NANMAC

Foremost in Temperature Measurement™

***NANMAC* is**

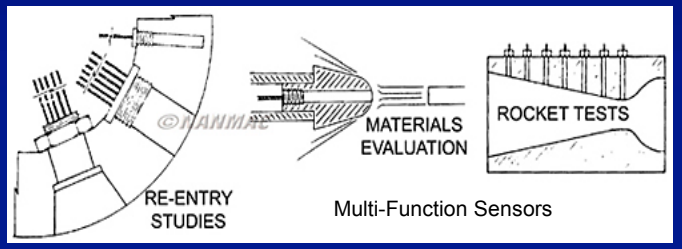
QUALITY

PERFORMANCE

SOLUTIONS

www.nanmac.com info@nanmac.com Tel: 001.508.872.4811 Fax: 001.508.879.5450

- Nanmac Corp. was established in 1956 by a group of scientists to develop high-performance temperature sensors



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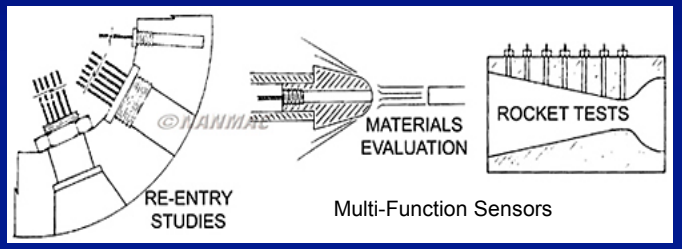

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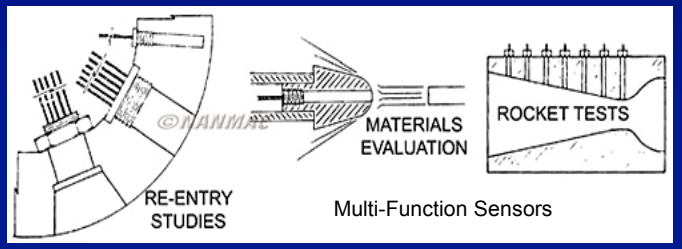

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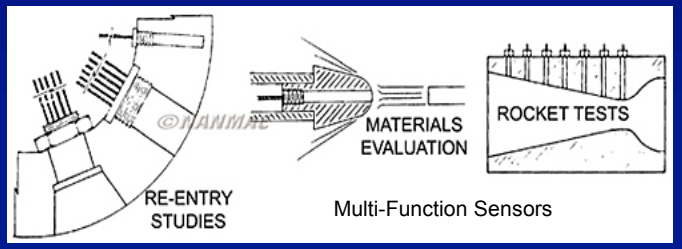
- Initial focus was on Government research & Military applications.
- Many of these have become commercial applications – plastics, materials evaluation, heat transfer studies, incineration
- Nanmac holds various patents on temperature sensors, erosion gages and “multi-function” sensors

“Right-Angle” Ribbon

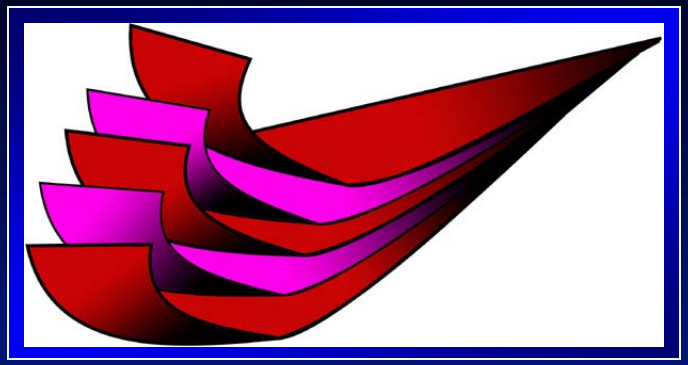
“Eroding” Thermocouple



Multi-Function Sensors

A12D Series – Ultra High Temp

"Eroding" Thermocouple



- 5 Layer construction
- 3 layers are very thin electrical insulators
- 2 layers are thermocouple alloy ribbon

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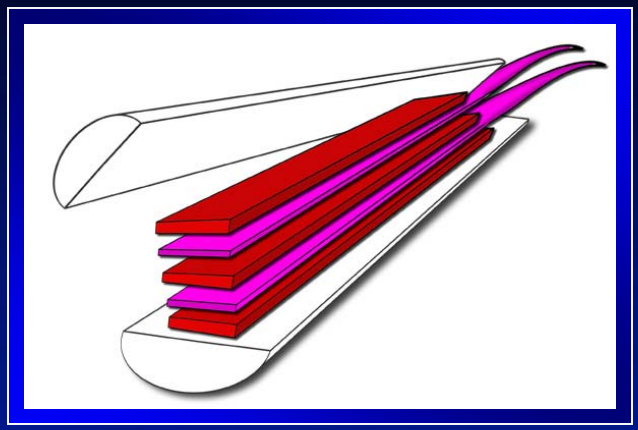

- All 5 layers are pressed between a split insert

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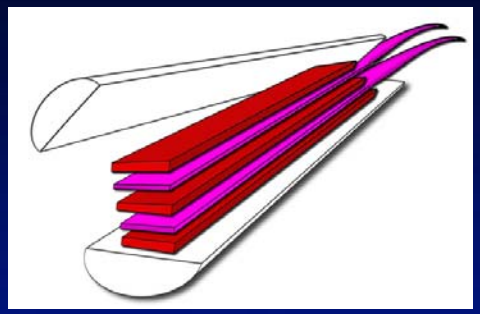

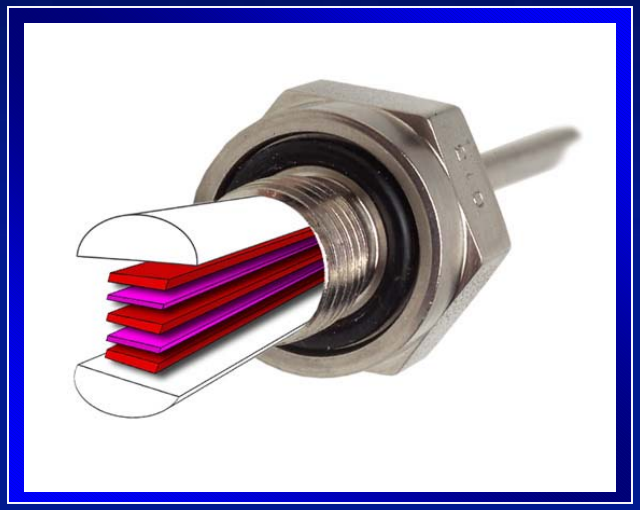

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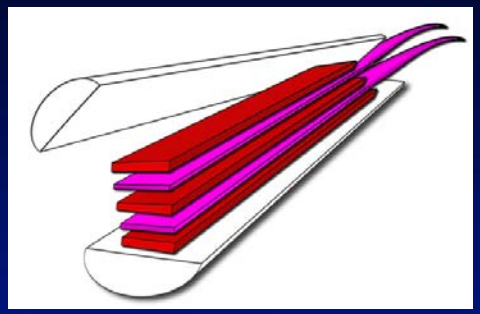

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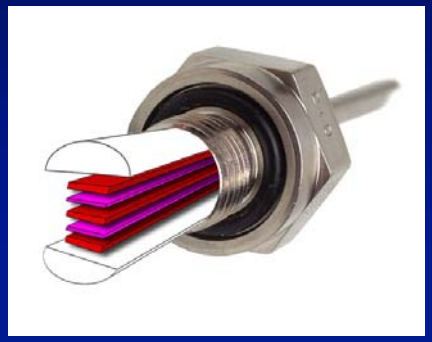

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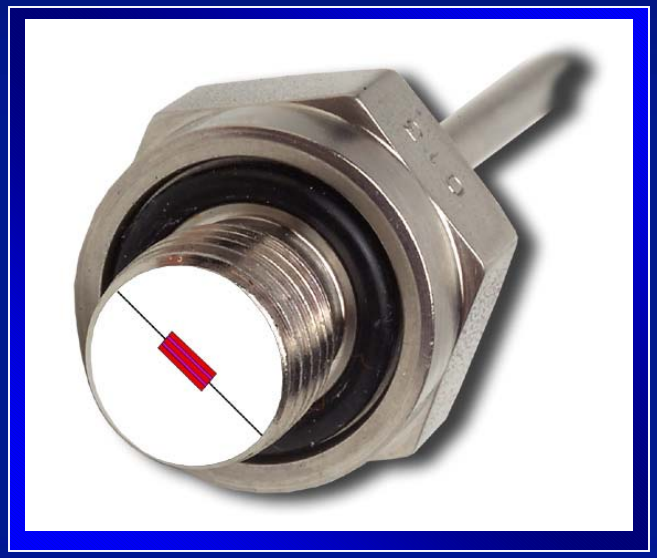

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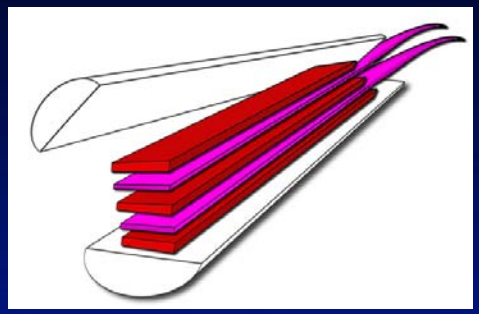

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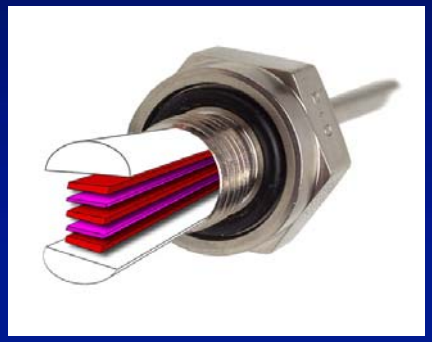

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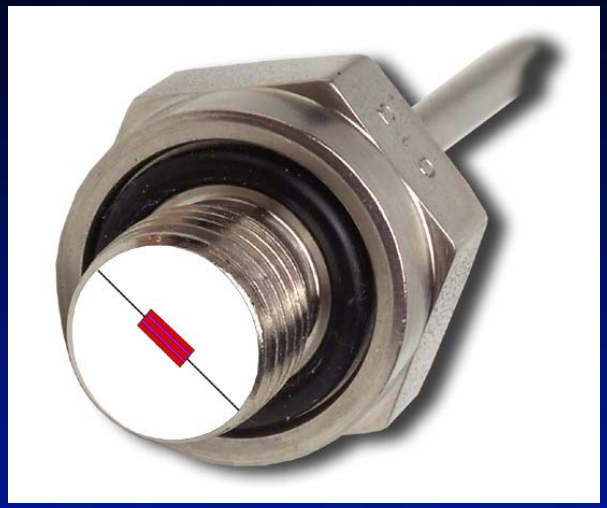
Thermocouple junction is formed by grinding motion across the layers
Junction is microscopic, continued grinding forms new junctions
Grinding motion can be from shaping, ablation, wear, etc…

"Eroding" Thermocouple

- Patented design



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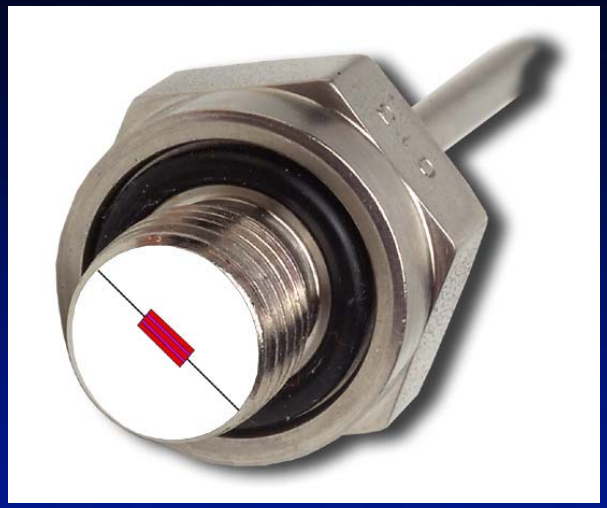
- Microsecond response time



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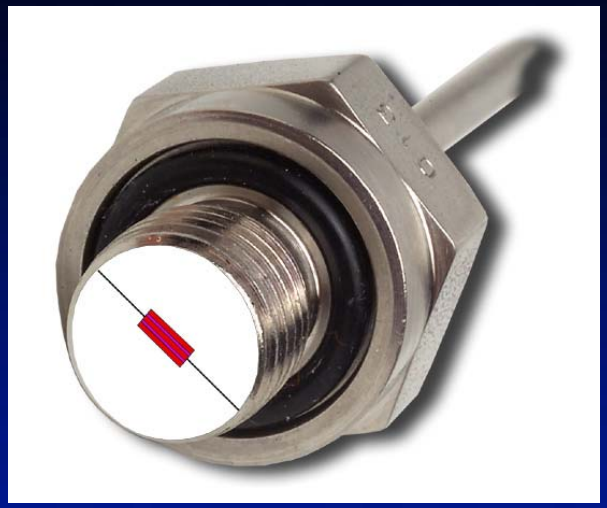

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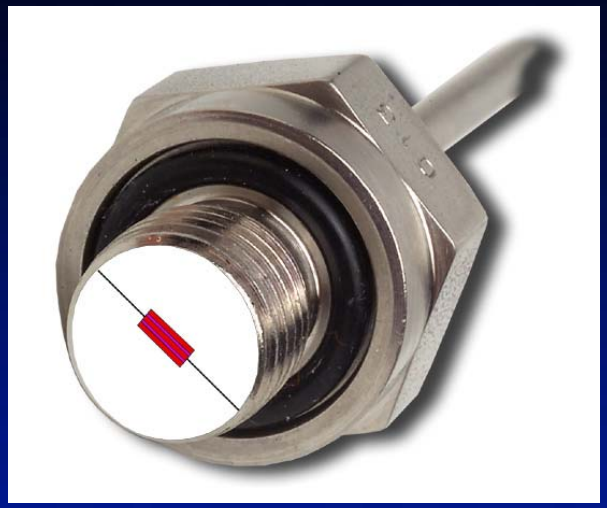

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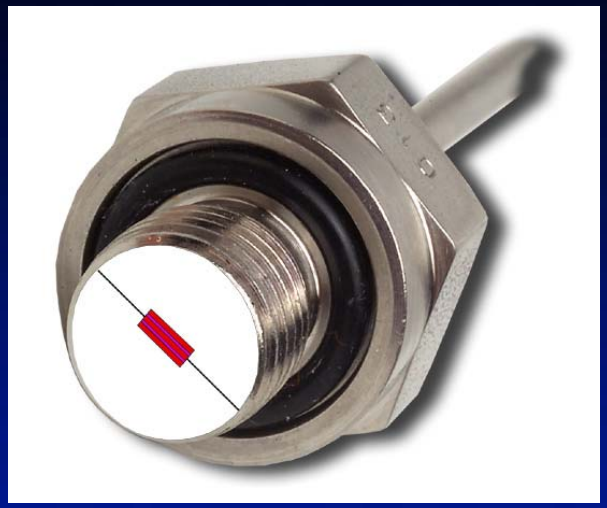

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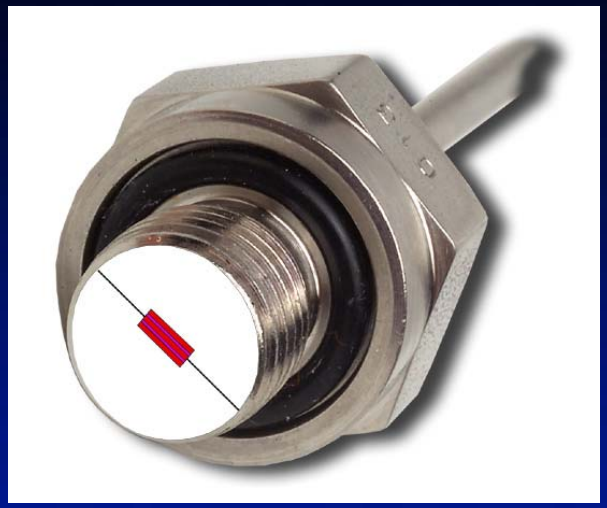
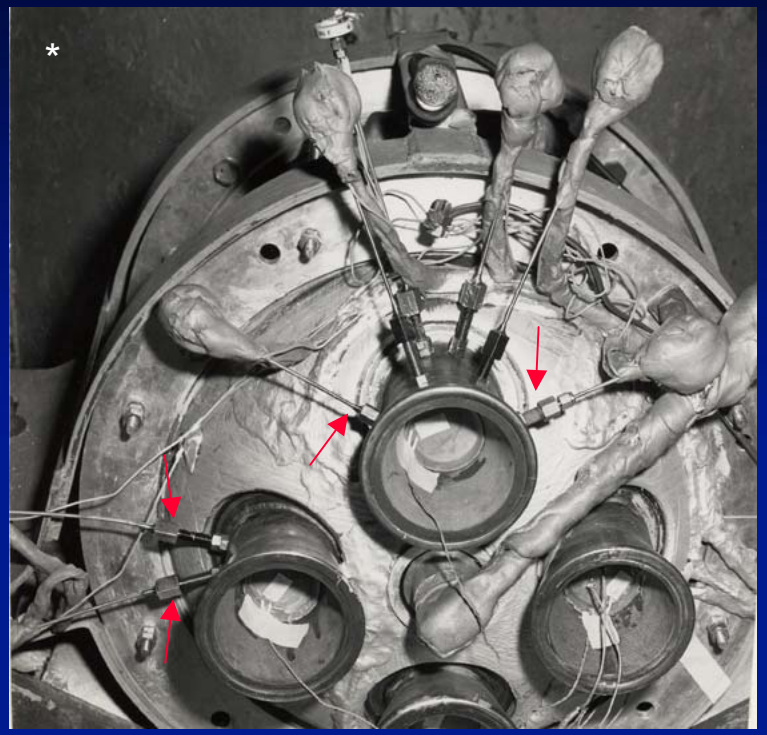
- Available in all thermocouple calibrations, including Type B & C



"Eroding" Thermocouples for Research

- Research applications include:
  - Rocket nozzle blast temperatures *
  - Interface measurements between moving surfaces – brake pads, piston walls, bearings
  - Ablation studies
- Unique performance characteristics
  - Millisecond & Microsecond response time
  - 2 dimension thermal junction, exact location placement
  - Sensing device can wear or "erode" up to 0.375" and continue to measure – even during erosion

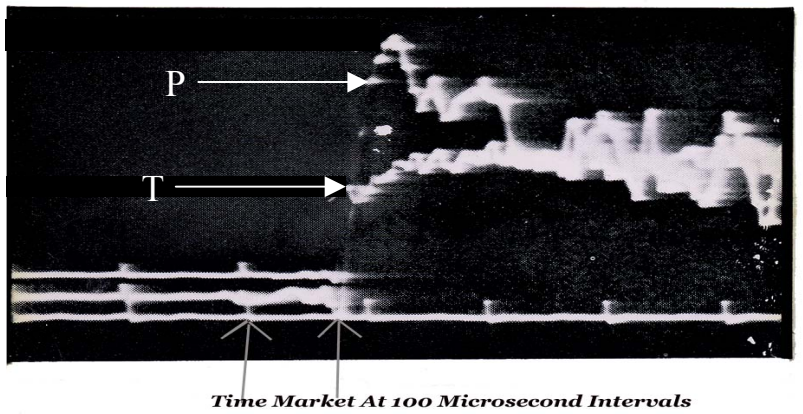


4 of 7 "Eroding" thermocouples – all 7 mounted flush to inside of nozzle

"Eroding" Thermocouples for Research

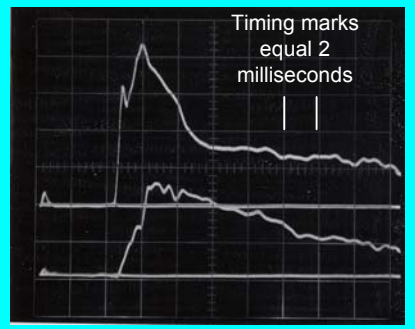
- Additional research applications include:
  - Shockwave measurements **
  - Projectiles and Gun barrel breaches
  - Explosions
  - Squibs and Igniters
- Unique performance characteristics
  - Sensing device can be machined to match wall contours
  - Distinct temperature of interest can be provided: the wall surface temperature (thermally grounded), or the interface {gas, flame, friction} temperature at the wall surface (thermally isolated)

**



P = pressure, ~ 1000 psi

T = temperature, ~ 650 Deg F



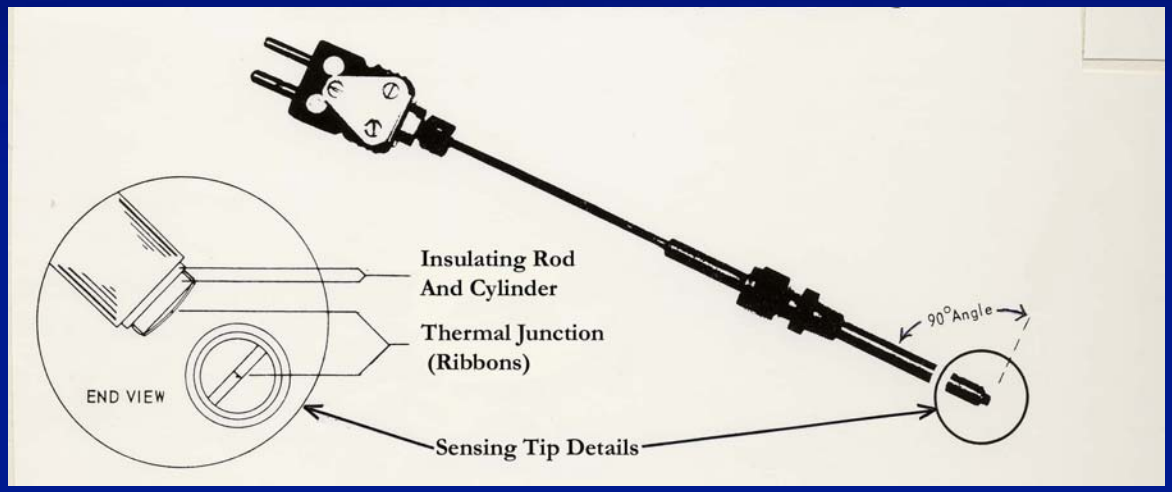
"Eroding" Thermocouples for Industry

- Industrial applications include:
  - Plastic processing
  - Thermal modeling
  - Combustion gases in diesel engines
  - Moving wires or textiles
  - Brake lining interface temps

- Unique performance characteristics
  - True plastic temperatures, unaffected by mold wall heat-sink
  - Sensor can can be shaped or machined to match wall surface contours – Mold walls, cylinder, manifolds, bearings
  - Multiple sensors can be located within a single housing with exact positioning

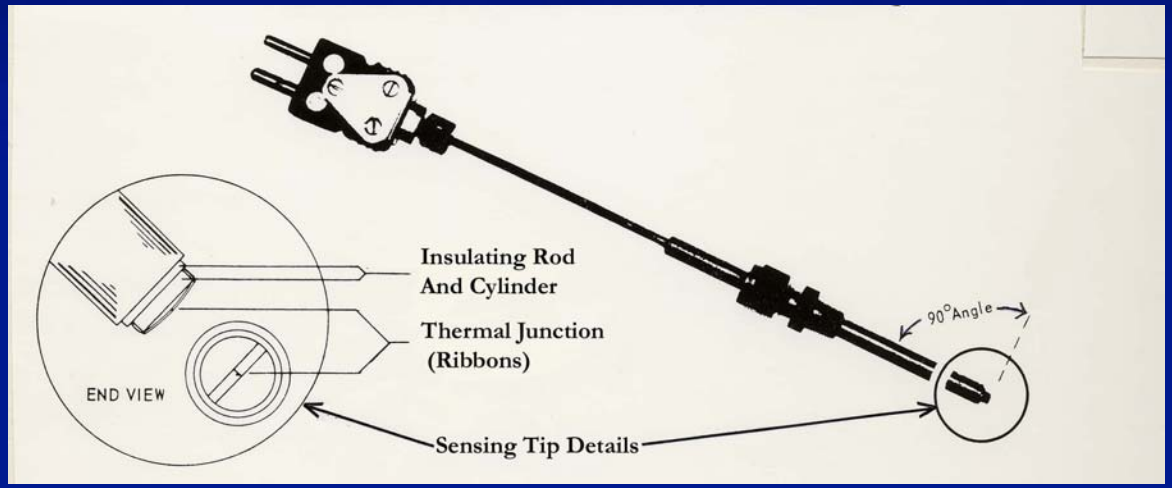
"Right-Angle" Ribbon Thermocouple

- Patented design



"Right-Angle" Ribbon Thermocouple

- Patented design
- Millisecond Response time



"Right-Angle" Ribbon Thermocouple

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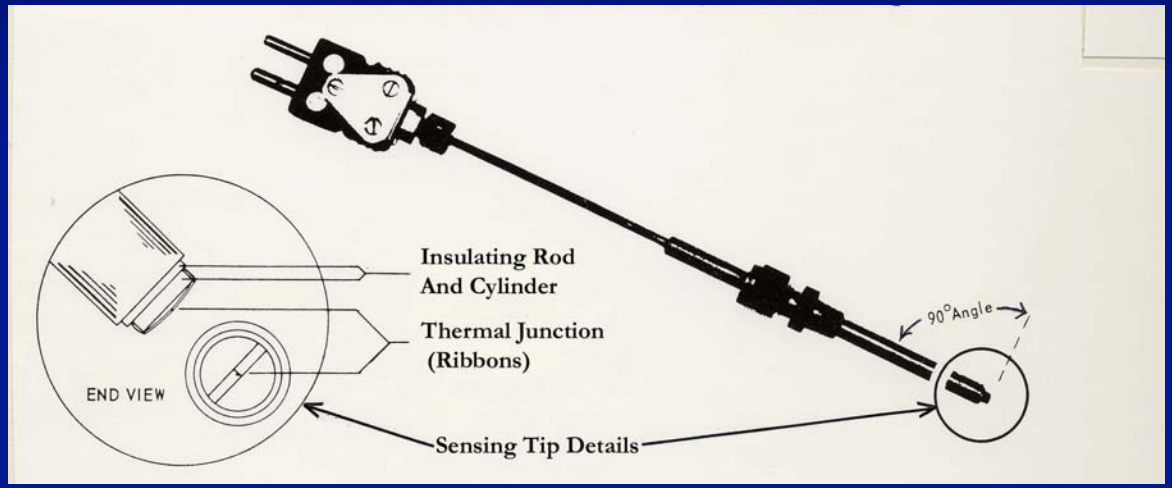
- Millisecond Response time
- Pressures to over 50,000 psi.



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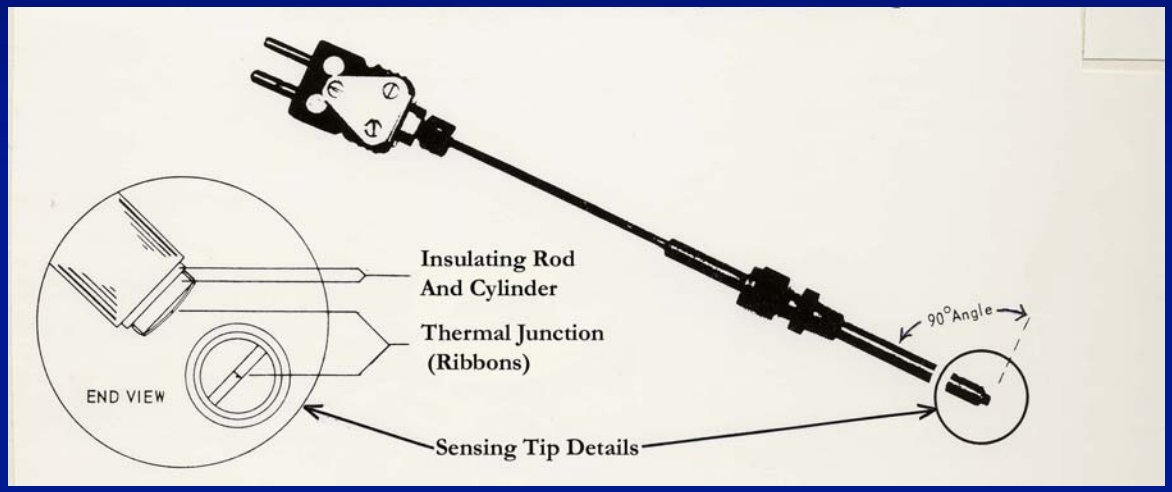
- No conduction Error – provides absolute temperature



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- Millisecond Response time
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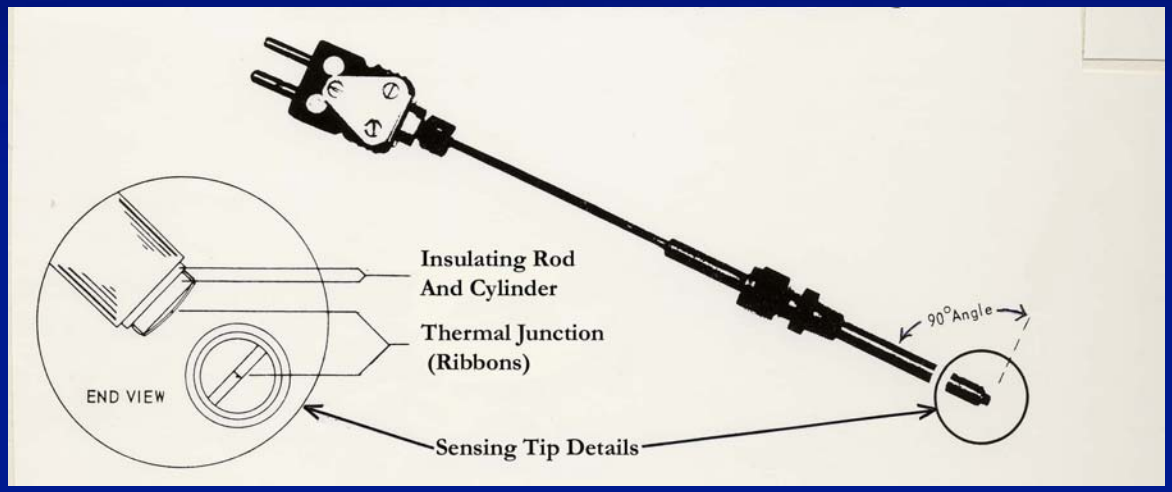
- No conduction Error – provides absolute temperature
- Temperatures > 2300°C



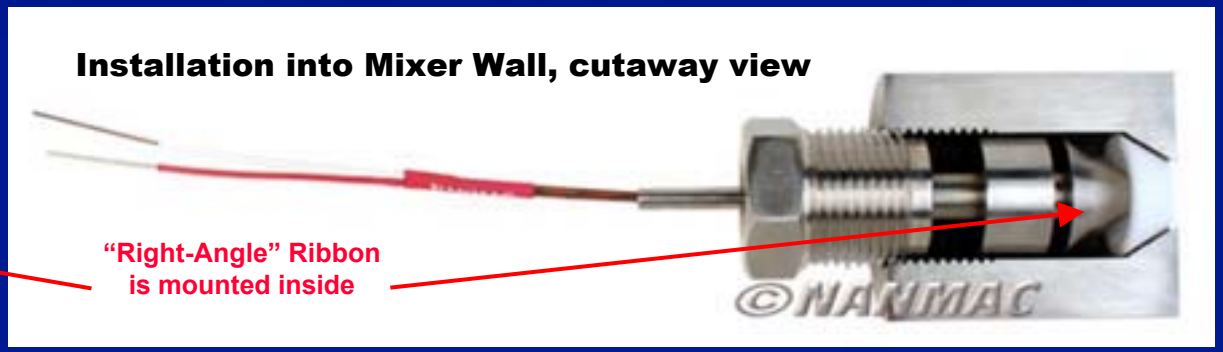
"Right-Angle" Thermocouples for Research

- Research applications include:
  - Rocket nozzle exhaust gases
  - Profile temperatures within chambers or pipelines
  - Flat-bottom, bored holes within walls

- Unique performance characteristics
  - Thermocouple junction is thermally isolated from the thermowell / mounting fixture
  - Thermowell can be designed with "radiation shield" for specific gas temperatures that are unaffected by chamber wall heating
  - Thermall junction (ribbon) is parallel to isotherm

"Right-Angle" Thermocouples for Industry

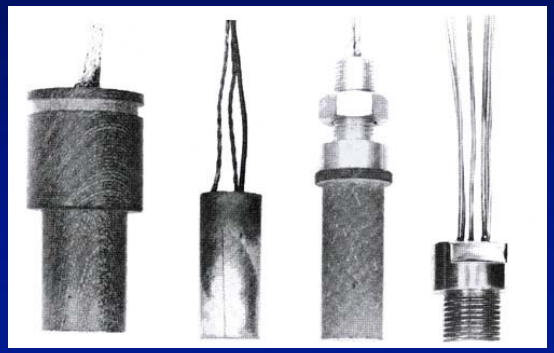
- Industrial applications include:
  - Gases or liquids in pipelines
  - Mixers for food, propellant or pharmaceutical process
  - Petrochemical systems
  - Smoke stacks and exhaust pipes
- Unique performance characteristics
  - Thermal sensor can be "Isolated" for sanitary applications
  - Various mounting configurations: In-wall, in-stream, adjustable immersion
  - Cryogenic temperatures

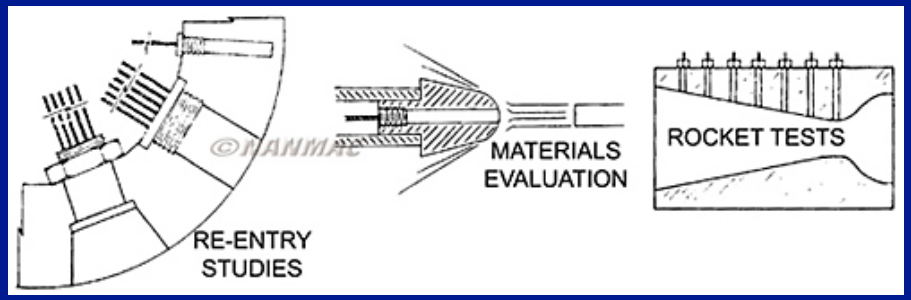


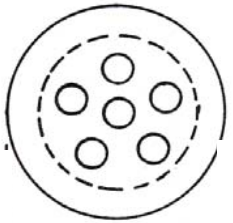
"Multi-Function" Thermocouples for Research

- Combine multiple **Eroding** & **Right-Angle** thermocouples within a single housing
- Thermocouple housing made from test-wall material to replicate exact thermal properties
- Heat flux & heat transfer studies, Ablative materials research

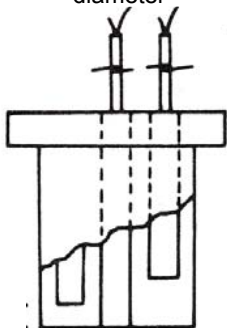
- Surface measurements and in-wall temperatures at the same time







As small as 1/2 Inch diameter



Combine Eroding & Right-Angle sensors within one housing

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Foremost in Temperature Measurement™

Ultra-High Temperature Thermocouples

- Industrial applications include:
  - Vacuum furnaces
  - Graphite lined furnaces or furnaces with graphite heaters
  - Petrochemical cracking furnace
  - Heat treating and sintering
  - Calibration, drift and uniformity & profile studies

- Unique performance characteristics
  - Temperatures to over 2300^{O}C
  - Accurate to +/- ½ % of reading, even at 2000^{O}C
  - Prolonged life in harsh environments – 10 times the life of standard sensors
  - Up to 70 inches long

A12D Series – Ultra High Temp

- Available in all thermocouple calibrations, including Platinum and Tungsten
- Made to order in less than 3 weeks

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Awards & Recognition

Industry Awards

- *Instrumentation, Systems & Automation Society (ISA)*
  …**One of the Top 20 New Products of the Year**
- *Materials in Design Engineering*
  … **Best use of Engineering Materials**
- *Chemical Equipment Magazine*
  … **Readers' Choice Award for Editorial Contributions**


Certificate of Participation

Presented to

Nanmac Corporation

In recognition of your contribution to the
PROPULSION MEASUREMENT SENSOR DEVELOPMENT WORKSHOP
in Huntsville, Alabama, May 13 – 15, 2003

NASA

Dennis A. Kross
Director
Space Transportation Directorate

Publications

- *Process Heating Magazine*
  "**Selecting the Right Thermocouple**"
- *Measurement and Control Magazine*
  "**Thermal Sensor Characteristics**"
- *Industrial Heating Magazine*
  "**Myths and Facts About Temperature Sensing**"


Society of Plastics Engineers

The mission of the Society shall be to promote the knowledge and education of plastics and polymers worldwide.

Jacob Nanigian

Senior

Member Since
1995

William A. Humphrey
President

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- Vacuum leak test utilizing Varian Systems equipment to 10^{-7} Torr
- Calibration & Test records on file for minimum of five years after date of manufacture

Some of our customers

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