Lab Services

Prototype Testing and Quality Certification

Watlow lab services start at the front end of product design by assisting you through a battery of tests to research and develop the optimum sensor for your application. At the back end, our certification processes can verify your finished product is built to specifications set forth by the world's leading standards agencies.

These in-house services are available also for testing your own temperature sensing products, not just the sensors, wire or cable we design and manufacture for you.

Product Development and Prototype Test Lab

Our prototype testing evaluates new sheath materials, new configurations, and new manufacturing processes; always stretching the limits, always searching for the better way to handle unique applications. We offer testing for:

- **Time response** to measure sensor output relative to a step change in temperature from ambient up to 70°C (160°F) per ASTM.
- **Vibration:** sine and random electrodynamic excitation.
- **High temperatures** to 1700°C (3090°F).
- **Cryogenic temperatures** to -195°C (-320°F) for liquid nitrogen; -80°C (-110°F) continuously variable up to 0°C (32°F).
- **Tensile and compression** testing to 500 kg (1,000 lb).
- **Humidity** to 95°C/95% RH (200°F/95% RH).

A lab service technician calibrates sensors to verify that they meet NIST standards.

- **Life** testing in molten aluminum and corrosive liquids.
- **Cycle and drift** testing up to 1700°C (3090°F).
- **Wire insulation abrasion** testing: repeated scrape and wire to wire.
- **Micro-hardness:** Vicker's scale or conversion to other common scales.
- **Dielectric breakdown** testing: capabilities to 5000V⎓(dc).

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Product Development and Prototype Test Lab

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A lab service technician performs a helium leak test to verify fitting integrity.

Customized Testing to Your Application

Watlow can provide testing during all phases of product development.

To guarantee Watlow temperature sensors retain their quality after long term use, we maintain a variety of custom designed furnaces and baths for long term drift and cycle testing at temperatures up to 1700°C (3090°F).

We can customize any number of standardized tests to meet your needs:

- To verify the quality and stability of our RTDs a recent test cycled the sensors from 93°C (200°F) to 260°C (500°F) for over 80,000 cycles.
- During initial product development for a turbine application, the customer requested performance information on Watlow RTD probes under various conditions. Vibration testing was carried out on several diameters and probe configurations providing the customer with resonance frequencies to 2000Hz and corresponding dB levels.
- Vibration testing was provided for a prototype sensor mounted on the shaft bearings of a large diesel engine. Watlow product and field engineers worked with the customer to develop a vibration dampening design.
- Watlow engineers selected materials and developed several configurations to answer a customer's need for a 20 meter (60 ft) long sheathed sensor capable of handling 1400°C (2550°F). The conditions were reproduced in the product test lab and a successful design selected.

Your Watlow sales engineer is your key to successful temperature monitoring. He/she can assure that your sensor is tested under your conditions.

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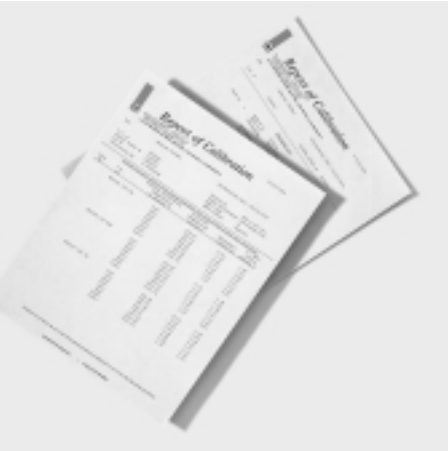

All tested sensors and wire are tagged with deviations and accompanied by a calibration report.

Today's demand for world class products that perform better, last longer, are more accurate and withstand harsher environments has led to an increased demand for certified compliance with manufacturing standards. Many high-tech industries demand certificates of compliance and traceability in the manufacturing process of the components they buy from you, their vendors. We at Watlow are able to meet this demand with our complete testing and certification services.

Watlow provides certification to verify the finished sensor is built to allowable initial calibration tolerances as established by ASTM Standard E 230. This standard is based on the thermodynamic temperature scale of ITS 90, succeeding IPTS 68.

These are initial tolerances as supplied by Watlow. All sensors are susceptible to change during use due to environmental factors such as contamination, temperature, furnace gradient and physical abuse.

Watlow has the advanced capabilities to calibrate your sensors over a broad range of temperatures, from cryogenic -195°C (-320°F) to 1700°C (3090°F).

MIL-STD-45662 is used as the guide for all sensor and instrument calibration making all results traceable to the National Institute of Standards and Technology—NIST. Standard methods and specifications for sensor calibration used are:

- ASTM E 207
- ASTM E 220
- ASTM E 230
- ASTM E 644
- AMS 2750C

We'll test and certify any temperature sensing product—whether made by Watlow, or not. Our objective is to provide you with a comprehensive service for determining compliance with established standards.

At an additional cost, we'll perform the requisite tests and calibrations, and provide all necessary documentation.

We offer:

- **Calibration testing** for thermocouples, thermistors and RTDs traceable to NIST standards.
- **End-to-end calibration** for thermocouple conductors.
- **Insulation resistance testing**.
- **Dielectric testing** to measure an insulation's performance in the presence of electrical discharges.
- **Helium leak testing** to verify sheath integrity.
- **Radiographic (X-ray) inspection** for internal defects, dimensional compliance and inclusions.
- **Liquid penetrant testing** for surface defects.
- **Metallographic examination** to evaluate constituents and structures of alloys.
- **Compaction density testing** to determine compaction of mineral insulations in metal sheathed cables.
- **Thermal cycling** to assure ruggedness under thermal transients.
- **Micro-hardness:** Vicker's scale destructive test used to determine sheath hardness.

For ASTM Standard E 230 tables, based on the ITS 90 scale, see Watlow's Thermocouple Temperature vs. EMF Outputs Reference Guide.

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Quality Certification Lab
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A lab service technician uses a metallurgical microscope to examine the microstructure of the metallic components in our mineral insulated metal sheathed cable, XACTPAK®.

See the Application Hints section for Tolerances on Initial Values of EMF vs. Temperature for Thermocouples chart on page 16.

Recommended Sensor Straight Length Required for Calibration

Temperature °C (°F)	Length inch (mm)			
	Thermocouples		RTDs	
	Minimum	Maximum	Minimum	Maximum
-195 only (-320 only)	6 (150)	60 (1525)	6 (150)	60 (1525)
-80 to 290 (-110 to 550)	6 (150)	60 (1525)	6 (150)	60 (1525)
290 to 1090* (550 to 2000*)	15 (380)	10 ft (3 m)	15 (380)	10 ft (3 m)
Above 1090 (Above 2000)	18 (455)	10 ft (3 m)	NA	NA

*In this temperature range some sensors longer than 6 inch (150 mm), but shorter than the stated length minimum of 15 inch (380 mm) can be calibrated. Please call Lab Services to see if your sensor meets the necessary criteria.

Thermocouple Calibration

Watlow offers testing for application temperatures other than the standard points in a range from -195 to 1700°C (-320 to 3092°F), depending on material. We do not recommend use outside of the temperature limits of ASTM E 230.

Existing EMF data is available from initial testing of base metal thermo-elements and from sample testing of manufactured lots of finished products. Data is at specific standard test temperatures for each thermocouple type, but may not be available on all lots.

Calibration* (Thermocouple Type)	Temperature °C (°F)	Specifications
E, K, J, N, T	0 to 1260 (32 to 2300)	ASTM E 207 ASTM E 220 ASTM E 230
B, R, S	0 to 1650 (32 to 3000)	
E, K, N, T	-195 plus -80 to 0 (-320 plus -110 to 32)	

*Maximum temperatures vary depending on thermocouple type.

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X-rays of the sensor verify the nonexistence of cracks at weld points that could let in humidity or gas and potentially shorten the life of the thermocouple.

RTD Calibration

Watlow RTD calibration is useful for defining the exact temperature coefficient of the sensor. Coefficients are obtained by calibrating the RTD at a cryogenic temperature, 0°C, 100°C and a high temperature that cannot exceed the maximum temperature capability of the RTD. Through the use of the coefficients, a resistance output table in one degree (°C or °F) increments can be generated for the entire temperature range of the RTD.

Certification Testing

Service	Description	Specifications
End-to-End Calibration	Comparison of each end of a length of thermocouple wire by utilizing a common junction measurement test. This is a requirement to verify homogeneity requirements.	ASTM E 207, E 220, E 230
Dielectric Testing	Performance levels of wire insulations in the presence of high, local fields caused by electrical discharges. Routinely used in Watlow quality control testing.	ASTM D 149
Helium Leak Test	Verifies the sheath integrity in metal-sheathed cable and sensors to 70 kg/cm^2 (1000 psi) in specially designed pressure chambers.	ASTM E 235
Radiographic Inspection	Determines dimensions, and detects and evaluates cracks, voids, inclusions and discontinuities. Technicians qualified under SNT-TC-1A.	ASTM E 94, E 142,
Liquid Penetrant Test	Detection of small surface defects using fluorescent post-emulsification methods. Technicians qualified under SNT-TC-1A.	ASTM E 165,
Metallographic Examination	Reveals the constituents and structures of metals. Also available: photomicrographs to determine and document average grain size and structure of prepared specimens.	ASTM E 3, E 112, E 235

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Certification Testing

Service	Description	Specifications
Compaction Density Test	Determines the compaction of insulating materials in metal-sheathed cable.	ASTM D 2771
Drift Test	Determines long term stability and drift characteristics.	ASTM E 601, E 644
Thermal Cycle Test	Individual sensors subjected to repeated cycling through a temperature range.	ASTM E 235
Insulation Resistance	Measures the electrical insulation resistance properties between the thermoelements and the sheath at ambient as well as elevated temperatures to determine the presence of moisture or impurities which could affect sensor performance.	ASTM E 780, E 235, E 644
Spurious EMF	Determines the homogeneity of the thermoelements. Performed at high temperatures on the entire length of XACTPAK mineral insulated, metal-sheathed cable.	Watlow
Micro-Hardness	Determines the hardness of sheath or conductors used to measure a material's resistance to penetration (hardness) as a predictor of strength, machinability, brittleness, ductility and wear resistance.	Vicker's