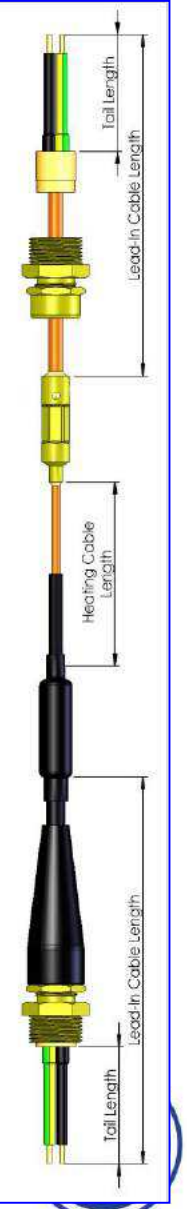
***Substitute TYP1 with either TYP2 or TYP3 depending on seal type required

Notes.

Maximum sheath temperatures: *Bare Copper = ???°C*
HDPE Served Copper = ???°C

Conductor resistance tolerance ± 10%

Standard tail lengths: 150mm, 300mm & 450mm.



TRM GROUP

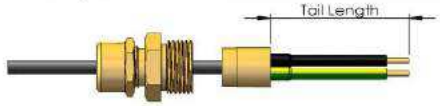
MI Heating Element Datasheets

Thermal Resources Management LTD
TEMPERATURE HOUSE
21 Sedling Road
Wear Industrial Estate
Washington
Tyne & Wear
NE38 9BZ
United Kingdom
Tel.: +44(0)191 4168884
Fax: +44(0)191 4192345
Email: sales@trmltd.co.uk

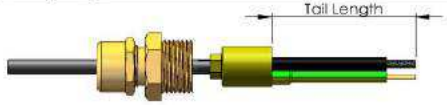
Heating Accessory Data Sheet - Lead-In Cable Termination Seal Types.

Seal Reference	TYP1
Description	ATEX Approved seal for use in hazardous area terminations
Conductor Type	Flexible
Earth Tail Type	Flexible earth tag complete with lock nut
Pot Type	Crimp on pot

Seal Reference	TYP2
Description	ATEX Approved seal for use in hazardous area terminations
Conductor Type	Solid
Earth Tail Type	Solid
Pot Type	Braze on pot with earth tail



Seal Reference	TYP3
Description	Wiring cable flexible tail seal
Conductor Type	Flexible
Earth Tail Type	Solid
Pot Type	Crimp on pot with earth tail



Ordering Information:

1. This accessory is ordered in conjunction with a standard heating element as illustrated on DS0003 and DS0004.
2. When ordering a heating element please specify the seal type and tail length required. Standard tail lengths available are: 150mm, 300mm & 450mm (Alternative lengths are available on request)

 www.temperature-house.com

TRM GROUP

Alloy 825 Trace Heating Cable

TRM-MI ALLOY 825
Thermal Resources Management

June 2006

Alloy 825 Trace Heating Cable & Design

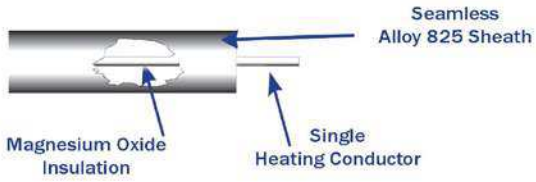
Alloy 825 sheathed heating cables and elements are ideal for industrial freeze protection, high temperature process maintenance heat tracing, and areas where good corrosion resistance are required.

Metal sheathed MI cable is the most durable heating cable available.

High wattage per foot of cable (limited per foot for hazardous areas).

Cables rated at 300V and 600V (see tables)

Cold Leads constructed of MI Cable.

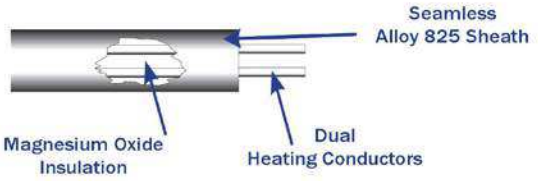


Applications

Industrial pipe tracing installations hazardous and non hazardous.

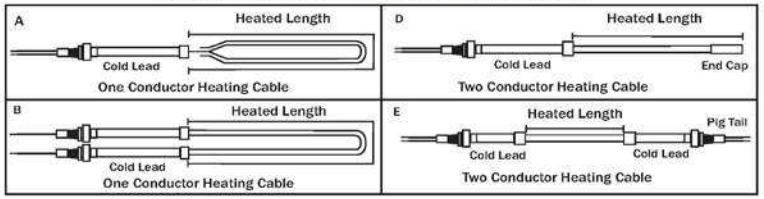
High temperature installations.

Long circuit tracing applications



Approvals

Factory Terminated Cable Units - Design Options



TRM-MI ALLOY 825
Thermal Resources Management

* Full Product Specifications
Available Upon Request *

CABLE REFERENCE

Nominal Cable Resistance @ 20°C			Nominal Cable Diameter		Sheath Thickness		Insulation Thickness		Conductor Diameter		Approx Wt
OHMS/FT	OHMS/ in.		in.	mm	in.	mm	in.	mm	in	mm	kg/km
600 Volt Single Conductor											
H1H200-2	2	6.56	0.146	3.7	0.012	0.3	0.052	1.32	0.018	0.46	47
H1H160-2	1.6	5.25	0.163	4.1	0.013	0.33	0.058	1.47	0.02	0.51	57
H1H130-2	1.3	4.27	0.16	4.1	0.013	0.33	0.056	1.42	0.022	0.56	57
H1H100-2	1	3.28	0.16	4.1	0.013	0.33	0.054	1.37	0.026	0.66	57
H1H850-3	0.85	2.79	0.17	4.3	0.014	0.36	0.057	1.45	0.028	0.71	63
H1H700-3	0.7	2.3	0.16	4.1	0.013	0.33	0.051	1.3	0.031	0.79	57
H1H500-3	0.5	1.64	0.18	4.6	0.015	0.38	0.057	1.45	0.037	0.94	72
H1H280-3	0.28	0.919	0.183	4.6	0.016	0.41	0.062	1.57	0.025	0.64	72
H1H200-3	0.2	0.656	0.18	4.6	0.015	0.38	0.056	1.42	0.038	0.97	72
H1H150-3	0.15	0.492	0.18	4.6	0.015	0.38	0.052	1.32	0.044	1.12	72
H1H118-3	0.118	0.387	0.183	4.6	0.016	0.41	0.064	1.63	0.023	0.58	72
H1H732-4	0.0732	0.24	0.184	4.7	0.016	0.41	0.061	1.55	0.029	0.74	75
H1H581-4	0.0581	0.191	0.184	4.7	0.016	0.41	0.059	1.5	0.032	0.81	75
H1H467-4	0.0467	0.153	0.183	4.6	0.016	0.41	0.062	1.57	0.025	0.64	72
H1H366-4	0.0366	0.12	0.184	4.7	0.016	0.41	0.061	1.55	0.029	0.74	75
H1H290-4	0.029	0.0951	0.184	4.7	0.016	0.41	0.059	1.5	0.032	0.81	75
H1H231-4	0.0231	0.0758	0.184	4.7	0.016	0.41	0.057	1.45	0.036	0.91	75
H1H183-4	0.0183	0.06	0.184	4.7	0.016	0.41	0.055	1.4	0.04	1.02	75
H1H145-4	0.0145	0.0476	0.184	4.7	0.016	0.41	0.053	1.35	0.045	1.14	75
H1H113-4	0.0113	0.0371	0.186	4.7	0.017	0.43	0.051	1.3	0.052	1.32	75
H1H651-5	0.00651	0.0214	0.187	4.7	0.018	0.46	0.055	1.4	0.041	1.04	75
H1H409-5	0.00409	0.0134	0.191	4.9	0.019	0.48	0.055	1.4	0.044	1.12	82
H1HC14	0.00258	0.00846	0.215	5.5	0.021	0.53	0.055	1.4	0.064	1.63	104
H1HC12	0.00162	0.00531	0.273	6.9	0.027	0.69	0.069	1.75	0.081	2.06	163
H1HC10	0.00102	0.00335	0.253	7.3	0.025	0.64	0.052	1.32	0.102	2.59	123
H1HC8	0.00064	0.0021	0.319	8.1	0.032	0.81	0.064	1.63	0.128	3.25	225

TRM GROUP

Alloy 825 Trace Heating Cable

TRM-MI Thermal Resources Management ALLOY 825

* Full Product Specifications Available Upon Request *

CABLE REFERENCE

	Nominal Cable Resistance @ 20°C (Loop)		Nominal Cable Diameter		Sheath Thickness		Insulation Thickness		Conductor Diameter		Approx Wts
	OHMS/FT	OHMS/M	in.	mm	in.	mm	in.	mm	in.	mm	kg/km
300 Volt Two conductor											
L2H110-1	11	36.1	0.13	3.3	0.011	0.25	0.028	0.66	0.012	0.3	37
L2H900-2	9	29.5	0.136	3.5	0.011	0.28	0.028	0.71	0.013	0.33	42
L2H750-2	7.5	24.6	0.136	3.5	0.012	0.3	0.031	0.79	0.015	0.38	42
L2H600-2	6	19.7	0.135	3.4	0.01	0.25	0.028	0.71	0.015	0.38	39
L2H400-2	4	13.1	0.146	3.7	0.012	0.3	0.028	0.71	0.018	0.46	47
L2H275-2	2.75	9.02	0.146	3.7	0.012	0.3	0.026	0.66	0.022	0.56	47
L2H200-2	2	6.56	0.18	4.6	0.015	0.38	0.033	0.84	0.026	0.66	72
L2H170-2	1.7	5.58	0.16	4.1	0.014	0.36	0.03	0.76	0.028	0.71	57
L2H114-2	1.14	3.74	0.17	4.3	0.017	0.43	0.035	0.89	0.023	0.58	63
L2H700-3	0.7	2.3	0.16	4.1	0.013	0.33	0.025	0.64	0.029	0.74	57
L2H472-3	0.472	1.55	0.169	4.3	0.017	0.43	0.039	0.99	0.016	0.41	63
L2H374-3	0.374	1.23	0.169	4.3	0.017	0.43	0.038	0.97	0.018	0.46	63
L2H293-3	0.293	0.961	0.17	4.3	0.017	0.43	0.037	0.94	0.02	0.51	63
L2H200-3	0.2	0.656	0.146	3.7	0.012	0.3	0.025	0.64	0.025	0.64	47
L2H150-3	0.15	0.492	0.16	4.1	0.013	0.33	0.026	0.66	0.028	0.71	57
L2H100-3	0.1	0.328	0.18	4.6	0.015	0.38	0.027	0.69	0.035	0.89	72
L2H734-4	0.0734	0.241	0.17	4.3	0.017	0.43	0.031	0.79	0.029	0.74	63
L2H583-4	0.0583	0.191	0.17	4.3	0.017	0.43	0.029	0.74	0.032	0.81	63
L2H458-4	0.0458	0.15	0.171	4.3	0.017	0.43	0.027	0.69	0.036	0.91	63
L2H324-4	0.0324	0.106	0.17	4.3	0.017	0.43	0.033	0.84	0.025	0.64	63
600 Volt Two Conductor											
H2H110-1	11	36.1	0.215	5.5	0.018	0.46	0.052	1.32	0.012	0.3	105
H2H900-2	9	29.5	0.215	5.5	0.018	0.46	0.051	1.3	0.013	0.33	105
H2H600-2	6	19.7	0.215	5.5	0.018	0.46	0.05	1.27	0.016	0.41	105
H2H414-2	4.14	13.6	0.211	5.4	0.02	0.51	0.051	1.3	0.018	0.46	101
H2H200-2	2	6.56	0.245	6.2	0.02	0.51	0.05	1.27	0.027	0.69	133
H2H115-2	1.15	3.77	0.211	5.4	0.02	0.51	0.051	1.3	0.018	0.46	101
H2H700-3	0.7	2.3	0.265	6.7	0.022	0.56	0.055	1.4	0.029	0.74	160
H2H505-3	0.505	1.66	0.206	5.2	0.02	0.51	0.051	1.3	0.015	0.38	94
H2H286-3	0.286	0.938	0.217	5.5	0.021	0.53	0.051	1.3	0.02	0.51	105
H2H200-3	0.2	0.656	0.245	6.2	0.02	0.51	0.052	1.32	0.025	0.64	133
H2H150-3	0.15	0.492	0.245	6.2	0.02	0.51	0.05	1.27	0.028	0.71	133
H2H100-3	0.1	0.328	0.265	6.7	0.022	0.56	0.051	1.3	0.035	0.89	160
H2H775-4	0.0775	0.254	0.234	5.9	0.023	0.58	0.051	1.3	0.028	0.71	124
H2H561-4	0.0561	0.184	0.245	6.2	0.024	0.61	0.051	1.3	0.033	0.84	133
H2H402-4	0.0402	0.132	0.258	6.6	0.025	0.64	0.051	1.3	0.039	0.99	155
H2H281-4	0.0281	0.0922	0.275	7	0.027	0.69	0.051	1.3	0.046	1.17	174
H2H200-4	0.02	0.0656	0.285	7.2	0.028	0.71	0.055	1.4	0.033	0.84	184
H2H C18	0.013	0.0427	0.304	7.7	0.029	0.74	0.055	1.4	0.04	1.02	211
H2H C16	0.00818	0.0268	0.311	7.9	0.032	0.81	0.055	1.4	0.051	1.3	222
H2H C14	0.00516	0.0169	0.364	9.2	0.035	0.89	0.055	1.4	0.064	1.63	333
H2HC12	0.00324	0.0106	0.402	10.2	0.033	0.84	0.059	1.5	0.081	2.06	409
H2HC10	0.00204	0.00669	0.496	12.6	0.041	1.04	0.072	1.83	0.102	2.59	625
H2HC8	0.00128	0.0042	0.543	13.8	0.04	1.02	0.069	1.75	0.128	3.25	749

TRM-MI Thermal Resources Management ALLOY 825

* Full Product Specifications Available Upon Request *

How To Specify A TRM Alloy 825 Heating Unit

[a] - [b] - [c] - [d] - [e] - [f] - [g] - [h]

a	Design – A,B,D,or E model
b	Cable reference – see tables above
c	Heating Cable Length in ft
d	Watts
e	Volts
f	Cold lead length in ft
g	Cold lead AWG
h	Cold lead joint rating

Example

[A] - [L8252S02000] - [30] - [807] - [208] - [6] - [14]

TRM GROUP

Trace Heating Management

Superior Management of

Electrical Heat-Tracing Systems!

PLAN CONTROL

PlanControl Ch32 **is an affordable and efficient heat-tracing Monitoring and Control system.**

PlanControl Ch32 system is versatile and easily scalable. Unique features designed specifically for electric heating applications, help to reduce costs from project planning stages through maintenance operations while enhancing the safety of your entire process.

Modular Structure and Bus Interface make for an affordable distributed system. System expansions and modifications can be made easily and flexibly and require minimal investment. Being modular in nature, the hardware can be steplessly matched to meet the number of needed inputs and outputs.

All heating circuit ***information*** is accessible from one point and can be read with the user interface at either the control unit or via PC using PManLine Software.

Stepless Power Adjustment provides added flexibility and security to engineering design criteria and simplifies heating cable selection. The Power Adjustment feature can also provide significant cost savings, because changes in the required maintain-temperature or in heating-cable lengths (series-circuits), can often be accommodated by adjusting wattage outputs of existing cables rather than altering or replacing them.

Condition-Monitoring Testing performed periodically and automatically ensures that heating cables and temperature sensors will work properly when they are needed and avoids costly, last-minute maintenance panic situations.

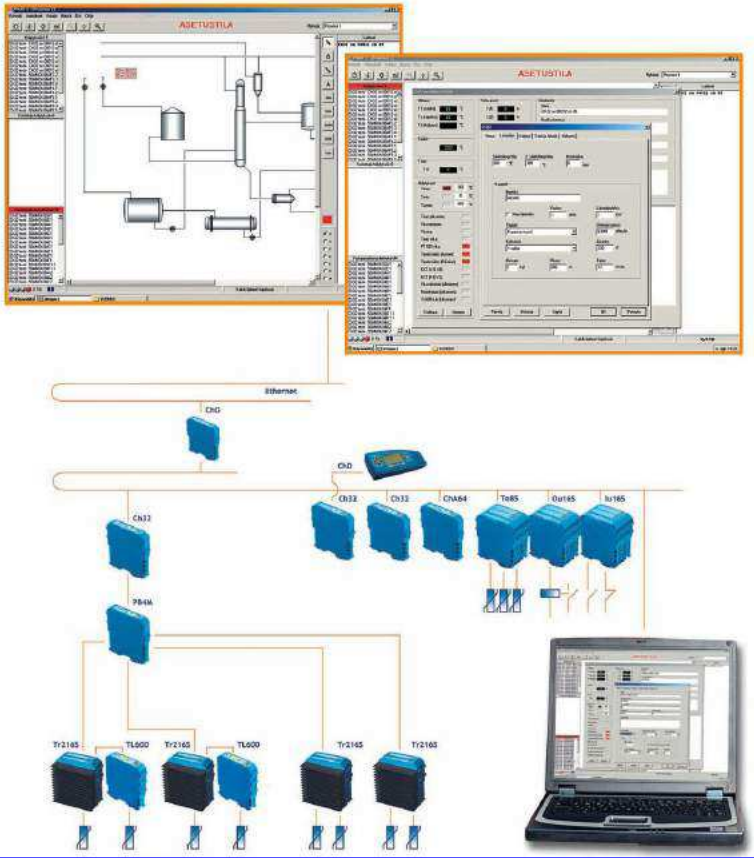
PlanControl Ch32 is conceived, designed, and built specifically for our Electrical Heat-Tracing Systems. It provides many additional capabilities with the user in mind. One such feature is ***Alarm-Blocking*** which can prevent fault-alarms due to an anticipated and acceptable process condition... higher-than-normal process-upset temperatures for example.

PLAN CONTROL

The Right Tools in the Right Place for the Right Application Size and Complexity...

PlanControl systems can be managed by using a simple portable ChD user-interface with a plug-in connection. As the number of circuits, devices and control requirements increase, managing your heat-tracing system most easily and efficiently is best achieved from a PC monitoring station or similar centralized automation location.

PC monitoring station ... Integration to automation ...



TRM GROUP

Trace Heating Management

Economical Solutions for Every Challenge!

PLAN CONTROL

Modular structure

Through Planet bus a single Ch32 control unit can be connected to the *inputs and outputs of 32 heating circuits*.

- 8 or 16 sensor inputs / sensor unit
- 8 or 16 relay outputs / output unit
- 8 or 16 digital inputs / input unit
- Triac outputs can be added in steps of one output

Input and output units connect to the bus with plug-in connectors directly to the device.

Power adjustment

The Planray Triac Unit adjusts Heat-Tracing wattage outputs *from 15%-100% of maximum power*, thereby providing a wider range-of-use of any contemplated engineering design or for cables already installed. This is of particular benefit when constant-wattage series-circuit cables are considered... no transformers required!

TL600

In hazardous areas ATEX-Approved PlanTerm TL600 Temperature Limiter is added to the line-up. TL600 captures the heating circuit temperature values from Pt-100 sensor and carries them forward to the Ch32 control unit and on to the PC or to a designated automation architecture.

The ChD user interface is equipped with a 160 symbol LCD that can provide simple and readable menus

ChD user interface

Modify any setting easily with the ***ChD user interface – Permissions Needed***. Display details of any heat tracing circuit. ChD connects to Ch32 control unit with a plug-in connector. Think of it as a Password Protected ScrewDriver. When you need it, it's there, but only if you have permission to use it.

TRM GROUP

Trace Heating Management

Efficient management!

PManLine software

With PManLine software you can easily manage large numbers of heating circuits as well as use various additional features that make controlling your process more effective. Piping and instrumentation diagrams of the processes are imported to PManLine software. Icons with heating circuit IDís are placed over top of those diagrams. By simply clicking an icon, you open the information window of the heating circuit that includes the actual values, settings, trends, alarm history and for example, links to technical drawings. Settings can also be modified from the information window of a heating circuit.

- **Lines feature**
  If there are several separate heating circuits in a pipeline, PmanLine can merge them into one line. Heating circuits selected to the line operate independently but they are seen on the monitor as one single icon which shows the lowest and highest temperature value of the pipeline.
- **Batch processing feature**
  With PmanLine software one can select heating circuits into different "recipe groups". When the recipe is changed, all the heating circuits in the group will automatically change. This feature brings efficiency and accuracy to the process control.

- **Links**
  Links to installation drawings, technical data and other heating circuit specific information can be added to PmanLine. Now all the information and drawings are directly accessible to the operator.
- **OPC data transfer**
  PmanLine can transmit and receive information from other systems which support OPC data transfer protocol. The amount of information to be transferred can be filtered simply by selecting the desired data.
- **Ethernet**
  The data transfer between PmanLine and the electric heating centre can utilize the Ethernet network of the factory.

PLAN CONTROL

Flexibility with modularity

The flexible modular structure of *Plancontrol Ch32* with the Planet bus allows you to build electric Heat-Tracing centers either as small distributed groups focused on a specific process sector or as larger centralized entities controlling an entire facility.

Regardless of your situation, you can monitor and permit control from a single point if need be!

Safety

Plancontrol system qualifies the essential safety regulations of the low-voltage directive 73/23/EY and 93/68/EY CE requirements and the requirements of standard EN 61010-1:2001. Certificates: SGS Fimko FI 21914-21916.

MICC GROUP

Cables for Life

MICC cable - For when 15 minutes is not enough!

www.micclt d.co.uk

What is MICC cable?

- Mineral Insulated Cable is without question the ultimate fire survival electrical cable system
- It comes in two forms;
  - *Copper sheath (Survives for 3hrs+ @ 1050°)*
  - *Alloy 825 sheath (Survives for 3hrs+ @ 1200°C*
- It provides proven upto 3 hour escape time in 'Real World' fire conditions
- It's the only electric cable to pass BS6387 'Enhanced' which specifies only one cable for all 3 tests allowed
- The only electric cable to pass modern furnace tests - i.e. German standard ISO834-1, test DIN 4102 1000°C 90mins
- The only cable technology approved & listed by UL2196 for 'unrestricted installation'

Who are MICC Ltd?

- MICC have 85 years of Mineral Insulated Cable manufacturing experience!
- Use the unique seamless tube manufacturing process developed by BICC in the 1930's
- Owned and operated by the ex-management team of BICC Pyrotenax
- Offer unrivalled experience in mineral insulated cable research, products and applications
- Specialists in hazardous area projects and installations
- Suppliers to the Nuclear industry since the 1st generation in the 1950's
- Truly Global business with Worldwide customer service
- The only manufacturer to produce both copper and alloy 825 sheathed wiring cables
- World's largest manufacturer of MI cable
- World's largest MI cable factory
- MICC do not make cables for anybody else

sales@micclt d.co.uk

Why is MICC the only true Fire Survival cable?

- Inorganic construction = Nothing to burn!
- Nothing to burn = Zero toxic emissions and Zero smoke!
- Inorganic materials = Last a lifetime!
  - *MICC wiring cables come with a life time guarantee!*
- Holistic fire survival = Zero combustion and Zero heat release
- Naturally armoured = Pest proof, no risk of rodent damage!
- Self-monitoring = Will not cause false alarms due to undetected damage on installation
- Furnace tested = Passes the only true life like fire test!

MICC cable... for when 15 minutes is not enough time to escape!

- MICC cable is essential for when 15 minutes egress time is not enough time to escape
- The British Standard for fire evacuation is 2.5 minutes per floor for moving from the accommodation final exit
- MICC is strongly recommended for any building more than 7 floors tall
- It is a MUST for metros, airports, prisons, hospitals, tunnels, shopping centres, schools
- And the correct choice for ALL life critical circuits:
  - *Fire alarms*
  - *Smoke alarms*
  - *Emergency lighting*
  - *Ventilation systems*
  - *Fireman's lifts*
  - *Emergency pumps*
  - *And more...*

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MICC Fire Survival Cables
The ONLY true fire proof cables!

Feature	LSF FP / FR Cable	Copper MICC Cable	Alloy 825 MICC Cable
Upto 15min egress time	✓	✓	✓
Over 15min egress time	✗	✓	✓
250°C Operating temperature	✗	✓	✓
650°C Operating temperature	✗	✗	✓
Exposure to 1040°C	✗	✓	✓
Exposure to 1350°C	✗	✗	✓
BS6387 CWZ	✓	✓	✓
BS6387 CWZ Enhanced	✗	✓	✓
BS8491 (Furnace test)	✗	✓	✓
Flame Retardant	✓	✓	✓
Seamless tube	N/A	✓	✓
Waterproof, submersible	✗	✓	✓
No self-ignition	✗	✓	✓
Mechanical shock & pressure resistant	✗	✓	✓
Zero toxic emissions, smoke, flame & gas	✗	✓	✓
Self-monitoring	✗	✓	✓
Non-aging, corrosion resistant	✗	✓	✓
Suitable for confined space/tunnel	✗	✓	✓
100% recyclable	✗	✓	✓
No conduit required	✗	✓	✓
High overload resistance	✗	✓	✓
Zero smoke on overload	✗	✓	✓
Gas, Bio / Chemical proof	✗	✓	✓
Rodent proof	✗	✓	✓

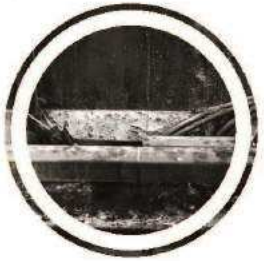
sales@micclld.co.uk

The Low Smoke myth!

Many polymeric cable manufacturers claim the polymers they use for insulation and jackets are low smoke. They often justify this by claiming compliance to tests like BS EN 61034.

These smoke obscuration tests are dependent on a specific sample weight of cable burned in a specific room / air volume. These results are not predictive end use simulations.

Smoke generation can be greater on high heating before flame and smoke volume is directly related to the amount of material burnt.



Singapore MRT 2013 - Newton Underground Station. Cable overloaded and caught fire

So how can a BS-EN 61034 low smoke cable give off so much smoke?

PVC gives off more smoke in flame but PE / XLPE (polyethylene) gives of more smoke on heating without flame,extremely costly!

Plasticized UPVC is used to make general electric cable. In flaming and none flaming mode both feature high smoke outputs, indeed very bad as a fire proof cable...

FP200 & FP600 use polyethylene – In a direct flame yes it shows as low smoke generation factor.... But under overload, short circuit or internal heat for any reason... 590DM is a lot of smoke!
It doesn't take an actual fire to cause an emergency evacuation, smoke with no fire is more common and extremely costly!

Material	Thickness (mm)	Maximum Specific Optical Density (DM) Non Flaming	Flaming
UPVC	3	400	580
Polyrthylene	3	590	83
FR Polyrthylene	3	790	780
Polypropylene	3	550	162
FR Polypropylene	3	820	600
Polystyrene	3	476	960
PMMA	3	63	117
Plasticised PVC	0.75	430	650

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The truth about BS6387 and flame vs furnace tests!

The duration and the maximum temperature of a fire in a building depends on several factors including the amount and configuration of available combustibles (including all electric cables), ventilation conditions, properties of the internal enclosures, weather conditions, etc. In common circumstances, the maximum temperature of a fully developed building fire will rarely exceed 1000°C

A flame test like BS6387 (CWZ). Max temperature 860°C (2013 revision)

- The flame is very small in comparison to a 'real' fire
- Most of heat is lost and not applied directly to cable
- Too many fixings are often used to keep the cable in place, this is just not practical and would be very expensive!
- The temperature isn't even hot enough for the average fire!
- The new BS50200 is worse at only 842°C and only for 2hrs
- Only fire rated cables are tested this way

A furnace test like ISO 843-1. Max temperature 1000°C (2014 revision)

- The closest to a real fire simulation, everything starts to melt!
- Every other fire rated component in the building must pass a furnace test
  - *Fire proof doors*
  - *Partitions etc*
- Only MICC cables pass this test

sales@micclte.co.uk

Mineral Insulated Cable is the perfect choice for ANY high temperature application!

- MICC (Mineral Insulated Cable Company Ltd) are the UK's only manufacturers of the full range of mineral insulated cable products. We have the history and experience of BICC via our directors and many managerial and production staff. We are the only company in the World to manufacture using the BICC seamless tube technique.

- TRM (Thermal Resources Management Ltd) have the same ownership as MICC and many highly experienced ex-BICC staff, we specialise in designing and turning our MI cable into an installable products / units. We also offer consultation and installation services.

- Both MICC and TRM have strong R&D and engineering teams ready to work with you on special and innovative solutions to your project challenges.

- We work across a wide range of industrial and commercial sectors including, Oil & Gas, Petrochemical, Iron & Steel, Pharmaceutical, Refrigeration, Water, Food & Beverage, Automotive, General Engineering, Chemical, Commercial Buildings; Metro Systems, Airports, Hospitals, Prisons and Power Generation; including all UK and many International Nuclear Power Stations.

- We specialise design, manufacture and installation of the 3 key areas of temperature control;
  - *Electric Trace Heating > Raise or maintain temperature on pipelines, tanks / vessels, rock crushers, car park access ramps, even helicopter pads & submarine power systems.*
  - *Temperature measurement > Industrial thermocouples and RTDs used to measure temperature upto 1200°C! They are used in a wide range of applications from pipelines to steel foundry's and extremely hazardous areas like Nuclear Power Station boilers.*
  - *Fire-Survival > The only true fire survival cable on the market, it guarantees 3hr plus escape time in the harshest of fires... our commercially focused copper system is rated upto 1083°C. These are used in high rise buildings, tunnels, metro systems, hospitals and war / refuge shelters in Kuwait.*

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Why take the risk? The facts!..

When it comes to smoke...

Cables which emit NO smoke will provide significantly improved evacuation speed and aid saving more lives!

About temperature rise and Oxygen depletion...

Cables with NO calorific value which have a ZERO heat of combustion per Kg will eat NO oxygen and generate NO heat will aid saving more lives!

Concerning toxic and irritant gasses

Cables with NO organic content, NO calorific values and Halogen Free will generate NO toxic or irritant gasses at all including Carbon Monoxide WILL aid saving more lives!
(Statistically CO is responsible for >90% of toxicity deaths in fires)

So what do we do now ?

Soft skin fire resistant cables are not bad cables...
They just don't give the performance they claim to.
We need to review the application and understand the limits of the current standards, this will allow the right product to be specified for the right application...

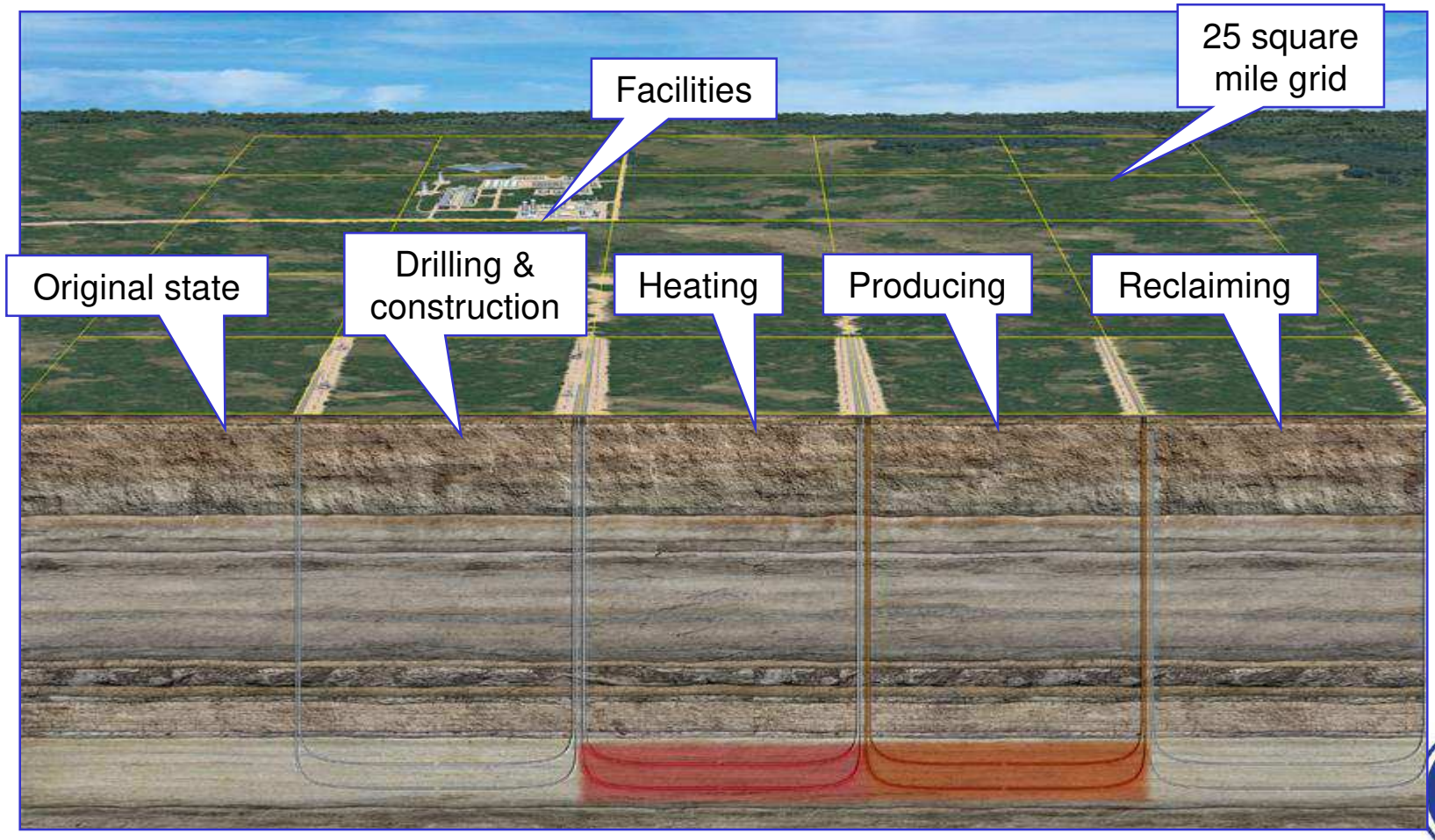
Life depends on it, choose a Cable for Life!

Office and Factory Address:
Temperature House, Unit 21 Sedling Road, Wear East Industrial Estate, Washington,
Tyne and Wear
United Kingdom, NE38 9BZ

+44 (0)191 416 8884 | info@trmltd.co.uk
www.temperature-house.com

Enhanced Oil Recovery

TRM Ltd provide down well heating and temperature profile applications, with our Mineral Insulated Thermocouple Assemblies and Heating Systems. We carryout logging of temperature profiles, aiding the release of oil deposits through the warming process.



TRM GROUP

Long Distance Trace Heating

SKIN–SYSTEM

Safe and reliable heating system for pipelines of an unlimited lenght designed for above-ground, buried and underwater pipelining, including ones in explosion hazardous zones

INDUCTION-RESISTIVE HEATING SYSTEM FOR LONG-DISTANCE PIPELINES

- *The only way to heat pipelines with the length up to 30 km without parallel supply network*
- *The most efficient way to heat any trunk pipelines of an unlimited length*
- *Inherent strength and reliability of system design*
- *Up to 120 W/m power output of the heating element*
- *Certificate of conformity GOST R (State Standart) and Permit of Federal Service for Ecological, Technological and Atomic Inspection for application in explosion hazardous zones*
- *Operating temperature up to 200°C*
- *Zero electrical potential on outer surfaces of heating elements. After earthing and heating elements do not require any electrical insulation*

SKIN–SYSTEM

APPLICATION FIELD

Induction-resistive heating system (IRHS) or SKIN-system is designed to maintain the product temperature, protect long trunk pipelines against freezing and ensure their start heating. SKIN-system is the only one, which is capable to heat a pipeline run of up to 30 km long with power supply from one point (without any parallel network); it is as well the most efficient and cost-effective solution for heating trunk pipelines of an unlimited length with parallel supply network.

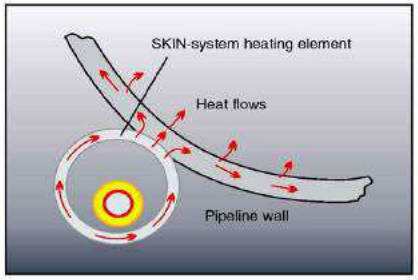
PRINCIPLE OF OPERATION

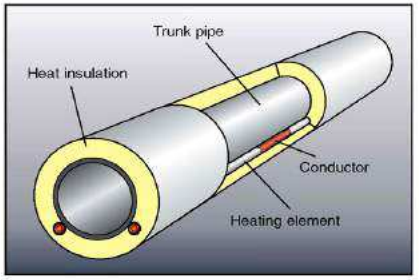
Heating element of the system consists of a ferromagnetic steel tube with the outer diameter of 20-60 mm and the wall thickness of at least 3.0 mm; there is an insulated copper or aluminum conductor with cross section of 10-50 mm² placed inside the tube.

The conductor is electrically connected to the tube at the end of a heating run while AC voltage is supplied between the conductor and the pipe at the run head; the voltage value is calculated basing on the required heat output and the heated run length.

Currents of the conductor and the tube have opposite directions and thus skin and proximity effects originate in the system. As a result the tube current flows in the inner layer close to the inner surface of the tube and there is no voltage available on the outer surface of the tube.

The conductor is non-magnetic (made of copper, aluminum), thus, it does not feature any noticeable skin effect and AC flows throughout the whole section of the conductor. The main heat producing element of IRHS is the tube, which produces up to 80% of the system output.





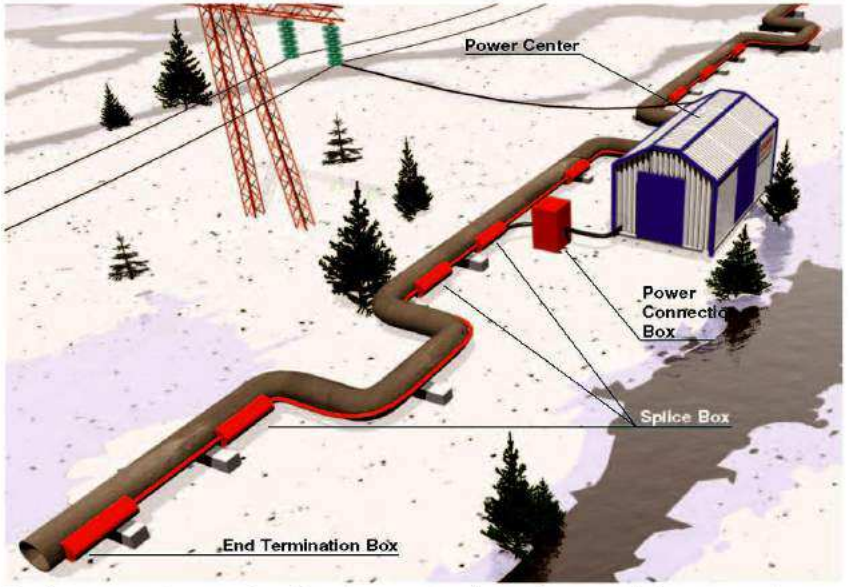
ADVANTAGES

1. Long range of a pipeline heated run. The system low resistance per a meter of length along with its high supply voltage makes possible to feed heated runs of up to 30km long from a single source.
2. One end powering. The SKIN-system inherently is designed to be electrically supplied from one end of a heated run.
3. Electrical safety. Outer surface of the heating element is earthed and its voltage potential relative to the earth is zero.
4. Good thermal contact. Metal heating element is welded directly to the pipeline or is fixed to it with special fasteners. In order to improve the thermal contact a special heat conducting paste is applied.
5. Easy installation. Heat producing elements have not any outer electric insulation which may be damaged during installation works.
6. Reliability. The steel heating tube ensures mechanical stability of the conductor and protects it against damages. This fact is especially important for buried and underwater pipelines.

One, two or three heating elements can be fitted on a trunk pipe depending on the required heating power and pipeline length.

SST designs and supplies IRHS-system as a full set including a special integrated transformer substation, all elements belonging to the heating system itself, monitoring and control systems.

ELECTRIC SUPPLY OF A PIPELINE RUN HEATED BY SKIN–SYSTEM



Electric power supply system is performed as an integrated transformer substation including distributing sells of the HV and LV sides, specialized balancing transformer, monitoring and control system. The integrated power center is located in a hermetically sealed and heated container.

Long Distance Trace Heating

SKIN-SYSTEM

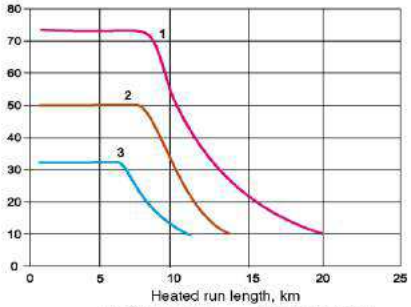
TECHNICAL SPECIFICATION

OPERATING TEMPERATURE RANGE -50°C ... +200°C

POWER SUPPLY up to 5 kVAC 50 Hz

POWER OUTPUT

Rated power output of one heating element, W/m



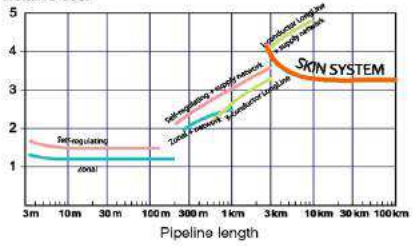
	Heating element tube diameter	Current-carrying conductor cross-section
1	42x3	40 mm²
2	32x3	20 mm²
3	25x3	10 mm²

CONSTRUCTION

Heat producing element	Low carbon steel tube with diameterof 20-60mm and wall thickness of 3-4mm
Current carrying conductor	Special conductor resistive to high voltage (up to 5kV), high temperature (up to 200°C) and mechanical stress at installation
Anticorrosion protection	epoxy coating of a SKIN heater (at Customer request)

EFFICIENCY OF SKIN SYSTEM IN COMPARISON WITH HEATERS OF OTHER TYPES

Relative cost



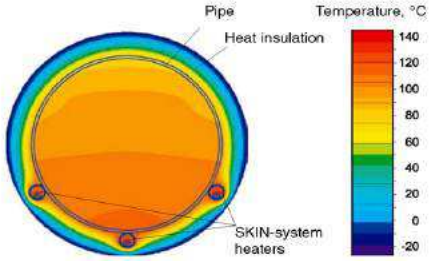
CONTROL SYSTEM

In order to improve its efficiency SKIN-system is provided with a control system, which decreases heating power in response to rise of ambient temperature.

Control system ensures reliable monitoring of the system status and revealing of emergency conditions.

ESTIMATED TEMPERATURE DISTRIBUTION

Rated power output of one heating element, W/m



Example of heat insulated pipeline heating by three heating elements of SKIN-system with the total output of 130 W/m, Pipe diameter is 530 mm, $t_{ambient\ air}$ = -20 °C.

APPROVAL DETAILS

Certificate of conformity with GOST R (State Standart) system No. РОСС RU.Г505.В02387 issued for heating systems with explosion protection marking 2ExellT3...T6 X.

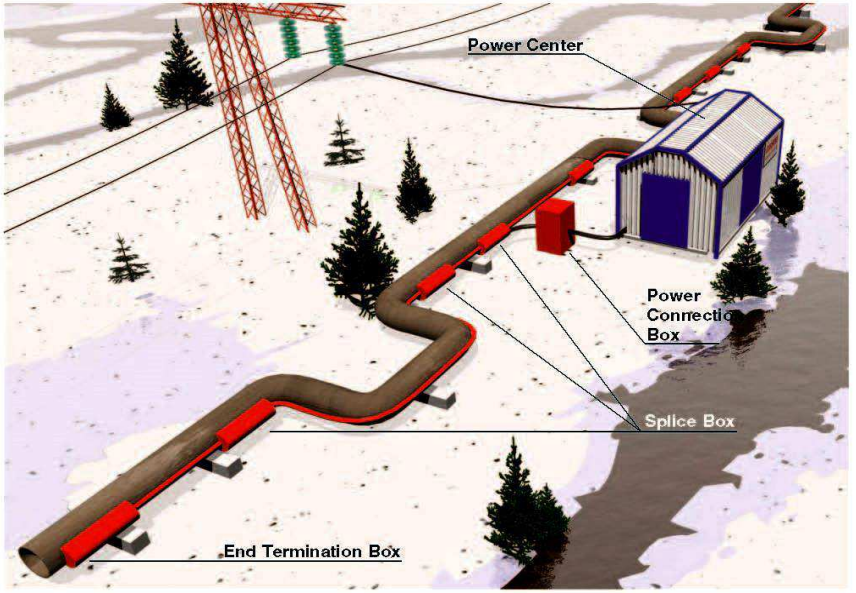
ADVANTAGES

1. Long range of a pipeline heated run. The system low resistance per a meter of length along with its high supply voltage makes possible to feed heated runs of up to 30km long from a single source.
2. One end powering. The SKIN-system inherently is designed to be electrically supplied from one end of a heated run.
3. Electrical safety. Outer surface of the heating element is earthed and its voltage potential relative to the earth is zero.
4. Good thermal contact. Metal heating element is welded directly to the pipeline or is fixed to it with special fasteners. In order to improve the thermal contact a special heat conducting paste is applied.
5. Easy installation. Heat producing elements have not any outer electric insulation which may be damaged during installation works.
6. Reliability. The steel heating tube ensures mechanical stability of the conductor and protects it against damages. This fact is especially important for buried and underwater pipelines.

One, two or three heating elements can be fitted on a trunk pipe depending on the required heating power and pipeline length.

SST designs and supplies IRHS-system as a full set including a special integrated transformer substation, all elements belonging to the heating system itself, monitoring and control systems.

ELECTRIC SUPPLY OF A PIPELINE RUN HEATED BY SKIN-SYSTEM



Electric power supply system is performed as an integrated transformer substation including distributing sells of the HV and LV sides, specialized balancing transformer, monitoring and control system. The integrated power center is located in a hermetically sealed and heated container.

TRM GROUP

Long Distance Trace Heating

SKIN-SYSTEM

SCOPE OF PROJECTS

Yuzhnoe Hylchue. Oil/gas- condensate field. Oil pipeline.
Customer: LUKOIL Oil Company NARJANMARNEFTEGAS LLC.

Total length of heated pipeline:	162 km
Amount of substations:	14
Pipeline diameter:	530 mm
Transportated liquids:	crude oil

Pestsovoye. Gas condensate field / water pipeline between site areas
Customer: GAZPROM Russian Stock Company. URENGOIGAZPROM LLC.

Total length of heated pipeline:	2 x 20 km
Amount of substations:	5
Pipeline diameter:	219 mm
Transportated liquids:	water

Toboyskoye. Oil/gas-condensate field. Oil and gas gathering collectors from well cluster to Central Processing Facility.
Customer: LUKOIL Oil Company NARJANMARNEFTEGAS LLC.

Total length of heated pipeline:	16,5 km
Amount of substations:	4
Pipeline diameter:	159, 219 mm
Transportated liquids:	crude oil

Yuzhno-Shapkinskoye. Oil/gas-condensate field water pipeline between areas.
Customer: LUKOIL Oil Company «Sever-TEK» CJSC.

Total length of heated pipeline:	13 km
Amount of substations:	3
Pipeline diameter:	159, 168, 219 mm
Transportated liquids:	water

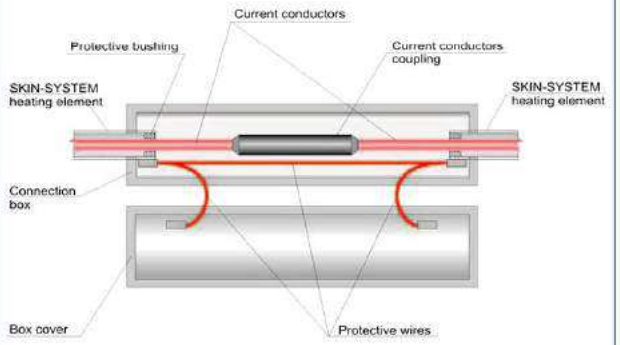
Beregovoe. Oil/gas- condensate field; Water pipeline between site areas.
Customer: ITERA OJSC , Siberian oil-gas company OJSC.

Total length of heated pipeline:	10 km
Amount of substations:	1
Pipeline diameter:	168 mm
Transportated liquids:	water

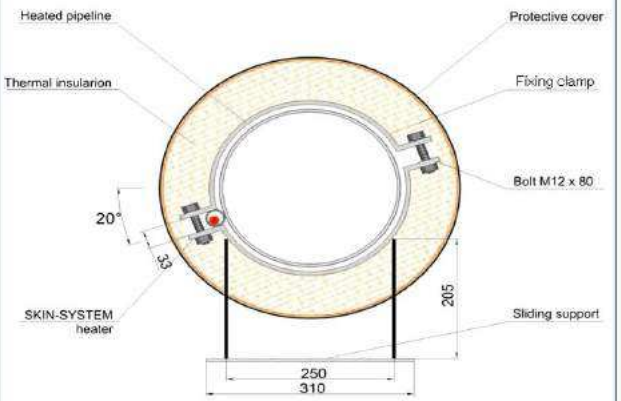
PROJECT DESIGN APPROACHES

SKIN-SYSTEM

SPLICE BOX FOR SKIN-SYSTEM HEATING ELEMENTS
(top view; the cover is open)



TUBE WITH SKIN SYSTEM HEATER PASSING TEMPERATURE COMPENSATING MOVABLE PIPELINE SUPPORT

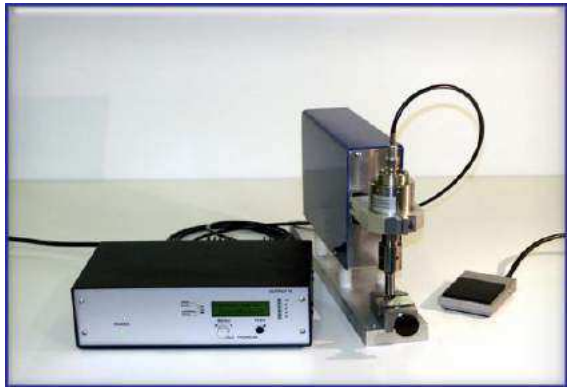


TRM GROUP

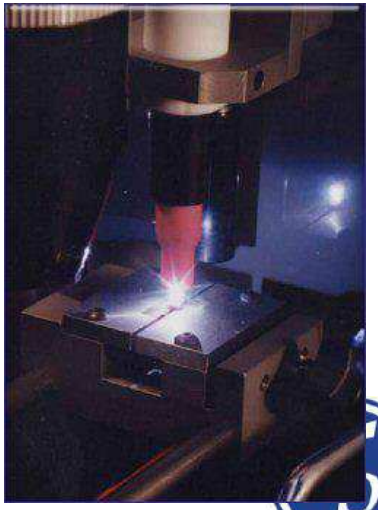
Tools and Accessories

TRM provide a range of tools and accessories to support our products.

Specialist fault locater designed to find faults in mineral insulated cables.



Ultra-sonic stripping machine removes metal sheath from mineral insulated cables.



MI sensor welding machine designed specifically to weld the Measuring (hot) junction of mineral insulated Thermocouples.

Bespoke Product Development

TRM are a total solution provider, we design, manufacture and install a range of bespoke thermocouples, harnesses, probes, heating cables & elements, for use in complex high temperature situations.

We spend a great deal of time on new product development and have a special cell at our factory to focus on this category of work.

This product is a **mineral insulated heating element and thermocouple**. It is fitted to a gas analyser tube providing high temperature with close control.

TRM GROUP

Silo Heating Coal Powder Incinerator

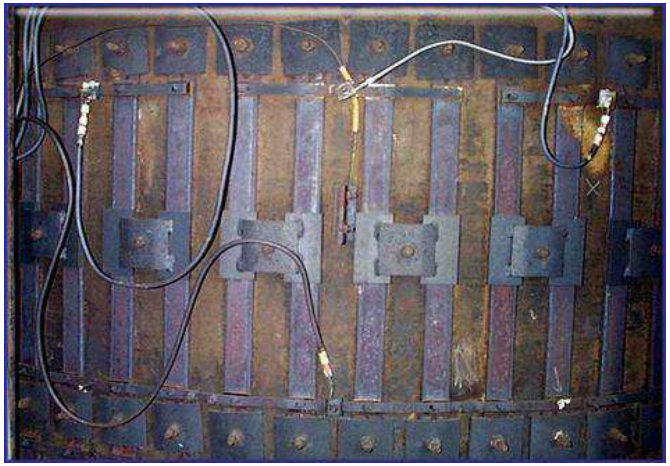
TRM designed, supplied and installed a **custom trace heating solution** to keep the silo funnel warm allow the coal powder to keep flowing freely.

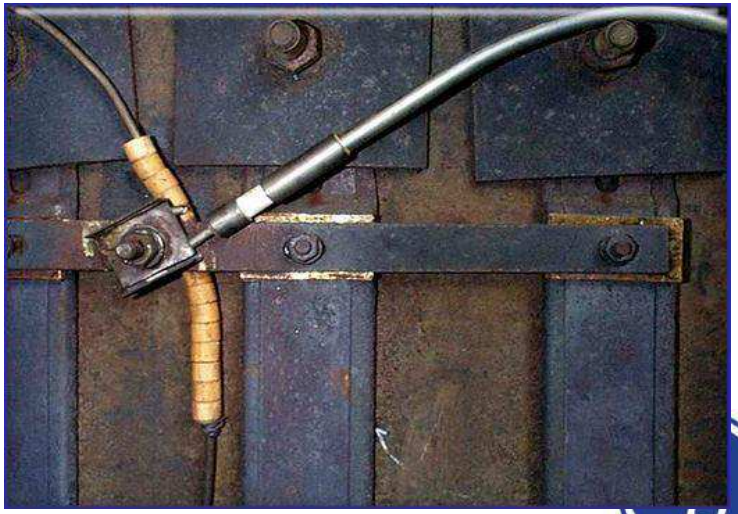
TRM GROUP

Ineos Chlorinator

Another example of a **TRM total design, supply and installation project**. Here we removed an unreliable none mineral insulated heating system with our full MI solution.

The key benefits here are significantly reduced downtime and maintenance costs.





TRM GROUP

West-east Natural Gas Transmission Project

Welding large objects like these natural gas pipes requires pre-heating of the surrounding weld area.

TRM provided a design, supply and installation service of **specialist heating belts** consisting of MI elements to fit around the pipes.

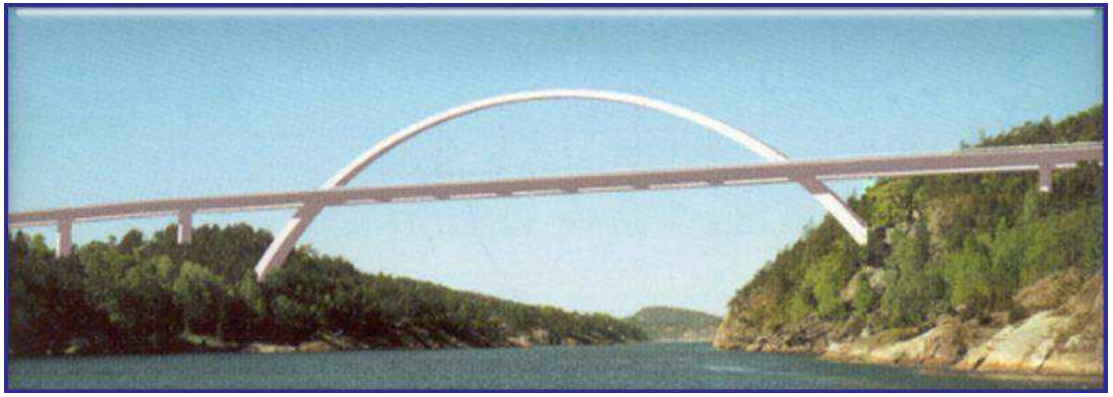
TRM GROUP

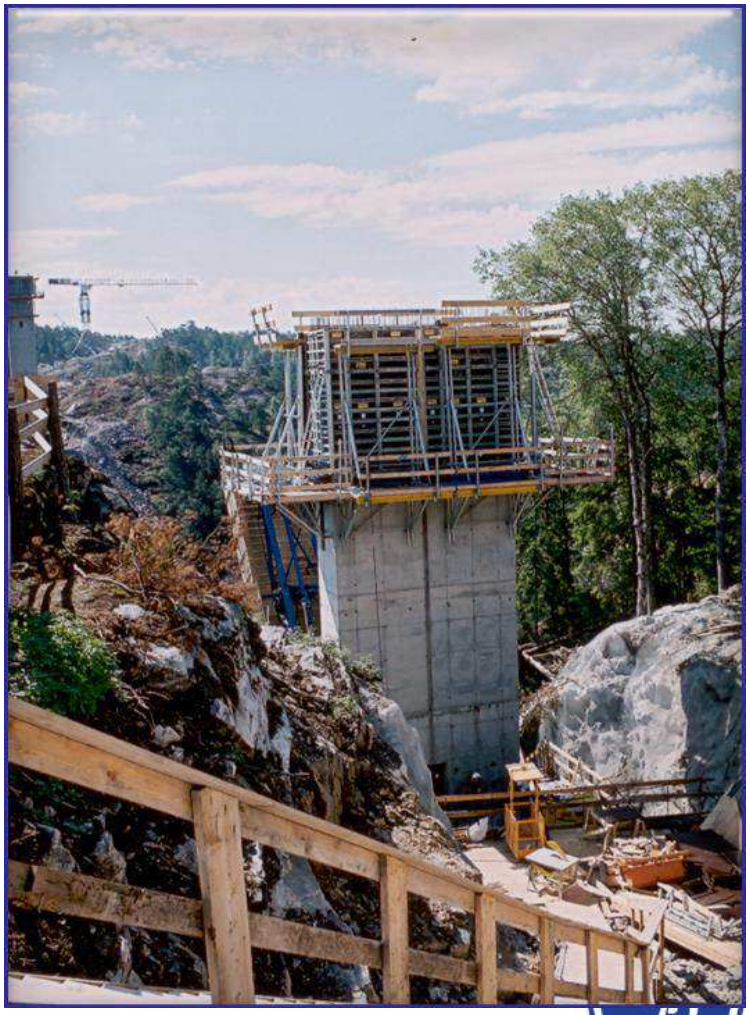
Southern Gas (Scotia) Holder Installation

On this project TRM supplied our **mineral insulated trace heating solution** to heat the water seal of the gas holder to prevent frost forming. This allows the storage container to expand safely in all weathers.

Sweden / Norway - Bridge Heating

A typical TRM design and supply project in Sweden. This new road bridge between Sweden and Norway shows the installation of **MI heating elements** in the arch to prevent ice and snow falling on the carriageway.





TRM GROUP

Aerodyn

Aerodyn Engineering Inc.

Instrumentation & Testing for Aerospace & Power Generation






Aerodyn Engineering – Slip Ring Technology

The traditional solution for data transfer from rotational portions of an engine or other rotating devices to the stationary world is slip rings. Slip rings are ubiquitous in the rotational measurement field and for decades have provided high quality data on strain, temperature and other parameters from live engines, rig tests, component spin tests, and practically anything requiring measurement that rotates at high speed. Even today, with the advent of Non-Intrusive Stress Measurement Systems, testers still rely heavily on slip ring technology because it is the only technique that directly measures strain. It continues to be consistently used in tandem with other systems as the primary means of data collection on rotating devices, and as a calibration and verification tool. High speed slip ring technology at Aerodyn Engineering encompasses a broad range of capabilities, including:

- 36 – 424 contact slip rings at speeds from 90,000 to 15,000 RPM
- Intermediate bearing assemblies with multiple termination capability (e.g. 200 termination contacts monitored by a 100 contact slip ring)
- On-rotor multiplexing switches to monitor a large number of channels
- Very small high speed rings- to 150,000 RPM
- Automotive transmission slip rings
- Flight test slip rings
- Silver Graphite slip rings for blade-off testing and power applications

Aerodyn Engineering (AEI) has been involved in many generations of slip rings supporting engine testing and produces what represents the current state of the art in high-speed/low noise slip ring solutions. AEI also provides telemetry and hybrid slip rings, multiplexing electronic solutions and other specialized equipment. AEI standard slip rings range in size from 36 contacts to 424 contacts and support engine development programs for most of the world's leading engine manufacturers.

Aerodyn slip ring performing strain survey on compressor. Pictured is a 36 contact slip ring capable of 90,000 RPM. A similarly designed 72 contact slip ring was provided to Williams International for fan and compressor strain surveys on the FJX/TSX and EJ22 turboshaft engines at speeds to 75,000 RPM.

Aerodyn

Aerodyn Engineering Inc. (AEI) focuses on rotating equipment and turbo machinery for the Aerospace, Power Generation, and Industrial markets, with a specialty in instrumentation and slip rings. AEI designs and manufacturers slip rings, applies strain and temperature gages to rotating equipment, provides instrumentation and performs field tests, and undertakes custom data reduction.

Slip Rings

AEI's primary business is the design and manufacture of slip rings for commercial and military customers. AEI has produced numerous slip ring designs ranging from small, high speed units to large slip rings used for power generation turbines. Typical slip ring characteristics supplied by AEI are listed below:

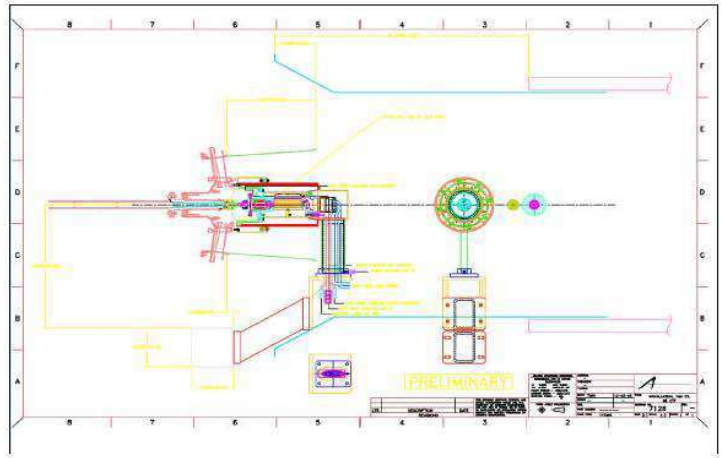
AEI 424 Contact Slip Ring. Used for testing large power generation turbines up to 20,000 RPM, it is the largest of its type ever built.

# Contacts	Speeds (RPM)
424	15,000
300	20,000
212	40,000
100	50,000
72	75,000
36	90,000

Typical life expectancy exceeds 100 Million revolutions, and bi-directional rotation is permitted. Bearing lubrication is oil/air, or grease packed bearings, and most current slip rings use a coolant supplied by a cooling cart (the exception being the fluid filled slip ring developed for the Comanche tail rotor). The maximum ambient temperature allowed for normal slip rings is 300 °F and the maximum ambient pressure is 50 PSIG.

AEI is involved in a number of new slip ring designs including the high temperature slip ring depicted on the next page (lower figure). Shown is an installation drawing of a 150 contact slip ring being designed to operate in the exhaust of GE CT7 engine. Exhaust temperatures are expected to be 1300°F. Note that the installation requires support of a cooling cart, but the "in flight" slip ring would not require life support to 700°F.

36-contact slip ring capable of speeds to 90,000 RPM.



Installation drawing of a 150 contact slip ring being designed to operate in the exhaust of GE CT7 engine. Exhaust temperatures are expected to be 1300°F. Note that the installation requires support of a cooling cart, but the "in flight" slip ring would not require life support to 700°F.

Aerodyn

Instrumentation & Testing

Aerodyn Engineering participates in testing and instrumentation for gas turbine engines used in marine, industrial and aerospace applications; projects are performed for commercial customers (Boeing, Williams International, GE, Pratt & Whitney, Honeywell, etc.), the military and government agencies. AEI is also involved in structural testing of aircraft and other industrial and commercial equipment. Testing activities include:

- Aero-thermodynamic testing
- Gas turbine engine vibration
- Airframe strain
- General rotating machinery
- Marine, industrial & aeronautical equipment
- Airfoil vibration testing

Gages applied to outside of aircraft in preparation for thermal expansion test.

- Acoustic instrumentation & testing
- Pressure, temperature & flow tests
- Strain & Vibration testing and instrumentation

Aerodyne is involved in significant instrumentation projects including:

- High Speed Slip-Rings
- High or Low Temperature Strain Gage Applications
- Thermocouples, RTD's or Thermistors
- Accelerometers and Velocimeters
- Dynamic or Steady-State Pressure Measurement
- Analog or Digital Recording
- Strain Gage Installation
- Custom Force Transducers

Detail of strain gage attachment on compressor blade

A fan used in an HCF test, with strain gages applied by AEI

- Thermocouples
- Pressure Sensors
- Slip Rings
- Telemetry
- Aerothermal Rake and Probe
- Aerothermal Surveys

Strain Gage Instrumentation of a large fan by AEI.

Key Personnel

David Lawrence

Mr. Lawrence is an internationally recognized expert in the design and use of slip rings and other instrumentation for gas turbine engines. Originally employed at Garret Turbine Engine, Mr. Lawrence founded Quality Aero Technology (QAT) where he developed designs and was issued a fundamental patent that is the basis for the modern slip ring.

Mr. Lawrence was also employed at Rolls-Royce Allison as a principal engineer in charge of test instrumentation, including slip rings and telemetry systems. He represented Allison at the Propulsion Instrumentation Working Group (PIWG), a consortium of gas turbine engine companies whose goal is to advance the development of instrumentation products and techniques; served on additional technical committees and authored numerous technical papers.

Mr. Lawrence holds two patents; one for slip rings, and another for the design of capacitive sensors. Mr. Lawrence has a BSME from the University of Michigan, and has 21 years

Aerodyn

experience in the development of slip rings, and in the instrumentation and testing of gas turbine engines.

Thomas Lawrence
Education and Employment

BSME Northwestern University
MSME Massachusetts Institute of Technology
MBA University of Wisconsin
BA Coe College
Licensed Professional Engineer

Thomas Lawrence began performing research at MIT's Aerophysics Laboratory while earning his master's degree in mechanical engineering.

R&D Principal Engineer for The Parker Pen Company, working on specialized gold coatings and planar magnetron sputtering.

Amphenol Connectors – Ran department for metal finishing; headed department for corporate process modernization and capital improvement; plant manager and ultimately corporate director of manufacturing engineering.

Bendix Aerospace Electric Power Division – In charge of manufacturing operations, manufacturing engineering and process development.

At Aerodyn Thomas is in charge of the Fluid Research project. The object of the effort is to study how coolant fluids chemically break down and how their chemical and mechanical properties affect the hydrodynamics that cause electrical signal noise in the high temperature electrical contact areas of slip rings.

Thomas Lawrence holds two patents and is a Certified Electroplater-Finisher.

Company Information and Facilities

Aerodyn Engineering, Inc. was established in Indianapolis and incorporated in 2002. Aerodyn purchased the Field Test and Instrumentation Division (FTID) of Test Devices, Inc., retained all the FTID personnel and added additional engineering capacity and professional technical support. Additional facilities and precision machining equipment and technology have also been added.

Aerodyn has two primary facilities. The Indianapolis office is 10,800 sqft and houses the instrumentation and machining departments. The Cincinnati facility is 7,500 sqft and concentrates on field test and data acquisition activities.

Aerodyn's focus is on the power generation and aerospace markets, specializing in gas turbine instrumentation and field testing.

Aerodyn manufacturers the world's highest precision slip rings, which are used in applications requiring the transfer of data from any rotating machinery or equipment. Aerodyne slip rings are used throughout the world to acquire stress and temperature data from engines, with speeds up to 120,000 RPM and capacities up to 424 contacts, all of which are standard in the Aerodyn product line.

Aerodyn also participates in specialized testing, including:

- Dynamic pressure measurements of engine combustors
- Dynamic pressure and strain of helicopter fuselage during missile firing
- Dynamic strain survey of locomotive turbocharger impeller
- Design and fabrication of engine performance rakes
- Custom data acquisition systems for gas pipeline turbines
- Speed control system for wind tunnel powered engine simulator
- IR and high-speed video of helicopter missile firings
- Custom slip rings for aero engine blade-out testing
- Gear tooth root stress measurements on advance gearbox
- Blade stress ratio and characterization of blades & vanes

Aerodyn

Customers for New Slip Rings/IBA's (Intermediate Bearing Assemblies), Cooling Carts - AEI Standards Product

GE Transportation
GE Power
GE Lynn
Wyle Labs (Air Force)
NAWCAD
Pratt Whitney
AFRL/PRTE
CIAM-Moscow
Purdue Aero Lab
Avio-Turin
Nouvo Pignone (Italy)
Rolls-Royce Corp
GEAE
Honeywell
Williams

Custom Designed Slip Rings
GEAE – CF34 Blade Out Slip Ring
Boeing – Comanche Tail Rotor Flight Test
Tech Dev – Wind tunnel Powered Simulators

Slip Ring Repair/Refurbishment/Rental

Aerodyn has emerged as the dominant slip ring manufacturing for turbo-machinery. In addition to selling slip rings, Aerodyn is often asked to repair/refurbish slip rings from others manufacturers such as QAT, Polyscientific, and P&W silver graphite slip rings. Aerodyn has test stands to spin slip rings to operating speeds up to 90,000 RPM and measure dynamic noise at Fourier translated frequency in the micro-volt peak to peak range. Aerodyn tests, diagnosis, and if necessary reverse engineers and provides replacement parts.

Borg Warner
NAWCAD
Pratt Whitney
Honeywell Engines
Tech Development
Turbomeca
Test Devices Inc.
Wyle Laboratories (Air Force)
Naval Post Graduate School
Allied Aerospace
GE Power Greenville
Wright Patterson Air Force Base
Timken (aircraft bearings)
Rolls-Royce Corp.

Flight Test
Kamov (Russia)
Boeing Comanche

Rake and Probe
Aerodyn is a trusted supplier custom aero-thermodynamic rakes and probes used in turbo-machinery testing:

Calpine
GE Power – Greenville
TRM
TDI Limited
Rolls –Royce Corporation
RAMGEN
Hood Technology
Power Systems Mfg
Honeywell

Instrumentation

Aerodyn will install strain gages and do instrumentation according to customer specifications; but most customers seek Aerodyn's recommendation on how best to instrument an application to fit their test information needs.

Tech Development
Holcim
Delco Remy
Honeywell Engines
RAMGEN
Borg Warner – Turbo wheels
GE Gas Turbine
Datatel (Germany)
GEAE
Ford Motor
Boeing Helicopter
Micromatic
GE Locomotive
Boeing
Pratt Whitney – E. Hartford
Northrup Grumman

Vibration Measurement/Blade Characterization
AEI has a dedicated test facility for vibration and dynamic strain measurement, mainly used for blade characterization of turbine blades. In such applications AEI almost always applies the gages.

Power Systems Mfg.
GE Power – Greenville
Delco Remy
GE Gas Turbine
Nouvo Pignone (Italy)
RR Allison
GE Energy

Telemetry Systems
Rolls-Royce Corporation
Northrup Grumman

Test Software and Test Stand Set-UP
Calpine TMG – Texas
GE M&I – Turkey
Delco Remy
Tech Dev
GE Power – Greenville

Field Test
Aerodyn engineers are experts at data conditioning, data recording and data reduction using virtual instrumentation applications. Field testing is very costly and everything depends on getting the right data in short period of time. Aerodyn has a long list of top of the line recommendations from world-class companies.

Power Generating Turbines
Calpine TMG
GE-Gas Turbines
GE M&I
GEAE – Brazil, Turkey
Rolls Royce Allison – Spain
GE Power – Greenville - U.S.A., France, Italy,
Northrop-Sunnyvale

Automotive
Delco Remy U.SA, Moscow
Ford ATPDC
UBE Automotive

Aircraft Engines
Avio – Turin (CT& -8)
Am. Aerospace

Miscellaneous
Eldorado
GE Power Schenectady – Steam Turbine
Crane Naval Weapons – Ammo Destruction Facility
GE Transportation – Strain Survey
Ohio State University
Rolls Royce Energy Systems

Aerodyn

Aerodyn Ltd designed and supplies the Rolls Royce Avon gas turbine **temperature measurement harness**.

TRM GROUP

Can TRM be a partner for your business?

Manufacturing the World's largest range of Mineral Insulated;

- Heating cable
- Thermoelectric cables
- Fireproof wiring cable
- CSA / ATEX approved Heating Elements and Temperature Measurement probes and assemblies.

TRM provide the unique 'all in one' solution of;

① Design ② Manufacture ③ Install

We can work with you on;

- Industrial Heating systems
- Temperature measurement solutions
- Enhanced Fire Survival wiring cable installations
- Special Mineral Insulated Cables

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Notes:

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