An introduction to the full range of services of the TRM Group including MICC Ltd and TET Ltd companies.
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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
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.
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.
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.
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.
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)
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!
**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
- Plan set in motion to double UK production output within 3 years, 2015.
- MICC Ltd gain KAHARAMAA 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.
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
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.
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
## Power Generation

**Typical temperature measurement applications**

<table>
<thead>
<tr>
<th>Main water feed</th>
<th>Concrete surrounding outlet headers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency cooling water</td>
<td>Steam valve metal and steam/valve passing</td>
</tr>
<tr>
<td>Pressure vessel cooling water</td>
<td>Dump steam</td>
</tr>
<tr>
<td>Main steam header</td>
<td>Start-up vessel</td>
</tr>
<tr>
<td>Performance rake – main steam</td>
<td>De-aerator</td>
</tr>
<tr>
<td>Hot reheat header</td>
<td>Steam trap passing</td>
</tr>
<tr>
<td>Cold reheat header</td>
<td></td>
</tr>
<tr>
<td>Weld leakage monitors (collars)</td>
<td></td>
</tr>
<tr>
<td>Primary header - main steam</td>
<td></td>
</tr>
<tr>
<td>Secondary header - main steam</td>
<td></td>
</tr>
</tbody>
</table>
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
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.
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 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.
MICC Ltd

MICC Ltd operates a large UK plant.

Temperature House in Washington.


MICC Ltd are the world's largest provider of stainless steel mineral insulated cable.
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.
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
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.
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
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
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
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.

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

D = Outside diameter  
C = Conductor diameter  
S = Sheath wall thickness  
I = Insulation thickness
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

<table>
<thead>
<tr>
<th>Cable Diameters</th>
<th>Inconel Range</th>
<th>AISI 310 Range</th>
<th>AISI 316 Range</th>
<th>AISI 321 Range</th>
<th>Nicrobell Range</th>
<th>446 Stainless Range</th>
<th>Hastalloy X Range</th>
<th>Alloy 825 Range</th>
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</thead>
<tbody>
<tr>
<td>6.4</td>
<td>T2K-600-64</td>
<td>T2K-310-64</td>
<td>T2K-316L-64</td>
<td>T2K-321-64</td>
<td>T2K-NIC-64</td>
<td>T2K-446-60</td>
<td>T2K-HSX-60</td>
<td>T2K-825-60</td>
</tr>
<tr>
<td>6</td>
<td>T2K-600-60</td>
<td>T2K-310-60</td>
<td>T2K-316L-60</td>
<td>T2K-321-60</td>
<td>T2K-NIC-60</td>
<td>T2K-446-60</td>
<td>T2K-HSX-60</td>
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<td>2</td>
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<td>T2K-310-20</td>
<td>T2K-316L-20</td>
<td>T2K-321-20</td>
<td>T2K-NIC-20</td>
<td>T2K-446-20</td>
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<td>1.6</td>
<td>T2K-600-16</td>
<td>T2K-310-16</td>
<td>T2K-316L-16</td>
<td>T2K-321-16</td>
<td>T2K-NIC-16</td>
<td>T2K-446-16</td>
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</tr>
<tr>
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<td>T2K-310-10</td>
<td>T2K-316L-10</td>
<td>T2K-321-10</td>
<td>T2K-NIC-10</td>
<td>T2K-446-10</td>
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The following duplex (4 core) cables are also available

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</tr>
</thead>
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<td>T4K-316L-64</td>
<td>T4K-321-64</td>
<td>T4K-NIC-64</td>
<td>T4K-446-60</td>
<td>T4K-HSX-60</td>
<td>T4K-825-60</td>
</tr>
<tr>
<td>6</td>
<td>T4K-600-60</td>
<td>T4K-310-60</td>
<td>T4K-316L-60</td>
<td>T4K-321-60</td>
<td>T4K-NIC-60</td>
<td>T4K-446-60</td>
<td>T4K-HSX-60</td>
<td>T4K-825-60</td>
</tr>
<tr>
<td>1.6</td>
<td>T4K-600-16</td>
<td>T4K-310-16</td>
<td>T4K-316L-16</td>
<td>T4K-321-16</td>
<td>T4K-NIC-16</td>
<td>T4K-446-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>T4K-600-10</td>
<td>T4K-310-10</td>
<td>T4K-316L-10</td>
<td>T4K-321-10</td>
<td>T4K-NIC-10</td>
<td>T4K-446-10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MI Thermocouple & RTD Units

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

Table 1 - Tolerance Class

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>± °C</td>
<td>± °C</td>
</tr>
<tr>
<td>-200</td>
<td>0.55</td>
<td>0.24</td>
</tr>
<tr>
<td>-100</td>
<td>0.35</td>
<td>0.14</td>
</tr>
<tr>
<td>0</td>
<td>0.15</td>
<td>0.06</td>
</tr>
<tr>
<td>100</td>
<td>0.35</td>
<td>0.13</td>
</tr>
<tr>
<td>200</td>
<td>0.55</td>
<td>0.20</td>
</tr>
<tr>
<td>300</td>
<td>0.75</td>
<td>0.27</td>
</tr>
<tr>
<td>400</td>
<td>0.95</td>
<td>0.33</td>
</tr>
<tr>
<td>500</td>
<td>1.15</td>
<td>0.38</td>
</tr>
<tr>
<td>600</td>
<td>1.35</td>
<td>0.43</td>
</tr>
<tr>
<td>700</td>
<td>1.56</td>
<td>0.48</td>
</tr>
<tr>
<td>800</td>
<td>1.76</td>
<td>0.53</td>
</tr>
<tr>
<td>900</td>
<td>1.96</td>
<td>0.58</td>
</tr>
</tbody>
</table>

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

Part Reference Example:
See table 1 for materials and specifications

© TRM Ltd Data Sheet No.: DS0010  www.temperature-house.com
MI Thermocouple & RTD Units

RTD Data Sheet - Non MI Construction RTD Assembly

Assembly Details:
- Tube Material: 316 Stainless Steel.
- Pt100 Detection: Thin Film, Class 'A'.
- Part Reference: Pt100 Flexible

Table 1 - Tolerance Class

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>±t°C</td>
<td>±t°C</td>
</tr>
<tr>
<td>-200</td>
<td>0.55</td>
<td>0.24</td>
</tr>
<tr>
<td>-100</td>
<td>0.35</td>
<td>0.14</td>
</tr>
<tr>
<td>0</td>
<td>0.15</td>
<td>0.06</td>
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<tr>
<td>100</td>
<td>0.35</td>
<td>0.13</td>
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<tr>
<td>200</td>
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<td>300</td>
<td>0.75</td>
<td>0.27</td>
</tr>
<tr>
<td>400</td>
<td>0.65</td>
<td>0.33</td>
</tr>
<tr>
<td>500</td>
<td>0.85</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Notes:
- RTD probes manufactured to IEC751.
- Minimum immersion length = 100mm.
- Maximum immersion length = 300mm.
- Standard tail length = 1000mm.
- Maximum operating temperature = 250°C.
- Minimum operating temperature = 0°C.
MI Thermocouple & RTD Units

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:

```
Part Reference: P 4 D - 316L - 60
```

<table>
<thead>
<tr>
<th>Sheath Material</th>
<th>Conductor Material</th>
<th>RTD Category</th>
<th>Cable Diameter</th>
<th>Tolerance Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>C = Copper D = Cupro Nickel</td>
<td>T = 316L S = 321</td>
<td>R = Premium Grade</td>
<td>4.5mm (45)</td>
<td>A = Class A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T = Commercial Grade</td>
<td>6.0mm (60)</td>
<td>B = Class B</td>
</tr>
</tbody>
</table>

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
23 Sealing Road
Wear Industrial Estate
Washington
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Tel.: +44(0)191 4168884
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Email:sales@tmrltd.co.uk
United Kingdom

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. Designations specified in mm, including immersion length and bend length.
3. Type of junction insulated (UJ) or bonded (BJ).
4. Any accessories required e.g. Lock nuts or terminal glands.
5. Any special test requirements.

Part Reference Example:
See table 1 for cable and specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Price</th>
<th>Number of Conductors</th>
<th>Conductor Material</th>
<th>Sheath Material</th>
<th>Overall/Outer Cable Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1

<table>
<thead>
<tr>
<th>Type &amp; Nominal Chromel/Nickel Conductors</th>
<th>Overall Diameter</th>
<th>Number of Conductors</th>
<th>Nominal Loop Resistance</th>
<th>Nominal Conductor Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A: Type A1 / Type A2</td>
<td>0.50</td>
<td>2</td>
<td>1.30</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>2</td>
<td>3.60</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>1.50</td>
<td>2</td>
<td>6.00</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>2</td>
<td>8.40</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>2.50</td>
<td>2</td>
<td>10.80</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Table 2.</th>
<th>Configuration</th>
<th>Insulation Colour Coding for Flexible Thermocouple Tails</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>MFR</td>
<td>Sheath Colour</td>
</tr>
<tr>
<td>K</td>
<td>NKL</td>
<td>Green</td>
</tr>
<tr>
<td>J</td>
<td>ICM</td>
<td>Blue</td>
</tr>
<tr>
<td>T</td>
<td>NTL</td>
<td>Brown</td>
</tr>
</tbody>
</table>

Notes:
- Minimum immersion length is 100mm.
- ISO sensitization is supplied with grey outer insulation standard. Minimum operating temperature of 100°C.
- Alternative materials are available on request.
- Flexible stranded tails available with PVDF or PTFE IEC colour coded insulation as standard. Other materials and colour coding available on request.
- EMP Characteristic: 8 nominal EAF 8 IEC 584-3.

TRM Ltd Data Sheet No.: D39008
www.temperature-house.com
MI Thermocouple & RTD Units

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. Types 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.

<table>
<thead>
<tr>
<th>Category</th>
<th>Probe</th>
<th>Number of Conductors</th>
<th>Conductor Material</th>
<th>Overall Cable Diameter x 10 (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P 2 K</td>
<td>321</td>
<td>15 S</td>
<td></td>
<td>EMT Tolerance</td>
</tr>
</tbody>
</table>

Table 1: Thermocouple Details

<table>
<thead>
<tr>
<th>Type</th>
<th>Overall Diameter</th>
<th>No. of Conductors</th>
<th>Sheath Material</th>
<th>Nominal Loop Resistance</th>
<th>Nominal Conductor Diameter</th>
<th>Minimum Operating Temperature</th>
<th>Nominal Conductor Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>2</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>3</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>4</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>5</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>6</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>7</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>8</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>9</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>10</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>11</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>12</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>13</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>14</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
<tr>
<td>A15</td>
<td>0.5 mm</td>
<td>15</td>
<td>-</td>
<td>10 x 6</td>
<td>0.18</td>
<td>800°C</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Table 2: Insulation Colour Coding for Flexible Thermocouple Plugs

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Insulation Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Red</td>
</tr>
<tr>
<td>J</td>
<td>Green</td>
</tr>
<tr>
<td>T</td>
<td>Blue</td>
</tr>
<tr>
<td>N</td>
<td>White</td>
</tr>
<tr>
<td>E</td>
<td>Yellow</td>
</tr>
<tr>
<td>NUC</td>
<td>Black</td>
</tr>
<tr>
<td>NUC</td>
<td>Brown</td>
</tr>
<tr>
<td>NUC</td>
<td>Orange</td>
</tr>
<tr>
<td>NUC</td>
<td>Pink</td>
</tr>
<tr>
<td>NUC</td>
<td>Green</td>
</tr>
<tr>
<td>NUC</td>
<td>Blue</td>
</tr>
<tr>
<td>NUC</td>
<td>Yellow</td>
</tr>
<tr>
<td>NUC</td>
<td>White</td>
</tr>
<tr>
<td>NUC</td>
<td>Red</td>
</tr>
</tbody>
</table>

Notes:
- Minimum immersion length is 100mm.
- ISO standardisation is included with every order as standard. Minimum operating temperature of seal.
- Accessories are available on request.
- Flexible insulated tails available with PVC or ETFE. Colour-coded insulation is standard. Other materials and length of tails are available on request.
- EMF Characteristic: 8 nominal EMA + IEC 584-3.

37 www.temperature-house.com
MI Thermocouple & RTD Units

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Wear Industrial Estate
Washington

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Page 1 of 2

# 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. Order quantities in mm, including immersion length and tail length.
3. Type of jacket (standard or bellows).
4. Any special features requested.

Part Reference Example:
See table 1 for details and specifications.

P 2 K - 321 - 60 S

Table 1 - Thermocouple 88# Tolerances

Table 2 - Insulation Colour Coding for Flexible Thermocouple Tails

Notes:
Minimum immersion length is 100mm.
MI Thermocouple & RTD – 100 Series

110# Series
Thermocouple & Resistance Thermometer Assemblies
- 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 316 SS.
- Available with “in-head” 2-wire Temperature Transmitter.

120# Series
Thermocouple & Resistance Thermometer Assemblies
- With choice of adjustable connectors.
- Long Pliable MI lead out, where required for intrusive installation and high temperature route.
- Certified for use in hazardous area.
- Available with “in-head” 2-wire temperature Transmitter.

Typical application area: turbine casing, 3100F and drum motor temperature measurements in power plants and measurement of temperature in high temperature application in Furnace and Petrochemical plants.

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

ORDERING EXAMPLE
110# SERIES T-H/6C-2X-RH-1+M/RS45/4E+M-73-3-3QG0

ORDERING EXAMPLE
120# SERIES 2 X-K-35E R-2-0-7-B-127-10-QL-155-QG-43-14
MI Thermocouple & RTD – 100 Series

121# Series
Thermocouple & Resistance Thermometer Assemblies with
- Integral Collar.
- Long Flexible MI lead wire, ideal for skin temperature measurement.
- Certified for use in hazardous areas.
- Available with "in-head" 2-wire Temperature Transmitter.
- Bracket mounting or 2" Nb pipe mounting.

Typical applications: measurement of surface temperature of refractory lined vessels, columns, reactors in Petrochemical plants or Oil Refineries.

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

122# Series
Thermocouple & Resistance Thermometer Assemblies with
- Weld pad or "strap-on" pad.
- Long Flexible MI lead wire, ideal for skin temperature measurement or pipe surface.
- Certified for use in hazardous areas.
- Available with "in-head" 2-wire Temperature Transmitter.
- Bracket mounting or 2" Nb pipe mounting.

Typical applications: measurement of surface temperature of refractory lined vessels, columns, reactors in Petrochemical plants or Oil Refineries and pipelines.

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

Thermocouples are provided with ungrounded junction unless specified otherwise.

ORDERING EXAMPLE
121# Series 3946G0100-006-705-4042-4-100-C-CL-1.5SWC-01S

ORDERING EXAMPLE
122# Series 3946G0100-006-705-4042-4-100-C-CL-1.5SWC-01S
MI Thermocouple & RTD – 100 Series

123# Series
Thermocouple & Resistance Thermometer Assemblies with
- "Grasp on" for pipe surface measurement.
- Flexible MI lead wire, ideal for surface measurement of pipe or vessel surface.
- Certified for use in hazardous areas.
- 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 Flexible MI lead out cable to enable its usage in in-situ installations and for monitoring the pipe surface for surface temperature measurement of gas/oil/pipelines or heat treated pipe lines.

These thermocouples or RTD’s are provided with a stand-off nipple for local mounting.

Thermocouples are also provided with ungrounded junction unless specified otherwise.

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
- Flexible and can be routed through high temperature environments
- 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)

**ORDERING EXAMPLE**

123 SERIES 1-Ph-M-315-FL-120V-100-32-EL-200-G(2060)

150 SERIES 1-KX-6-S-CT200-GL-10M-TL1-120/TL2-200-HANDI/4N-2-OPTION 0
MI Thermocouple & RTD – 100 Series

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 environment
- Provided with PTFE insulated & colour coded flex tails for termination in Junction Box or instrument enclosures
- Available with a choice of glands & Flameproof Endcaps (Optional)

ORDERING EXAMPLE
151# SERIES 1-Cu-6-T-CJT201G-RL=19M-TL1-159/TL2-209-1-6N-2-OPTION 0
MI Thermocouple & RTD – 300 Series

300# Series
Thermocouple & Resistance Thermometer Assemblies with
- A threaded tapped thermowell.
- Certified for use in hazardous areas.
- Safe design as per ASME PTC9.3.
- 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 unified complete assembly ready for use in the application designed for. The design of the complete assembly depends on various parameters such as, temperature, dynamic pressures, 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, straight tubes as well as multiport to suit practically every process. Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as inconel 800, inconel 600, Monel 400, Hastelloy alloys C-276 and alloy B.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with concentric entry of 1/8NPT and ungrounded Junction for Thermocouples.

<table>
<thead>
<tr>
<th>Code</th>
<th>Bit of Element</th>
<th>Elements</th>
<th>Process Conn.</th>
<th>Options</th>
<th>B</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>1</td>
<td>1/8NPT</td>
<td>17</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Head in 3/8NPT</td>
<td>2</td>
<td>5/8NPT</td>
<td>22</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Head in 3/4NPT</td>
<td>3</td>
<td>5/8NPT</td>
<td>35</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Head in 1NPT</td>
<td>4</td>
<td>5/8NPT</td>
<td>45</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extension in 3/8NPT</td>
<td>5</td>
<td>1/2NPT</td>
<td>22</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Extension in 3/4NPT</td>
<td>6</td>
<td>5/8NPT</td>
<td>35</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Extension in 1NPT</td>
<td>7</td>
<td>5/8NPT</td>
<td>45</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Extension in 1-1/2NPT</td>
<td>8</td>
<td>1NPT</td>
<td>35</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Extension in 2NPT</td>
<td>9</td>
<td>1NPT</td>
<td>45</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Extension in 2-1/2NPT</td>
<td>10</td>
<td>1NPT</td>
<td>55</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Extension in 3NPT</td>
<td>11</td>
<td>1NPT</td>
<td>65</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Extension in 3-1/2NPT</td>
<td>12</td>
<td>1NPT</td>
<td>75</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Extension in 4NPT</td>
<td>13</td>
<td>1NPT</td>
<td>85</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Extension in 4-1/2NPT</td>
<td>14</td>
<td>1NPT</td>
<td>95</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Extension in 5NPT</td>
<td>15</td>
<td>1NPT</td>
<td>105</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>

ORDERING EXAMPLE
300 SERIES 1/4-1/2 X 3/8-5/8 X 0-150°F 1-8 4

310# Series
Thermocouple & Resistance Thermometer Assemblies with
- EN Standard 0145.00 Threaded Thermowell.
- Certified for use in hazardous areas.
- Safe design as per ASME PTC9.3.
- 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 EN standard 0145.00, is ideally suited for use in Feather plating, Rhenium and Palladium chemistries.

The assembly can be supplied with 316LSS terminal head and nipple-united-nipple in 316LSS, as a standard feature in weight proof or remelted forging. This will withstand atmospheric corrosion and hold in carrying out periodic maintenance with more ease.

Heavy Duty well with process connection 1.5/8NPT and tapped sheet tapping from 32mm to 38mm is checked as a standard design for use on very high pressure application such as syrups compressor discharge.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as inconel 800, inconel 600, Monel 400, Hastelloy alloys C-276 and alloy B.

<table>
<thead>
<tr>
<th>Code</th>
<th>Bit of Element</th>
<th>Elements</th>
<th>Process Conn.</th>
<th>Options</th>
<th>B</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>1</td>
<td>1/8NPT</td>
<td>17</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Head in 3/8NPT</td>
<td>2</td>
<td>5/8NPT</td>
<td>22</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Head in 3/4NPT</td>
<td>3</td>
<td>5/8NPT</td>
<td>35</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Head in 1NPT</td>
<td>4</td>
<td>5/8NPT</td>
<td>45</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extension in 3/8NPT</td>
<td>5</td>
<td>1/2NPT</td>
<td>22</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Extension in 3/4NPT</td>
<td>6</td>
<td>5/8NPT</td>
<td>35</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Extension in 1NPT</td>
<td>7</td>
<td>5/8NPT</td>
<td>45</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Extension in 1-1/2NPT</td>
<td>8</td>
<td>1NPT</td>
<td>35</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Extension in 2NPT</td>
<td>9</td>
<td>1NPT</td>
<td>45</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Extension in 2-1/2NPT</td>
<td>10</td>
<td>1NPT</td>
<td>55</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Extension in 3NPT</td>
<td>11</td>
<td>1NPT</td>
<td>65</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Extension in 3-1/2NPT</td>
<td>12</td>
<td>1NPT</td>
<td>75</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Extension in 4NPT</td>
<td>13</td>
<td>1NPT</td>
<td>85</td>
<td>85</td>
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</tr>
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<td>13</td>
<td>Extension in 4-1/2NPT</td>
<td>14</td>
<td>1NPT</td>
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<td>14</td>
<td>Extension in 5NPT</td>
<td>15</td>
<td>1NPT</td>
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</table>

ORDERING EXAMPLE
310 SERIES 1/4-1/2 X 3/8-5/8 X 0-150°F 1-8 4

44 www.temperature-house.com
# MI Thermocouple & RTD – 300 Series

## TT310# Series (Y)

**Temperature Transmitters with Thermocouple or RTD Assemblies**

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

**MI Thermocouple or Resistance Transmitter with Thermowell**

The assemblies are designed as per IEC 60875-1(2001)/BS 7148:2004 & complete assemblies with Thermowell meet the requirements 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. 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 C226 & C3, and Flanges in ASTM grades A105, A152 and A350 and in sizes 3/4” to 2” (DN 20 to DN 50).

**TT310# Series(Y)**

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Code Options</th>
<th>Code</th>
<th>No. of Elements</th>
<th>Code</th>
<th>No. of Elements</th>
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<tr>
<td>1</td>
<td>Simplex</td>
<td></td>
<td>4</td>
<td>Extension in 316 SS</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Duplex</td>
<td></td>
<td>5</td>
<td>1/4” NPT</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Triplex</td>
<td></td>
<td>6</td>
<td>3/8” NPT</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

**Process Conn:**

- P: Flange
- B: 1/2” NPT
- T: 3/4” NPT

**Code No. of Elements**

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Code</th>
<th>No. of Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simplex</td>
<td>2</td>
<td>Duplex</td>
</tr>
<tr>
<td>3</td>
<td>Triplex</td>
<td>5</td>
<td>1/4” NPT</td>
</tr>
<tr>
<td>6</td>
<td>3/8” NPT</td>
<td>8</td>
<td>Extension in 316 SS</td>
</tr>
</tbody>
</table>

**Code Sheet Material**

- 316: AISI 316, SS 316L
- 321: AISI 321, SS 321L
- 314P: AISI 314, Super Stainless
- 310S: AISI 310, SS 310L

**Code Well Material**

- 316: AISI 316, SS 316L
- 321: AISI 321, SS 321L
- 314P: AISI 314, Super Stainless
- 310S: AISI 310, SS 310L

**Code Well Insertion**

- T: Flange
- U: Define

**Code Well Material**

- 316: AISI 316, SS 316L
- 321: AISI 321, SS 321L
- 314P: AISI 314, Super Stainless
- 310S: AISI 310, SS 310L

**Code No. of Connectors**

- 1: One entry
- 2: Two entries

**ORDERING EXAMPLE**

TT 310# Series(Y) - 1-K-6-316-YYA 1161-N-316L-F316L-U-250-T-20-3/4”NPT(M)-Option 4

---

## 320# Series

**Thermocouple or Resistance Transmitter Assemblies**

- A threaded stepped shaft or straight shank well.
- Certified for use in hazard zone area.
- Safe design as per ASME PTC 19.3.
- Available with "in-line" heat exchanger temperature transmitter.

**MI Thermocouple or Resistance Transmitter Assemblies**

The assemblies are designed as per IEC 60875-1(2001)/BS 7148:2004 & complete assemblies meet the requirements 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, 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 as well as in exotic materials such as Incoloy 800, Inconel 600, Monel 400, Hastelloy C226 & C3, and Flanges in ASTM grades A105, A152 and A350 and in sizes 3/4” to 2” (DN 20 to DN 50).

**320# Series**

<table>
<thead>
<tr>
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<tbody>
<tr>
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<tr>
<td>3</td>
<td>Triplex</td>
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<td>1/4” NPT</td>
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<tr>
<td>6</td>
<td>3/8” NPT</td>
<td>8</td>
<td>Extension in 316 SS</td>
</tr>
</tbody>
</table>

**Process Conn:**

- P: Flange
- B: 1/2” NPT
- T: 3/4” NPT

**Code No. of Connectors**

- 1: One entry
- 2: Two entries
MI Thermocouple & RTD – 300 Series

330 Series
Thermocouple & Resistance Thermometer Assemblies with
A Threaded tapered Thermowell.
Certified for use in hazardous areas.
Safe design as per ASME PTC19.3.
Available with “in-head” 2-wire Temperature Transmitter.

340# Series
Thermocouple & Resistance Thermometer Assemblies with
Solid Sintered Tungsten Carbide Thermowell for mill Classifier outlet.
Rheniumalloyed Silicon Carbide for use on high temperature and abrasive services.
Certified for use in hazardous areas.
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 optional Stainless head with conduit entry of 3/8 NPT and 1/2 NPT. The 330 Series is certified for use in hazardous areas. A threaded tapered thermowell is provided as standard and is certified for use in hazardous areas. The temperature range is 300°F to 3000°F. The 340# Series is designed for use in high temperature and abrasive services.

Code Options
1. Series
2. Head
3. Extension
4. Material
5. Wall Material
6. Head Type

Code Options
1. Series
2. Head
3. Extension
4. Material
5. Wall Material
6. Head Type

TRM GROUP
MI Thermocouple & RTD - 400 Series

400 Series
Thermocouple & Resistance Thermometer Assemblies with
- A flanged tapered Thermowell,
- Certified for severe hazardous areas,
- Safe design as per ASME PTC19.3,
- Available with "in-head" 2-wire Temperature Transmitter.

TT400# Series
Temperature Transmitters with Thermocouple or RTD Assemblies
- Factory assembled, configured & calibrated units
- Transmitters to customer choice
- Various Thomowell 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 60335-3-82, EIA-214 and 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 304 stainless steel as well as exotic materials such as Inconel 800, Monel 600, Hastelloy C276 & B3, and flanges in ASTM grades A105, A182 and A350 and in sizes 3/4" to 2" (DN20 to DN50).

The standard execution shown in this leaflet is with plain GS extension and Aluminum head with conduct entry of 1/4NPT and ungrounded junction for Thermocouples unless specified otherwise.
TT400# Series
Temperature Transmitter with Thermocouple or RTD Assemblies

TT400# Series (Y)
Temperature Transmitters with Thermocouple or RTD Assemblies
- Factory assembled, configured & calibrated 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 it stocks a wide range manufactured by "Yokogawa".

The assemblies are designed as per IEC 60795-1(2001) and 60214-2004. A 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, etc. The 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 ANSI 309 series stainless steels as well as, in exotic materials such as Inconel 600, Inconel 601, Monel 400, Hastelloy C276 & B-3, and Flanges in ASTM grades A105, A182 and A351 and in sizes 3/4" to 2" (DN 20 to DN 50).

**TT400# Series (Y)**

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<tr>
<td>E</td>
<td>Chromel-Cobalt</td>
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<tr>
<td>J</td>
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<td>312</td>
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**TT400# Series (Y)**

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**TT400# Series (Y)**

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<td>BTY 308</td>
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<td>STT</td>
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**TT400# Series (Y)**

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**ORDERING EXAMPLE**

TT 400# Series(Y) - [1-12-6-316-YTA 110-1-N-316L-F316L-A-U=250-T=78-1.5" IRF- Option 4]
MI Thermocouple & RTD – 400 Series

410 Series
Thermocouple & Resistance Thermometer Assemblies with
- EMI Standard
- 0.0001\% Type J Thermowells
- Certified for use in hazardous areas
- 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 back step Thermowell as per EMI standard 0.0001\%, is usually suited for use in Process plants, Refineries and Petrochemical complexes.

The assembly can be supplied with 316LSS terminal head and complete assembly in 316LSS as a standard fixture in weatherproof or flameproof execution. The will resist atmospheric corrosion and help in carrying out periodic maintenance with ease.

Thermowells are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Inconel 800, Inconel 600, Monel 400, Hastelloy C276 and alloy 8 and flanges in ASME grades A105, A182 and A182 and in sizes 1/4" to 21/2" (DN20 to DN50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminium head with conduit entry of 1/2"NPT and ungrounded junction for Thermocouples.

420 Series
Thermocouple & Resistance Thermometer Assemblies with
- A flanged stepped shank or straight shank well
- Certified for use in hazardous areas
- 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 back step Thermowell would form a typical complete assembly ready for use in the application designed for.

Heavy Velocity losses 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 Inconel 800, Inconel 600, Monel 400, Hastelloy C276 and alloy 8 and flanges in ASME grades A105, A182 and A182 and in sizes 3/4" to 21/2" (DN20 to DN50).

The standard execution as shown in this leaflet is with plated CS extension and Aluminium head with conduit entry of 1/2"NPT and stepped shank Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

The standard execution as shown in this leaflet is with plated CS extension and Aluminium head with conduit entry of 1/2"NPT and stepped shank Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.
MI Thermocouple & RTD – 400 Series

430 Series Thermocouple & Resistance Thermometer Assemblies with:
- A Flanged straight and tapered shank Thermowell.
- Certified for use in Hazardous areas.
- Safe design as per ASME PTC30.3.
- Available with "in-head" 2-wire Temperature Transmitter.

The Thermocouple or Resistance Thermometer Sensor illustrated in this leaflet is a typical design specified by MI Engineers India Ltd. A diecast brass Thermowell is used to suitably blind flange by employing a groove and file Teflon weld joint. For pressure rating 9000 and above a full penetration weld is carried out.

Heavy Velocity cooling can be provided to reduce the suspended length of thermowell and meet ASME PTC-19.3 requirement. Thermocouples are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Inconel 800, Inconel 400, Monel 400, Hastelloy alloys, C-276 and alloy K and flanges in ASTM grades A105, A182 and A190 and in sizes 3/4” to 2” (DN25 to DN60).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 3/4" NPT and straight and tapered Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal head and provided with head extension and solid stainless steel cable Thermowell would then typically a complete assembly for use in Power Plants for highly corrosive services such as mill classifier outlet for temperature measurement of Coal in Air Mixtures.

For use at relatively high temperatures we recommend recrystallized Silicon Carbide, which also has a very high corrosion resistance characteristic. These are recommended for use in a few critical cases in power plants or for use in high temperature and/or high erosion duties.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 3/4" NPT and weld entry of 3/4" NPT and ungrounded Thermocouple.

440 Series Thermocouple & Resistance Thermometer Assemblies with:
- Solid Sintered Tungsten Carbide Thermowell for a lower Cost Effective Solution.
- Recrystallized Silicon Carbide for use in Reheating and superheater areas.
- Certified for use in hazardous areas.
- Available with "in-head" 2-wire Temperature Transmitter.

The Thermocouple or Resistance Thermometer Sensor illustrated in this leaflet is a typical design specified by MI Engineers India Ltd. A diecast brass Thermowell is used to suitably blind flange by employing a groove and file Teflon weld joint. For pressure rating 9000 and above a full penetration weld is carried out.

Heavy Velocity cooling can be provided to reduce the suspended length of thermowell and meet ASME PTC-19.3 requirement. Thermocouples are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Inconel 800, Inconel 400, Monel 400, Hastelloy alloys, C-276 and alloy K and flanges in ASTM grades A105, A182 and A190 and in sizes 3/4” to 2” (DN25 to DN60).

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 3/4" NPT and straight and tapered Thermowell. The Thermocouple junctions are ungrounded unless otherwise specified.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal head and provided with head extension and solid stainless steel cable Thermowell would then typically a complete assembly for use in Power Plants for highly corrosive services such as mill classifier outlet for temperature measurement of Coal in Air Mixtures.

For use at relatively high temperatures we recommend recrystallized Silicon Carbide, which also has a very high corrosion resistance characteristic. These are recommended for use in a few critical cases in power plants or for use in high temperature and/or high erosion duties.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 3/4" NPT and weld entry of 3/4" NPT and ungrounded Thermocouple.
MI Thermocouple & RTD – 400 Series

450 Series
Thermocouple & Resistance Thermometer Assemblies with
- A flanged well with liner.
- Lining in Ta, Ti, Ni, Hastelloy C.
- Available in hazardous areas.
- Certified for use in hazardous areas.
- Available with “in-head” 2-way Temperature Transmitter.

The thermocouples or resistance thermometers are often required with Thermowell which can withstand corrosion caused by the process medium. It is expensive to manufacture bar stock thermocouples in materials which can withstand the corrosion. An effective and less expensive alternative is to manufacture the thermocouples from 300 stainless steel. A helical or a helical ovoid and provide a sleeve or a tubesheet over the entire length portion of the well including the rated face of the flange, which can withstand the corrosive attack from process medium.

Thermocouples can be provided with liners in various materials such as Titanium (Ti), Stainless Steel (SS), Nickel-based alloys, Hastelloy C, Hastelloy B, Silver (Ag) and Platinum-Rhodium alloy (PdRh). The diameter of the well as shown in this leaflet is with plated CB (cemented) and Aluminum foil with control of 37%Ni and wall of molybdenum and uncoated Thermocouples.

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460 Series
Thermocouple & Resistance Thermometer Assemblies with
- A VanStone Thermowell with or without weld joints.
- Certified for use in hazardous areas.
- Safe design as per ASME PTC 19.3.
- Available with “in-head” 2-way Temperature Transmitter.
- Raised face or RTJ facing.
- Monel flange in 150 or ASME F150.
- 100% Radiography for weld joints.
- PN16
- Hardness in NACE MR-01-75

The design shown in this leaflet fulfills these criteria. Thermocouples 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 the leaflet fulfills these criteria. Thermocouples without a weld joint are recommended. If weld joints cannot be avoided, full penetration weld is carried out and checked by 100% radiography test.

---

ORDERING EXAMPLE
450 SERIES 140-0.0005 8.38 0.09 T301 105 0.08

ORDERING EXAMPLE
460 SERIES 140-0.0005 8.38 0.09 T301 105 0.08
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 areas.
- Available with "in-line" 2-wire.

MI Thermocouple or Resistance Thermometer Sensor fitted into a terminal head, and provided with or without fluid 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.

Prestressing tubes are built from seamless tubes with hot- and plugged and TIG welded and a blind flange is drilled in at the outer diameter of the tube and TIG welded to it. These thermocouples are available in standard AISI 300 series Stainless Steel as well as exotic materials such as Inconel 900, Inconel 600, 446 and flanges in ASTM grades A182, A182 and A182 in class 300 to 1500.

The standard connection as shown in this brochure is with plated 22 extension and an aluminum head with conduit entry of 1/2 NPT and ungrounded junction for Thermocouples unless specified otherwise.

### MI Thermocouple RTD 400 Series

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<td>7</td>
<td>Brass Cap &amp; Gland</td>
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Other sizes and dimensions on request.

### MI Thermocouple RTD 400 Series

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<td>F304L</td>
<td>ASTM A312 F304L</td>
</tr>
<tr>
<td>P304</td>
<td>ASTM A312 P304</td>
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Other materials are also available. See chart.

### MI Thermocouple RTD 400 Series

<table>
<thead>
<tr>
<th>Code</th>
<th>Tube Dimensions O.D x WALL</th>
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<tbody>
<tr>
<td>4/30</td>
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<tr>
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<tr>
<td>4/30</td>
<td>0.3750 x 2.15</td>
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<tr>
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<tr>
<td>4/30</td>
<td>0.4688 x 1.59</td>
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<tr>
<td>4/30</td>
<td>0.4992 x 1.47</td>
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<td>4/30</td>
<td>0.5357 x 1.34</td>
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<td>4/30</td>
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<tr>
<td>4/30</td>
<td>0.6250 x 1.05</td>
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</table>

Other dimensions are also available.

---

ORDERING EXAMPLE

**470 SERIES 1-K-0-316SS-310S-5-J5-M1-P100-M00-U600-T05-2-190-C00**
MI Thermocouple & RTD – 500 Series

500# Series
Thermocouple & Resistance

- A Weld in Thermowell.
- Form D as per DIN 43760.
- Certified for use in hazardous areas.
- 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, abrasive 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 multiplexed to suit practically every process. Thermowells are available in standard AISI 300 series Stainless Steel as well as in ferrous steels such as 13CrMo4-5 or 10CrMo910.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 1/2"NPT and ungrounded junction for Thermocouples.

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
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<tbody>
<tr>
<td>1</td>
<td>Simple</td>
</tr>
<tr>
<td>2</td>
<td>Duplex</td>
</tr>
<tr>
<td>3</td>
<td>Triplex</td>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Elements</th>
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<tbody>
<tr>
<td>U</td>
<td>Iron-Cast</td>
</tr>
<tr>
<td>E</td>
<td>Chrom-Alum</td>
</tr>
<tr>
<td>M</td>
<td>Copper-Alum</td>
</tr>
<tr>
<td>P</td>
<td>Inconel</td>
</tr>
<tr>
<td>N</td>
<td>Inconel 600</td>
</tr>
<tr>
<td>H</td>
<td>Chrom-Cobalt</td>
</tr>
<tr>
<td>I</td>
<td>Chrom-Alum</td>
</tr>
<tr>
<td>A</td>
<td>Chrom-Nickel</td>
</tr>
<tr>
<td>1</td>
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</tr>
<tr>
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<td>Stainless 316</td>
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<td>114</td>
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<td>119</td>
<td>Stainless 316</td>
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<tr>
<td>101</td>
<td>Inconel 600</td>
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<tr>
<td>8</td>
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<td>15.9mm</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>W</td>
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<tr>
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<thead>
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<td>2</td>
<td>Duplex</td>
</tr>
<tr>
<td>3</td>
<td>Triplex</td>
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</tbody>
</table>

510# Series
Thermocouple & Resistance

- A Bar stock Weld-In fitted with 2-wire or single socket welded or straight through socket.
- Certified for use in hazardous areas.
- Safe design as per ASME PCC-1.
- 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, abrasive 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 in ferrous steels such as Inconel 600, Inconel 600, Monel 400, Hastelloy C276 and Incoloy 800.

The standard execution as shown in this leaflet is with plated CS extension and Aluminum head with conduit entry of 1/2"NPT and ungrounded junction for Thermocouples.

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<thead>
<tr>
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<tr>
<td>C</td>
<td>Heating cartridge</td>
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<tr>
<td>D</td>
<td>Heating cartridge</td>
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<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>W</td>
<td>Welded</td>
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<td>None</td>
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</tbody>
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ORDERING EXAMPLE:
500# SERIES 500-006-4F-03-12-25-24-1457

510# SERIES 510-006-5F-03-12-25-24-1457
MI Thermocouple & RTD – 500 Series

520 Series
Thermocouple & Resistance Thermometer Assemblies
- A Weld-In Stepped Shank Wall
- Certified for use in hazardous areas
- Safe design as per ASME PTC19.3
- Available with “tubular” 2-wire Temperature Transmitter

The thermocouple or RTD assembly illustrated in this layout is with a weld in wet having straight shank wall. These units are provided with a cylindrical head for welding and a socket weld or straight through socket.

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

The standard execution as shown in this layout is with plated CS extension and aluminum head with conduit entry of NPT and ungrounded Junction for Thermocouples.

530# Series
Thermocouple & Resistance Thermometer Assemblies with Weld-Through Shank
- Certified for use in hazardous areas
- Safe design as per ASME PTC19.3
- Available with "tubular" 2-wire Temperature Transmitter

The thermocouple or RTD assembly illustrated in this layout is with a weld in wet having straight shank wall with a welded fit. These units are provided with a cylindrical head for welding and are socketed or straight through socket.

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

The standard execution as shown in this layout is with plated CS extension and aluminum head with conduit entry of NPT and ungrounded Junction for Thermocouples unless specified otherwise. Define dimensions B1 same as dimension f, when a fully straight shank wall is required.

Code | No of Elements | Options
--- | --- | ---
1 | Single | Single
2 | Duplex | Duplex
3 | Triplex | Triplex

Code | Options
--- | ---
1 | Hotline 7458 | Hotline 7458
2 | Hotline 9160 | Hotline 9160
3 | Extension in 3650 | Extension in 3650
4 | Extension in 3650 | Extension in 3650
5 | Other | Other
6 | Insulation | Insulation
7 | Brass Cable | Brass Cable
8 | SS Cable & Gd | SS Cable & Gd
9 | Special Material | Special Material

Code | Options
--- | ---
1 | Single | Single
2 | Duplex | Duplex
3 | Triplex | Triplex

Code | Options
--- | ---
1 | Insulation | Insulation
2 | Cover | Cover
3 | Copper | Copper
4 | Brass | Brass
5 | Stainless Steel | Stainless Steel
6 | Copper Clad | Copper Clad
7 | Stainless Steel Clad | Stainless Steel Clad
8 | Special Material | Special Material

Code | Options
--- | ---
1 | 3/0.025 | 3/0.025
2 | 3/0.025 | 3/0.025
3 | 3/0.025 | 3/0.025
4 | 3/0.025 | 3/0.025
5 | 3/0.025 | 3/0.025

Code | Options
--- | ---
1 | Single entry | Single entry
2 | Two entries | Two entries
3 | Three entries | Three entries

ORDERING EXAMPLE

MI Thermocouple & RTD – 500 Series

540# Series
Thermocouple & Resistance Thermometer Assemblies with
- A High Pressure weld in well.
- Certified for use in hazardous areas.
- Safe design as per ASME PTC19.3.
- Available with "in head" 2-wire Temperature Transmitter.

550# Series
Thermocouple & Resistance Thermometer Assemblies with
- A built web design tapered well.
- Certified for use in hazardous areas.
- Safe design as per ASME PTC19.3.
- Available with "in head" 2-wire Temperature Transmitter.

The assembly shown in this leaflet is with welded Thermowell manufactured from bar stock as per ASTM A276 grade 316S or 316L SS, duly tested prior to manufacture as per agreed test 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 built welded on the weldstock provided on the piping and the collar provided on the thermowell. No welding is done in the pipe. This way, the suspended length of the thermowell is minimized, thereby meeting the ASME PTC19.3 code requirement.

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

The standard execution as shown in this leaflet is with plated AISI extension and Aluminum head with conduct entry of 3/4NPT and ungrounded junction for Thermocouples unless specified otherwise.

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Elements</th>
<th>Code</th>
<th>Options</th>
<th>Elements</th>
<th>Code</th>
<th>Options</th>
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<td>J</td>
<td>0</td>
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<td>2</td>
<td>2-wire</td>
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<td>Head in T54S</td>
<td>F</td>
<td>1</td>
<td>Head in T54S</td>
</tr>
<tr>
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<td>1-wire</td>
<td>K</td>
<td>2</td>
<td>Head in T316S</td>
<td>K</td>
<td>2</td>
<td>Head in T316S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>3</td>
<td>Simple 150 Bar</td>
<td>L</td>
<td>3</td>
<td>Simple 150 Bar</td>
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<tr>
<td></td>
<td></td>
<td>T</td>
<td>4</td>
<td>Birth 6&quot;</td>
<td>T</td>
<td>4</td>
<td>Birth 6&quot;</td>
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<td></td>
<td>N</td>
<td>5</td>
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<td>N</td>
<td>5</td>
<td>Birth 6&quot;</td>
</tr>
<tr>
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<td></td>
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<td>6</td>
<td>Birth 6&quot;</td>
<td>P</td>
<td>6</td>
<td>Birth 6&quot;</td>
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<tr>
<td></td>
<td></td>
<td>E</td>
<td>7</td>
<td>Conduit 1/2&quot;</td>
<td>E</td>
<td>7</td>
<td>Conduit 1/2&quot;</td>
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<tr>
<td></td>
<td></td>
<td>D</td>
<td>8</td>
<td>Conduit 1/2&quot;</td>
<td>D</td>
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<tr>
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<td></td>
<td>A</td>
<td>9</td>
<td>Conduit 3/4&quot;</td>
<td>A</td>
<td>9</td>
<td>Conduit 3/4&quot;</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>10</td>
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<td>C</td>
<td>10</td>
<td>Conduit 3/4&quot;</td>
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<td></td>
<td>B</td>
<td>11</td>
<td>Conduit 3/4&quot;</td>
<td>B</td>
<td>11</td>
<td>Conduit 3/4&quot;</td>
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</tbody>
</table>

Code Options
0 None
1 Head in T54S
2 Head in T316S
3 Simple 150 Bar
4 Birth 6"
5 Birth 6"
6 Birth 6"
7 Conduit 1/2"
8 Conduit 1/2"
9 Conduit 3/4"
10 Conduit 3/4"
11 Conduit 3/4"

Code Elements
J Thermowell
K Chrome-Plated
L Conduit
T Aluminum
N None
P Birth 6" enclosure
E Conduit
D Extension
A Insulation
C Box
B Birth 6"
A Insulation
C Box
D Extension
0 None
1 Head in T54S
2 Head in T316S
3 Simple 150 Bar
4 Birth 6"
5 Birth 6"
6 Birth 6"
7 Conduit 1/2"
8 Conduit 1/2"
9 Conduit 3/4"
10 Conduit 3/4"
11 Conduit 3/4"
MI Thermocouple & RTD – 500 Series

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

Thermowells are built up from seamless tubes with bell portion of 400mm made from bar stock and TIG welded. These units are suitable for welding onto a straight through socket. Thermowells are available in standard AISI 304 series Stainless Steel as well as exotic materials such as Inconel 800, Inconel 800, and SS316.

The standard execution as shown in this layout is with plated CS extension and Aluminum head with conduit entry of 1/2NPT and ungrounded Junction for Thermocouples unless specified otherwise.

<table>
<thead>
<tr>
<th>Code</th>
<th>No of Elements</th>
<th>Options</th>
<th>Code</th>
<th>Wall Type</th>
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<th>Code</th>
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<tr>
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<td>321S</td>
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<th>Code</th>
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<tbody>
<tr>
<td>316</td>
<td>316S</td>
<td>304</td>
<td>304S</td>
</tr>
</tbody>
</table>

ORDERING EXAMPLE
560# SERIES 16 25 0D 7 316 DIAM 3.0 ENDS 7 12 0.95 0.5 0.95 0.5
MI Thermocouple & RTD – 600 Series

600# Series
Thermocouple & Resistance Thermometer Assemblies
- A Protecting Tube
- Built-up screws and brass nuts
- Certified for use in hazardous areas
- Available with "in-head" 2-wire Temperature Transmitter

601# Series
Thermocouple & Resistance Thermometer Assemblies
- A Welded and Enclosed Protective Tube
- Made from drilled bar stock, plain or adjustable or welded (Fixed) threaded connection
- Certified for use in hazardous areas
- Available with "in-head" 2-wire Temperature Transmitter

Legend:
- Codes and Options
- No. of Elements
- Elements
- Sheath Size
- Insulation
- Tube Diameter & Material
- Wall Assembly

CREATING EXAMPLE
600 SERIES: H66005-G/B/B, H6605/G/B/B, 301SS/304L/316L/316TI/321/01PT/P012TI/P012SS

57 www.temperature-house.com
TRM GROUP
MI Thermocouple & RTD – 600 Series

606# Series

A Remote Mounted Head or Junction Box.
A Protective Tube.
Built up from seamless tubes, plain or Flanged connection.
Flameproof or weatherproof explosion in 3163 or Al.
Available with "in head" 2-wire Temperature Transmitter.

611# Series

Thermocouple & Resistance Thermometer Assemblies with:
- A protecting tube of ceramic.
- Metallic support tube with fixed or adjustable flange.
- Certified for use in explosive gas/air mixtures.
- Available with "in head" 2-wire Temperature Transmitter.

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

The shielded and protecting tubing is employed for non-crystallized, stabilized Type 770 containing 99.7% Aluminium oxide & conforming to Type 770 as per DIN VDE 0620 & can be used for temperatures up to 1000 Deg C. These tubes are impregnated 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 (0.51 mm) for type 'R', 'S' and 'B' & 16 AWG for all base metal Thermocouples.

606# Series

<table>
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<tr>
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<tr>
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<tr>
<td>3</td>
<td>Copper</td>
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<tr>
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611# Series

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<td>3</td>
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</tr>
<tr>
<td>4</td>
<td>Brass</td>
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</tbody>
</table>

CROSSING EXAMPLE

59 www.temperature-house.com
## 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 “inch-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 ended protecting tube normally employed is re-crystallized Aluminium Type 710 containing 99.7% Aluminium core & conforming to Type 766 as per DIN VDE 0835 & can be used for temperatures up to 1000 Deg C. These tubes are impervious and are fixed to metallic support tube by means of ceramic to metal cement.

The Thermocouple wire used when used as a beaded thermocouple is 24 AWG (0.51 mm) for type "K", "B" and "R" & 26 AWG for all base metal Thermocouples.

### Code Options

<table>
<thead>
<tr>
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<th>Options</th>
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<tr>
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<td>2</td>
<td>Fixed in 1&quot;</td>
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<tr>
<td>5</td>
<td>Extension Weld</td>
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<tr>
<td>4</td>
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<td>6</td>
<td>In Fixed Tube</td>
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<tr>
<td>7</td>
<td>Base Celsius</td>
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<tr>
<td>8</td>
<td>S&amp;G Code Chord</td>
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### Code - Range Ability

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<td>HF</td>
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### Code - Overall Length

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### Code - Range Material

<table>
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### Code - Outer Insulating Tube

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<tr>
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<tr>
<td>AO</td>
<td>Protection Armored</td>
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<tr>
<td>AF</td>
<td>Protection Armored</td>
</tr>
<tr>
<td>AF</td>
<td>Protection Armored</td>
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### Code - Insulation Material

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<tbody>
<tr>
<td>AO</td>
<td>Silicones</td>
</tr>
<tr>
<td>AO</td>
<td>Silicones</td>
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### ORDERING EXAMPLE

812# SERIES: M8-2 R-I & 6/4 R-2 3/4" - INF 750/1500 4-WIRE USE 2342-2344 TRM 935/936 OR 4-PIN HEAD FOR 3909 4-PIN ELECTRONIC TEMP.

---

ISO 9001

TRM GROUP
MI Thermocouple & RTD – 800 Series

800# Series
Wedge Shaped (Knife Edge) Skin Thermocouples
- Almost accurate temperature measurement of:
  - Ferrule Heater tubes
  - Boiler Tubes
  - Reference 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 areas.
- Many Thermocouple Types and shield materials to choose from.

810# Series
Wedge Shaped (Knife Edge) Skin Thermocouples
- Almost accurate temperature measurements of:
  - Ferrule Heater tubes
  - Boiler Tubes
  - Reference 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 areas.
- Retaining Clamp furnished.
- Many Thermocouple Types and shield materials to choose from.

Code
Nos. of Elements
1 Single
2 Dual

Elements
- Iron Constantan
- Chromel Alumel
- Chromel Constantan
- Nickel Chrome
- Nickel Niel

Sheath Material
- Type 310S
- Type 316L
- Inconel 600
- Monel 400

Heat Type
- Weldable
- Snapfit
- JUNCTION BOX

Installation Types
- 1 Single set spot
- 2 Preparations to tube wall

No of entries
- 1 One entry
- 2 Two entries

Installation Code
- INSTALLATION CODE 1
- INSTALLATION CODE 2

Ordering Example
800 SERIES 1K-1627-122-2-1-1-400-CL-02

Code
Nos. of Elements
1 Single
2 Dual

Elements
- Iron Constantan
- Chromel Alumel
- Chromel Constantan
- Nickel Chrome
- Nickel Niel

Sheath Material
- Type 310S
- Type 316L
- Inconel 600
- Monel 400

Heat Type
- Weldable
- Snapfit
- JUNCTION BOX

Installation Types
- 1 Single set spot
- 2 Preparations to tube wall

No of entries
- 1 One entry
- 2 Two entries

Installation Code
- INSTALLATION CODE 3
- INSTALLATION CODE 4

Ordering Example
800 SERIES 1K-1627-122-2-1-1-400-CL-02
MI Thermocouple & RTD – 800 Series

820# Series
Wedge Shaped (Knife Edge) Skin Thermocouples
- Almost accurate temperature measurements of
- Fitted Monitor 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 areas.
- Hot end designed to wrap around the tube.

Many Thermocouple Types and Sheath materials to choose from.

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Options</th>
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<tr>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Element</th>
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</thead>
<tbody>
<tr>
<td>J</td>
<td>Stainless Steel</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Chromal Mural</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Chromal Corundum</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Monel Metal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Options</th>
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<td>Single</td>
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ORDERING EXAMPLE:
820 SERIES 1A-12-T-4665-00-00-00-00-00

830# Series
Wedge Shaped (Knife Edge) Skin Thermocouples
- Almost accurate temperature measurements of
- Fitted Monitor 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 areas.
- Expansion loop furnished.
- Hot end designed to wrap round the tube.

Many Thermocouple Types and Sheath materials to choose from.

<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Options</th>
</tr>
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<tbody>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Element</th>
<th>Options</th>
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<tbody>
<tr>
<td>J</td>
<td>Stainless Steel</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Chromal Mural</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Chromal Corundum</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Monel Metal</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Code</th>
<th>No. of Elements</th>
<th>Options</th>
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<tbody>
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<table>
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<tr>
<th>Code</th>
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<th>Options</th>
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<tbody>
<tr>
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<table>
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<tr>
<th>Code</th>
<th>Insulation Type</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Fused in tube end</td>
<td></td>
</tr>
</tbody>
</table>

ORDERING EXAMPLE:
830 SERIES 1A-12-T-4665-00-00-00-00-00
MI Thermocouple & RTD – 800 Series

**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

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

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 600°C to 900°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**

<table>
<thead>
<tr>
<th>Code</th>
<th>No of Elements</th>
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<td>Duplex (D)</td>
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<td></td>
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<td>Special requirement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Insulation type</td>
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</table>

**Code Tube ‘OD’**

- D: Define YF
- E: Define Y
- F: Define Y

**Code Overall Length**

- 6.55: 6.55
- 9.50: 9.50
- 14: 9.50

**Code Expansion Loop**

- Y: 2 times the dia ‘YF’
- U: 2 times the dia ‘Y’

**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°

**No of Entries**

- One entry
- 2 entries

**ORDERING EXAMPLE**

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

**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

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

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 600°C to 900°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**

<table>
<thead>
<tr>
<th>Code</th>
<th>No of Elements</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Duplex (D)</td>
<td>1</td>
<td>Name</td>
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<td>Head in SS304</td>
<td>2</td>
<td>Head in SS316</td>
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<td></td>
<td></td>
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<td>Grounded junction</td>
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</table>

**Code Tube ‘OD’**

- D: Define YF
- E: Define Y
- F: Define Y

**Code Overall Length**

- 6.55: 6.55
- 9.50: 9.50
- 14: 9.50

**Code Expansion Loop**

- Y: 2 times the dia ‘YF’
- U: 2 times the dia ‘Y’

**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°

**No of Entries**

- One entry
- 2 entries

**ORDERING EXAMPLE**

830F# SERIES 2-K-9.5-446-D-2-11-Y-OL-D-OPTION 10, 15
MI Thermocouple & RTD – 900 Series

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® or Fieldbus® or Profinet® protocol.

965# Series

<table>
<thead>
<tr>
<th>Code</th>
<th>No of TC Points</th>
<th>Code</th>
<th>Options</th>
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<td>8</td>
<td>No</td>
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<tr>
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<td>2</td>
<td>10</td>
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</tr>
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</tr>
<tr>
<td>9</td>
<td>9</td>
<td>6</td>
<td>N</td>
</tr>
</tbody>
</table>

Code | Each TC Element
|------|----------------|
| K    | Single
| E    | Element Type
| K    | Chromel-Alumel
| E    | Chromel-Constantan
| As per ASTM E250 / ASME Sec IX / MIL-I-288

Code | Sheath diameter
|------|----------------|
| 0.8 | 0.8 mm
| 1.0 | 1.0 mm
| 1.5 | 1.5 mm
| 2.1 | 2.1 mm

Code | Sheath material
|------|----------------|
| 316 | 316
| 321 | 321
| 330 | 330

Code | Junction Box
|------|----------------|
| 2C  | Flammproof HIC

ORDERING EXAMPLE
965# Series - 9-1-K-9.5-347-JC-2-X-X-I=3'-1500°FRTJ(F347)-'U' to 'U'-N=M-Option 10

Reactor Section A'-A' Showing HJ Locations A1 to A4
Reactor Section B'-B' Showing HJ Locations B1 to B4 and C1 to C4
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 world’s 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;
  - Welding machines
  - Drilling machines
  - Cable stripping machines
  - Calibration solutions
- A wide range of associated accessories
- World widest range of MI cable and accessories
- Save time and money;
  - Innovative technologies make manufacture faster & easier!
  - Don’t waste time searching the market what you need.
  - Benefit from 'valued' customer multi-buy discounts.

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

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 action for conductors and sheath closure (CD & TIG)
- Automatic recharge on OD 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 joint junctions of mineral insulated thermocouples. Either earthed (Bonded) Junction or Insulated Junction welds can be accommodated. The machine will weld thermocouples from 1.0mm to 6.0mm outside diameter. The welder is divided into two sections to accommodate the two welding processes associated with the junction of an MI thermocouple.
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.

Ultrasounds 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 Dioxide free Welds
- Long cables accommodated
- Automatic Weld control
- Low running costs
- Reduced strip down
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 M.I. cables
- Precise alignment: even at 1mm
- Reduced preparation time
- Selectable footswitch control option
- Selectable speeds up to 4000rpm
- Comprehensive accessories
- All drills, gilders and collets supplied
- Bench fixing kit
- Full printed instruction manual (pdf also available on CD or via email)

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 run 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 dependent)
4. "Grip"
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 relevancy, 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 colls 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.
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 MICC, 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 finished. Pickling requires a chemical process and chemicals that cannot be recycled. Finishing spreads cracks and risks weakness in the sheath.

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

Our quality system ensures traceability of cable to sheath, conductor and insulation batch.

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.
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.

<table>
<thead>
<tr>
<th>Outside diameter of cable (D) Nominal ±tolerance mm</th>
<th>Sheath wall thickness (S) minimum mm</th>
<th>Diameter of conductor (C) minimum mm</th>
<th>Insulation thickness (I) minimum mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 ± 0.025</td>
<td>0.05</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>1.0 ± 0.025</td>
<td>0.10</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>1.5 ± 0.025</td>
<td>0.15</td>
<td>0.23</td>
<td>0.12</td>
</tr>
<tr>
<td>2.0 ± 0.025</td>
<td>0.20</td>
<td>0.30</td>
<td>0.16</td>
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<tr>
<td>3.0 ± 0.030</td>
<td>0.30</td>
<td>0.45</td>
<td>0.24</td>
</tr>
<tr>
<td>4.5 ± 0.045</td>
<td>0.45</td>
<td>0.55</td>
<td>0.36</td>
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<tr>
<td>6.0 ± 0.060</td>
<td>0.60</td>
<td>0.90</td>
<td>0.48</td>
</tr>
<tr>
<td>8.0 ± 0.080</td>
<td>0.80</td>
<td>1.20</td>
<td>0.64</td>
</tr>
</tbody>
</table>

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

### Cables Diameters

<table>
<thead>
<tr>
<th>Cable Diameters</th>
<th>Inconel Range</th>
<th>AISI 310 Range</th>
<th>AISI 316 Range</th>
<th>AISI 321 Range</th>
<th>Hastelloy X Range</th>
<th>Alloy 825 Range</th>
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<tbody>
<tr>
<td>0.8</td>
<td>T2K-020-32</td>
<td>T2K-100-32</td>
<td>T2K-120-32</td>
<td>T2K-125-32</td>
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<tr>
<td>0.4</td>
<td>T2K-030-32</td>
<td>T2K-100-32</td>
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<tr>
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<td>T2K-125-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
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<td>T2K-030-32</td>
<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.4</td>
<td>T2K-030-32</td>
<td>T2K-100-32</td>
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<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.6</td>
<td>T2K-030-32</td>
<td>T2K-100-32</td>
<td>T2K-125-32</td>
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<td>T2K-HS 32</td>
<td>T2K-825-32</td>
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<tr>
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<td>T2K-100-32</td>
<td>T2K-125-32</td>
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<td>T2K-HS 32</td>
<td>T2K-825-32</td>
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<td>0.4</td>
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<td>T2K-825-32</td>
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<tr>
<td>0.6</td>
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<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.8</td>
<td>T2K-030-32</td>
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<td>T2K-125-32</td>
<td>T2K-125-32</td>
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</tr>
<tr>
<td>0.4</td>
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<td>T2K-125-32</td>
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<tr>
<td>0.6</td>
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<td>T2K-125-32</td>
<td>T2K-125-32</td>
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<td>T2K-825-32</td>
</tr>
<tr>
<td>0.8</td>
<td>T2K-030-32</td>
<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
</tbody>
</table>

The following smaller (4 core) cables are also available:

<table>
<thead>
<tr>
<th>Cable Diameters</th>
<th>AISI 310 Range</th>
<th>AISI 316 Range</th>
<th>AISI 321 Range</th>
<th>Hastelloy X Range</th>
<th>Alloy 825 Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>T2K-020-32</td>
<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.4</td>
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<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.6</td>
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<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
<tr>
<td>0.8</td>
<td>T2K-030-32</td>
<td>T2K-100-32</td>
<td>T2K-125-32</td>
<td>T2K-HS 32</td>
<td>T2K-825-32</td>
</tr>
</tbody>
</table>
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.
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.

<table>
<thead>
<tr>
<th>The typical applications we specialise in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace Heating - Frost Protection</td>
</tr>
<tr>
<td>Trace Heating – Process Temperature Maintenance</td>
</tr>
<tr>
<td>Trace Heating - Hot Water Temperature Maintenance</td>
</tr>
<tr>
<td>Leak Detection Systems</td>
</tr>
<tr>
<td>Audit and Maintenance Services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The core industries we serve:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil &amp; Gas</td>
</tr>
<tr>
<td>Petrochemical</td>
</tr>
<tr>
<td>Waste – Incineration Plants</td>
</tr>
<tr>
<td>Pharmaceutical</td>
</tr>
<tr>
<td>Nuclear</td>
</tr>
<tr>
<td>Power Generation</td>
</tr>
<tr>
<td>Refrigeration</td>
</tr>
<tr>
<td>Transport</td>
</tr>
<tr>
<td>General Engineering</td>
</tr>
<tr>
<td>Chemical</td>
</tr>
<tr>
<td>Commercial Building.</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>
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
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
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.
## MI Trace Heating

### A SELECTION OF TRACE HEATING PROJECTS COMPLETED

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

### A SELECTION OF TRACE HEATING PROJECTS COMPLETED

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

**A SELECTION OF TRACE HEATING PROJECTS COMPLETED**

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

### A SELECTION OF TRACE HEATING PROJECTS COMPLETED

<table>
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<tr>
<th>Customer</th>
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<th>Details</th>
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<tbody>
<tr>
<td>EWE</td>
<td>Hydro Polymers</td>
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<td>24</td>
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<tr>
<td>Balfour Beatty</td>
<td>Iggesund Board CHP</td>
<td>80,000</td>
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<td>Frost protect water and boiler pipe work</td>
</tr>
<tr>
<td>AMEC Lurgi</td>
<td>Crossness STW</td>
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<td>Beckton STW</td>
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<td>20</td>
<td>Temperature maintenance of hoppers and ducting</td>
</tr>
<tr>
<td>Zarafshan Newmont</td>
<td>Uzbekestan</td>
<td>52,000</td>
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<td>Frost protection of water pipe work</td>
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<tr>
<td>BP Oil</td>
<td>Belfast</td>
<td>25,000</td>
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<td>Trace heating fuel oil pipe work in zone 1 hazardous area</td>
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<tr>
<td>CGB Humbertherm</td>
<td>Didcot CCGT</td>
<td>36,000</td>
<td>-</td>
<td>Steam pipe work boilers and power cabling</td>
</tr>
<tr>
<td>Lodge Sturtevant</td>
<td>China</td>
<td>40,000</td>
<td>6</td>
<td>Supply of 72 sets of hopper heating equipment</td>
</tr>
</tbody>
</table>
### MI Trace Heating

**A SELECTION OF TRACE HEATING PROJECTS COMPLETED**

<table>
<thead>
<tr>
<th>Customer</th>
<th>Site</th>
<th>Approx. Value (£)</th>
<th>Duration (weeks)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Absorbents</td>
<td>Courtaulds</td>
<td>110,000</td>
<td>2 – Window</td>
<td>Process heating project including high tech computer interlocked control system – overall management of all sub-contract disciplines</td>
</tr>
<tr>
<td>Simon Storage</td>
<td>Immingham</td>
<td>26,000</td>
<td>2</td>
<td>Acetic acid turnkey contract</td>
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<tr>
<td>Simon Storage</td>
<td>Immingham</td>
<td>32,000</td>
<td>2</td>
<td>Acetic acid turnkey contract</td>
</tr>
<tr>
<td>Nooter Eriksen</td>
<td>Conoco</td>
<td>27,000</td>
<td>6</td>
<td>CHP Plant – Boiler pipe work and power cabling</td>
</tr>
<tr>
<td>Wm Lee</td>
<td>Dronfield Sand Plant</td>
<td>20,000</td>
<td>2</td>
<td>Frost protection of CW pipe work and thermal insulation</td>
</tr>
<tr>
<td>AMEC Lurgi</td>
<td>Beckton</td>
<td>72,000</td>
<td>20</td>
<td>Temperature maintenance (160°C) of hoppers, cyclones, conveyors and ducting</td>
</tr>
<tr>
<td>Customer</td>
<td>Site</td>
<td>Approx. Value (£)</td>
<td>Duration (weeks)</td>
<td>Details</td>
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<td>---------------------------------</td>
<td>---------------------------</td>
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<td>--------------------------------------------------------------------------</td>
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<tr>
<td>Powertherm</td>
<td>Rolls Royce Derby</td>
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<tr>
<td>BP Chemicals</td>
<td>Salt End Hull</td>
<td>160,000</td>
<td>4</td>
<td>Trace heating for temperature maintenance in zone 1 hazardous area</td>
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<tr>
<td>Jas Scott</td>
<td>Sutton Bridge CHP</td>
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<td>CHP plant boiler and balance of plant pipe work</td>
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<tr>
<td>Kvaerner Process Engineering</td>
<td>VAM/ETAC Project BP Chemicals</td>
<td>250,000</td>
<td>16</td>
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<tr>
<td>Hertel (UK) Ltd</td>
<td>Coryton CHP</td>
<td>320,000</td>
<td>20</td>
<td>CHP plant boiler and balance of plant pipe work</td>
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</table>

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

<table>
<thead>
<tr>
<th>Cable Reference S/S 316</th>
<th>Cable Reference Alloy 825</th>
<th>Cable Reference Inconel</th>
<th>Overall Diameter mm</th>
<th>Conductor Resistance Ω/m @20°C</th>
<th>Recommended Cold lead-in Reference</th>
<th>OD mm</th>
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</thead>
<tbody>
<tr>
<td>H321A10K</td>
<td>H825A10K</td>
<td>H600A10k</td>
<td>3.2</td>
<td>10.00</td>
<td>W321-C2.5-750V</td>
<td>5.3</td>
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<tr>
<td>H321A6300</td>
<td>H825A6300</td>
<td>H600A6300</td>
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<td>W321-C2.5-750V</td>
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<td>H825A4000</td>
<td>H600A4000</td>
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<td>4.00</td>
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<tr>
<td>H321A2500</td>
<td>H825A2500</td>
<td>H600A2500</td>
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<td>5.3</td>
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<tr>
<td>H321A1600</td>
<td>H825A1600</td>
<td>H600A1600</td>
<td>3.6</td>
<td>1.60</td>
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<td>H321A1000</td>
<td>H825A1000</td>
<td>H600A1000</td>
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<td>1.00</td>
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<td>H825A6300</td>
<td>H600A6300</td>
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<td>0.63</td>
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<tr>
<td>H321A4000</td>
<td>H825A4000</td>
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</tr>
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<td>H321A2500</td>
<td>H825A2500</td>
<td>H600A2500</td>
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<td>0.25</td>
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<td>H321A160</td>
<td>H825A160</td>
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**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

<table>
<thead>
<tr>
<th>Reference</th>
<th>Overall Diameter mm</th>
<th>Conductor Resistance Ω/m @20°C</th>
</tr>
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<tbody>
<tr>
<td>H400B1600</td>
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<td>1.60</td>
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<tr>
<td>H400B1000</td>
<td>3.4</td>
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<td>H400B630</td>
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<td>H400B400</td>
<td>4.0</td>
<td>0.40</td>
</tr>
<tr>
<td>H400B250</td>
<td>4.4</td>
<td>0.25</td>
</tr>
<tr>
<td>H400B160</td>
<td>4.9</td>
<td>0.16</td>
</tr>
<tr>
<td>H400C63</td>
<td>3.2</td>
<td>0.063</td>
</tr>
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<td>H400C40</td>
<td>3.4</td>
<td>0.040</td>
</tr>
<tr>
<td>H400C25</td>
<td>3.7</td>
<td>0.025</td>
</tr>
<tr>
<td>H400C17</td>
<td>4.6</td>
<td>0.017</td>
</tr>
<tr>
<td>H400C11</td>
<td>4.9</td>
<td>0.011</td>
</tr>
<tr>
<td>H400C7</td>
<td>5.3</td>
<td>0.007</td>
</tr>
<tr>
<td>H400C4</td>
<td>5.9</td>
<td>0.004</td>
</tr>
</tbody>
</table>

**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.
## MI Trace Heating Cable Datasheets

### Copper Sheathed Single Core Heating Cables – Bare and HDPE Covered

<table>
<thead>
<tr>
<th>Cable Reference Bare</th>
<th>Cable Reference HDPE Covered</th>
<th>Overall Diameter mm</th>
<th>Conductor Resistance Ω/m @20°C</th>
<th>Recommended Cold lead-in Reference</th>
<th>OD mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>H122D2000</td>
<td>H122D2000HDPE</td>
<td>2.8</td>
<td>2.000</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122D1250</td>
<td>H122D1250HDPE</td>
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<td>1.250</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122D800</td>
<td>H122D800HDPE</td>
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<td>0.800</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122D630</td>
<td>H122D630HDPE</td>
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<td>0.630</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122D450</td>
<td>H122D450HDPE</td>
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<tr>
<td>H122D315</td>
<td>H122D315HDPE</td>
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<td>0.315</td>
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<tr>
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<td>0.220</td>
<td>W122-C2.5-750V</td>
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<tr>
<td>H122D140</td>
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<tr>
<td>H122D100</td>
<td>H122D100HDPE</td>
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<td>0.100</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122C63</td>
<td>H122C63HDPE</td>
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<td>0.063</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122C40</td>
<td>H122C40HDPE</td>
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<td>0.040</td>
<td>W122-C2.5-750V</td>
<td>5.3</td>
</tr>
<tr>
<td>H122C25</td>
<td>H122C25HDPE</td>
<td>3.7</td>
<td>0.025</td>
<td>W122-C6.0-750V</td>
<td>6.4</td>
</tr>
<tr>
<td>H122C17</td>
<td>H122C17HDPE</td>
<td>4.6</td>
<td>0.017</td>
<td>W122-C6.0-750V</td>
<td>6.4</td>
</tr>
<tr>
<td>H122C11</td>
<td>H122C11HDPE</td>
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<td>0.011</td>
<td>W122-C6.0-750V</td>
<td>6.4</td>
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<tr>
<td>H122C7</td>
<td>H122C7HDPE</td>
<td>5.3</td>
<td>0.007</td>
<td>W122-C10.0-750V</td>
<td>7.3</td>
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<tr>
<td>H122C4</td>
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<td>0.004</td>
<td>W122-C16.0-750V</td>
<td>8.3</td>
</tr>
</tbody>
</table>

### 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.
## MI Heating Element Datasheets

### Heating Accessory Data Sheet - Lead-In Cable Termination

#### Seal Types:

<table>
<thead>
<tr>
<th>Seal Reference</th>
<th>TYP1</th>
<th>TYP2</th>
<th>TYP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>ATEX Approved seal for use in hazardous area terminations</td>
<td>ATEX Approved seal for use in hazardous area terminations</td>
<td>Wiring cable flexible tail seal</td>
</tr>
<tr>
<td>Conductor Type</td>
<td>Flexible</td>
<td>Solid</td>
<td>Flexible</td>
</tr>
<tr>
<td>Earth Tail Type</td>
<td>Flexible earth tag complete with lock nut</td>
<td>Solid</td>
<td></td>
</tr>
<tr>
<td>Pot Type</td>
<td>Crimp on pot</td>
<td>Brazed on pot with earth tail</td>
<td>Crimp on pot with earth tail</td>
</tr>
</tbody>
</table>

### Tail Length:
- **TYP1**
- **TYP2**
- **TYP3**

### 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.

---

87 www.temperature-house.com
# Alloy 825 Trace Heating Cable

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.

**Applications**
- Industrial pipe tracing installations hazardous and non-hazardous.
- High temperature installations.
- Long circuit tracing applications.

**Approval**

<table>
<thead>
<tr>
<th>OHMS/FT</th>
<th>OHMS/in.</th>
<th>Nominal Cable Diameter</th>
<th>Nominal Cable</th>
<th>Sheath Thickness</th>
<th>Insulation Thickness</th>
<th>Conductor Diameter</th>
<th>Approx Wt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>600 Volt Single Conductor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1H200-2</td>
<td>0.0006</td>
<td>0.0051</td>
<td>1.64</td>
<td>0.06</td>
<td>0.006</td>
<td>0.12</td>
<td>0.16</td>
</tr>
<tr>
<td>H1H250-2</td>
<td>0.0005</td>
<td>0.0041</td>
<td>1.68</td>
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<td>0.006</td>
<td>0.12</td>
<td>0.16</td>
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<tr>
<td>H1H300-2</td>
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<td>0.0031</td>
<td>1.74</td>
<td>0.06</td>
<td>0.006</td>
<td>0.12</td>
<td>0.16</td>
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<tr>
<td>H1H350-2</td>
<td>0.0003</td>
<td>0.0024</td>
<td>1.80</td>
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<td>0.006</td>
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<td>0.16</td>
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<tr>
<td>H1H400-2</td>
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<td>0.0019</td>
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<td>H1H450-2</td>
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<td>H1H550-2</td>
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<td>0.16</td>
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<tr>
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<td>0.0008</td>
<td>2.16</td>
<td>0.06</td>
<td>0.006</td>
<td>0.12</td>
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<td>H1H750-2</td>
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<td>0.0006</td>
<td>2.29</td>
<td>0.06</td>
<td>0.006</td>
<td>0.12</td>
<td>0.16</td>
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<tr>
<td>H1H800-2</td>
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<tr>
<td>H1H850-2</td>
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<td>0.0004</td>
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<tr>
<td>H1H900-2</td>
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<td>0.006</td>
<td>0.12</td>
<td>0.16</td>
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</table>

* Full Product Specifications Available Upon Request *
**Alloy 825 Trace Heating Cable**

**CABLE REFERENCE**

<table>
<thead>
<tr>
<th>Nominal Cable</th>
<th>Resistance @ 30°C (0.01)</th>
<th>OHMS/FT</th>
<th>Nominal Cable Diameter</th>
<th>Sheath Thickness</th>
<th>Insulation Thickness</th>
<th>Conductor Diameter</th>
<th>Approx Wts</th>
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<tbody>
<tr>
<td>300 Volt Two conductor</td>
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<td>0.026</td>
<td>0.012</td>
<td>3.3</td>
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<tr>
<td>L2H360-2</td>
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<td>3.0</td>
<td>0.011</td>
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<td>3.3</td>
</tr>
<tr>
<td>L2H750-3</td>
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<td>3.0</td>
<td>0.012</td>
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<td>0.015</td>
<td>3.6</td>
</tr>
<tr>
<td>L2H650-2</td>
<td>2</td>
<td>0.15</td>
<td>3.4</td>
<td>0.01</td>
<td>0.026</td>
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<td>L2H450-3</td>
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<td>0.16</td>
<td>3.7</td>
<td>0.012</td>
<td>0.026</td>
<td>0.016</td>
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</tr>
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<td>0.17</td>
<td>4.3</td>
<td>0.017</td>
<td>0.025</td>
<td>0.023</td>
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</tr>
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<td>L2H120-3</td>
<td>0.7</td>
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<td>0.017</td>
<td>0.025</td>
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</tr>
<tr>
<td>L2H973-3</td>
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<td>0.15</td>
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<td>0.017</td>
<td>0.024</td>
<td>0.024</td>
<td>3.4</td>
</tr>
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<td>L2H743-3</td>
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<td>L2H286-3</td>
<td>0.206</td>
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</tr>
<tr>
<td>L2H200-3</td>
<td>0.15</td>
<td>0.16</td>
<td>4.4</td>
<td>0.017</td>
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<tr>
<td>L2H150-3</td>
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<td>0.18</td>
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<td>0.019</td>
<td>0.027</td>
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<tr>
<td>L2H200-3</td>
<td>0.02</td>
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<td>0.025</td>
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</tr>
<tr>
<td>L2H150-3</td>
<td>0.01</td>
<td>0.15</td>
<td>4.3</td>
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<td>0.023</td>
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<tr>
<td>L2H100-3</td>
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<td>L2H75-3</td>
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<td>L2H50-3</td>
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<td>L2H25-3</td>
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<td>4.3</td>
<td>0.017</td>
<td>0.025</td>
<td>0.023</td>
<td>3.6</td>
</tr>
</tbody>
</table>

**How To Specify A TRM Alloy 825 Heating Unit**

- **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 - L8252502000 - 30 - 8077 - 208 - 6 - 14
```

**TRM MI**

- **Cable** - Alloy 825
- **Temperature** - 25°C
- **Voltage** - 208 Volts
- **Resistance** - 0.022 Ohms/ft
- **Current** - 14 Amps
PlanControl Ch32 is an affordable and efficient heat-tracing Monitoring and Control system.

PlanControl Ch32 is versatile and easily scalable. Unique features designed specifically for electric heating applications, help to reduce costs from project planning stage, through maintenance operations while enhancing the safety of your entire process.

Modular Structure and Bus Interface makes 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 PlanView Software.

Stepless Power Adjustment provides added flexibility and security in 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 upsets temperatures for example.
Trace Heating Management

Economical Solutions for Every Challenge!

Modular structure

Through PlanTron single CHD 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

These 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.

TL600

In hazardous areas ATEX Approved PlanTron TL600 Temperature Limiter is added to the PlanTron TL600 alarm, the heating circuit temperature values from Pt100 sensor and sends them forward to the CHD control unit and on to the PC or to a dedicated automation architecture.

Power adjustment

The PlanTron TL600 adjusts the heating power output from 15% to 100% of maximum power, thereby providing a wider range of use for any preconceived engineering design or needs already existent. This is of particular benefit when constant temperature and slight 'bull's eye' control are considered. Redundant transformers required.

ChD user interface

Modify any setting easily with the CHD user interface — Permission needed. Display details of any reset heating circuit. CHD connects to CHD control unit with a plug-in connector. Think of it as a Programmed Protection System when you need it, let's there, but only if you have permission to use it.
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 IDs are placed over top of these diagrams. By simply clicking on 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 facility.

Flexibility with modularity

The flexible modular structure of Plancontrol Ch32 with a common 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

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 30min @ 200°C)
  - Alloy 655 sheath (Survives for 30min @ 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 8 tests allowed.
- The only electric cable to pass modern furnace tests - i.e. German standard DIN16881 test DIN 4102 1000°C ignites.
- The only cable technology approved & listed by U.I.A. for 'unrestricted installation'.

Who are MICC Ltd?

- MICC have 55 years of Mineral Insulated Cable manufacturing experience!
- Use the unique switch-it cable manufacturing process developed by MICC in the 1920's.
- Owned and operated by the same management team of EICC Eyres Ltd.
- Have unrivalled experience in mineral insulated cable research, products and applications.
- Specialists in bespoke new projects and installations.
- Suppliers to the Nuclear industry since the 1960's generation in the 1950's.
- Truly Global business with worldwide customer service.
- The only manufacturer to produce both copper and Alloy 655 insulated wiring cables.
- World's largest manufacturer of MI cable.
- World’s largest MI cable factory.
- MICC do not make cables for anybody else.
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 - Fire proof, no risk of radiant damage
- Self-monitoring - Will not cause false alarms due to undetected damage on installation
- Furnace tested - Passes the only true fire like fire test!

MICC cable... for when 15 minutes is not enough time to escape!

- MICC cable is essential when in minutes escape time is not enough time to escape
- The British Standard for fire evacuation is 15 minutes per door for moving from the accommodation
- MICC is strongly recommended for any building more than 2 levels tall
- Inter ALST for trains, airports, prisons, hospitals, tunnels, shopping centres, schools
- And the correct choice for ALL life critical circuits:
  - Fire alarm
  - Smoke alarms
  - Emergency lighting
  - Ventilation systems
  - Elevators/ lifts
  - Emergency pumps
  - And more...

---

MICC Fire Survival Cables
The ONLY true fire proof cables!

<table>
<thead>
<tr>
<th>Feature</th>
<th>LSF TP / FR Cable</th>
<th>Copper MICC Cable</th>
<th>Alloy 25 MICC Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 30 min. exposure time</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Over 15 min. exposure time</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>95°C Operating temperature</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>85°C Operating temperature</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Exposure to 100°C</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Exposure to 150°C</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ribo-CWZ Enhanced</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ribo-CWZ (Furnace test)</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flame Retardant</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Selenium tube</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Waterproof, submersible</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fireproof</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mechanical shock &amp; pressure resistant</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Zero toxic emissions, smoke, flammable &amp; gas</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Self-monitoring</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Navigating, corrosion resistant</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Suitable for confined space / tunnel</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>100% recyclable</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Non-conduit neutralised</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>High overload resistance</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Zero smoke on overload</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Gas, Oil / Chemical proof</td>
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<td>✓</td>
</tr>
<tr>
<td>Soundproof</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

sales@micc-ltd.co.uk
The Low Smoke myth!

Many polymer 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 and use simulations.

Smoke generation can be greater on high heating before flame and smoke volume is directly related to the amount of material burned.

So how can a BS-EN 61034 low smoke cable give off so much smoke?

PVC gives off more smoke in flares but PE / XLPE (polyethylene) gives of more smoke on heating without flame extremely costly!

Plasticised UPVC is used to make general electric cable. In flaming and non-flaming mode both feature high smoke outputs, indeed very bad as a fire proof cable...

PE100 & PP600 use polyethylene – In a direct flame test it shows as low smoke generation factor... But under overheat, short circuit or internal heat for any reasons... ISO 9815 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!

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (mm)</th>
<th>Maximum Specific Optical Density (DM)</th>
<th>Non-Flaming</th>
<th>Flaming</th>
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<tbody>
<tr>
<td>PVC</td>
<td>3</td>
<td>400</td>
<td>380</td>
<td>530</td>
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<tr>
<td>Polyethylene</td>
<td>3</td>
<td>560</td>
<td>43</td>
<td>93</td>
</tr>
<tr>
<td>PE Polyethylene</td>
<td>3</td>
<td>390</td>
<td>280</td>
<td>280</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>3</td>
<td>390</td>
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<td>FF Polypropylene</td>
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<td>390</td>
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<td>Polyurethane</td>
<td>3</td>
<td>475</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>3</td>
<td>475</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>PMMA</td>
<td>3</td>
<td>475</td>
<td>350</td>
<td>350</td>
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<tr>
<td>Plasticized PVC</td>
<td>0.75</td>
<td>420</td>
<td>350</td>
<td>350</td>
</tr>
</tbody>
</table>

* +44 (0) 191 416 8884

sales@miccltd.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 specialise in 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 up to 1200°C. They are used in a wide range of applications from pipelines to steel foundries and extremely hazardous areas like Nuclear Power Station boilers.
  - Fire-Survival: The only true fire survival cable on the market, it guarantees the plus escape time to the harshest of fires... our commercially focussed copper system is rated up to 1083°C. These are used in high rise buildings, tunnels, metro systems, hospitals and war / refuge shelters in Rwanda.

Why take the risk? The facts!...

When it comes to smoke...

Cables which emit NO smoke will provide significantly improved evacuation speed and add saving more lives.

About temperature rise and Oxygen depletion...

Cables with NO halogen content. NO halogen values and Halogen Free will generate NO toxic or irritant gases at all including Carbon Monoxide WILL add saving more lives.

Concerning toxic and irritant gases

Cables with NO halogen content. NO halogen values and Halogen Free will generate NO toxic or irritant gases at all including Carbon Monoxide WILL add saving more lives.

Statistically CO is responsible for 90% of toxicity deaths in fires.

So what do we do now?

Sort each the resistant cables are not bad cables...

They just don’t do 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, Saling Road, West End Industrial Estate, Washington, Tyne and Wear, United Kingdom: NE69 6EG. +44 (0) 191 416 8884 | info@trmltd.co.uk

www.temperature-house.com

+44 (0) 191 416 8884 | info@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 carry out logging of temperature profiles, aiding the release of oil deposits through the warming process.
Long Distance Trace Heating

SKIN-SYSTEM
Safe and reliable heating system for pipelines of an unlimited length designed for above-ground, buried and underwater pipelining, including ones in explosion hazardous zones

- 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 Standard) 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 surface of heating elements. After earthing and heating elements do not require any electrical insulation

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 safe 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 16-30 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 30 km long from a single source.
2. One and 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 conductive 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 power supply system is performed as an integrated transformer substation including distributing sets 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**

### Technical Specification

<table>
<thead>
<tr>
<th>Operating Temperature Range</th>
<th>-5°C to +120°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>up to 5 kVAC 50 Hz</td>
</tr>
</tbody>
</table>

**Control System**

In order to improve its efficiency the 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

Heated run length, km

<table>
<thead>
<tr>
<th>Heated run length, km</th>
<th>Heating element unit diameter, mm</th>
<th>Current-carrying conductor cross-section, mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
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</tr>
<tr>
<td>15</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

**Construction**

- **Heat producing element**: Low carbon steel tube with diameter 20-80 mm and wall thickness 3-4 mm
- **Current carrying conductor**: Special conductor resistant to high voltage (up to 66 kV), high temperature (up to 300°C) and mechanical stress at installation
- **Anti-corrosion protection**: epoxy coating of a SKIN heater (at Customer's request)

**Advantages**

1. Long range of a pipeline heated run. The system low resistance per 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 and 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 an control systems.

**Example of insulated pipeline heating by three heating elements of SKIN-system with the total output of 130 W/m. Pipe diameter is 330 mm, θ, вэфф = 105°, t = 15°C.**

**Electric supply of a pipeline run heated by SKIN-system.**

Electric power supply system is performed as an integrated transformer substation including distributing sets 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

### Scope of Projects

**Yashma Hydrom, Oil gas condensate field, Oil pipeline**
- **Customer:** LUKOIL Oil Company NAJANIMANINETEGAS LLC
  - Total length of heated pipeline: 162 km
  - Amount of substations: 14
  - Pipeline diameter: 530 mm
  - Transporated liquid: crude oil

**Pestovoyage, 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
  - Transporated liquid: water

**Tobayaklye, Oil gas-condensate field, Oil and gas gathering collectors from well cluster to Central Processing Facility**
- **Customer:** LUKOIL Oil Company NAJANIMANINETEGAS LLC
  - Total length of heated pipeline: 15.5 km
  - Amount of substations: 4
  - Pipeline diameter: 150-219 mm
  - Transporated liquid: crude oil

**Yashma-Shapikinskiye, Oil gas condensate field, Water pipeline between sites**
- **Customer:** LUKOIL Oil Company - Sever-TER-DESCG
  - Total length of heated pipeline: 10 km
  - Amount of substations: 3
  - Pipeline diameter: 150-168
  - Transporated liquid: water

**Barenjeve, Oil gas-condensate field, Water pipeline between site areas**
- **Customer:** TERA OJSC, Siberian oil gas company OJSC
  - Total length of heated pipeline: 10 km
  - Amount of substations: 1
  - Pipeline diameter: 168 mm
  - Transporated liquid: water

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### Project Design Approaches

**Splice Box for Skin-System Heating Elements**
- (Top view, the cover is open)
- Skin-system heating element
- Current conductors
- Electro-magnetic coupling
- Protective covering

**Tube with Skin System Heater**
- Passing temperature compensating movable pipeline support
- Heated pipeline
- Thermal insulator
- Protective cover
- Sliding support
- Bolt M12 x 80
Tools and Accessories

TRM provide a range of tools and accessories to support our products.

**Specialist fault locator** 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.
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.
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.
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.
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.
Aerodyn Engineering Inc.

Instrumentation & Testing for Aerospace & Power Generation

Aerodyn Engineering – Slip Ring Technology

Traditionally, solutions for data transfer from rotational portions of an engine or other rotating devices to the stationary world rely on 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 speeds. Even today, with the advent of Non-Intrusive Stress Measurement systems, users 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:

- 30 – 424 contact slip rings at speeds from 80,000 to 15,000 RPM
- Intermediate bearing assemblies with multiple termination capability (e.g., 200 termination contacts monitored by a 100 contact slip ring)
- One-over-multiplying 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 designs 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 electronics, and other sophisticated 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 similar design 72 contact slip ring was provided to Williams International for fan and compressor strain surveys on the FJ12X and FJ22 turboshaft engines at speeds to 75,000 RPM.
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 manufactures 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:

<table>
<thead>
<tr>
<th># Contacts</th>
<th>Speeds (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>424</td>
<td>15,000</td>
</tr>
<tr>
<td>300</td>
<td>20,000</td>
</tr>
<tr>
<td>212</td>
<td>40,000</td>
</tr>
<tr>
<td>100</td>
<td>50,000</td>
</tr>
<tr>
<td>72</td>
<td>75,000</td>
</tr>
<tr>
<td>36</td>
<td>90,000</td>
</tr>
</tbody>
</table>

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 field filled slip ring developed for the Comanche tail rotor). The maximum ambient temperature allowed for normal slip rings is 100°F and the maximum ambient pressure is 5000 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 CF7 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, Grif, 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 & aerospace equipment
- Airfoil vibration testing

- Acoustic instrumentation & testing
- Pressure, temperature & flow tests
- Strain & Vibration testing and instrumentation

Aerodyn 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

- 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 Garrett 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 31 years
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
Licenced 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 – Run 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 Aerodyne Thomas is in charge of the Fluid Research project. The object of the effort is to study how coolant fluids chemically breakdown 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

Aerodyne Engineering, Inc. was established in Indianapolis and incorporated in 2002. Aerodyne purchased the Fluid 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.

Aerodyne has two primary facilities: The Indianapolis office is 16,000 sq ft and houses the instrumentation and machining departments. The Cincinnati facility is 7,500 sq ft and concentrates on field test and data acquisition activities.

Aerodyne’s focus is on the power generation and aerospace markets, specializing in gas turbine instrumentation and field testing.

Aerodyne manufactures 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 426 contacts, all of which are standard in the Aerodyne product line.

Aerodyne 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 racks
- 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 advanced gearbox
- Blade stress ratio and characterization of blade & vanes
Customers for New Slip Rings/IA's (Intermediate Bearing Assemblies), Cooling Carts - AEI Standards Product

GE Transportation
GE Power
GE Lyona
Wyle Labs (Air Force)
NAWCAD
Pratt Whitney
AFRL/PRTE
CIAM Moscow
Purdue Aero Lab
Aero-Turn
Novaco 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
Aerodyne has emerged as the dominant slip ring manufacturing for turbine machinery. In addition to selling slip rings, Aerodyne is often asked to repair/refurbish slip rings from others manufacturers such as QAT, Polyscientific, and P&W silver graphite slip rings. Aerodyne 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. Aerodyne tests, diagnoses, and if necessary reverse-engineers and provides replacement parts.

Borg Warner
NAWCAD
Pratt Whitney
Honeywell Engines
Tech Development
Turboena
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
Aerodyne 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
Aerodyne will install strain gages and do instrumentation according to customer specifications; but most customers seek Aerodyne’s recommendation on how best to instrument an application to fit their test information needs.

Tech Development
Halcyon
Delco Rexon
Honeywell Engines
RAMGEN
Borg Warner – Turbo wheels
GE Gas Turbine
Daimler (Germany)
GEAE
Ford Motor
Boeing Helicopter
Micromatic
GE Locomotive
Boeing
Pratt Whitney – E. Hartford
Northrop Grumman
Vibration Measurement/Blade Characterization
Aerodyn has a dedicated test facility for vibration and dynamic strain measurement, mainly used for blade characterization of turbine blades. In such applications Aerodyn almost always applies the gages.

Power Systems Mfg
GE Power – Greenville
Delco Remy
GE Gas Turbine
Narco Pirocne (Italy)
RR Allison
GE Energy

Telemetry Systems
Rolls Royce Corporation
Northrop 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
GIEAE – Brazil, Turkey
Rolls Royce Allison – Spain
GE Power – Greenville - U.S.A., France, Italy,
Northrop Sunnyvale

Automotive
Delco Remy U.S.A., Moscow
Ford ATPDC
UBE Automotive

Aircraft Engines
Avto – Turin (C16-8)
Am. Aerospace

Miscellaneous
Eldorado
GE Power Schenectady – Steam Turbine
Cone Naval Weapons – Ammu Destruction Facility
GE Transportation – Strain Survey
Ohio State University
Rolls Royce Energy Systems
Aerodyn Ltd designed and supplies the Rolls Royce Avon gas turbine temperature measurement harness.
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
Notes: