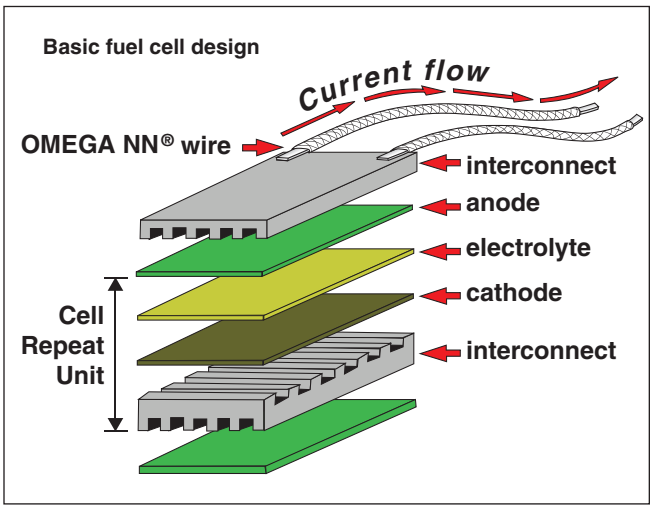
Custom Wire and Sleeving for Fuel Cell Applications

MADE IN USA

- **Solid Oxide Fuel Cell Anode and Interconnect Wire**
- **High Temperature 1200°C (2200°F)**
- **Nickel, Stainless and Platinum Based Alloys**
- **Multiple Shapes, Diameters and Insulations**
- **Increased Surface Area, Improved Electrical Performance**
- **Low Resistance at High Temperature**
- **Low Coefficient of Expansion**

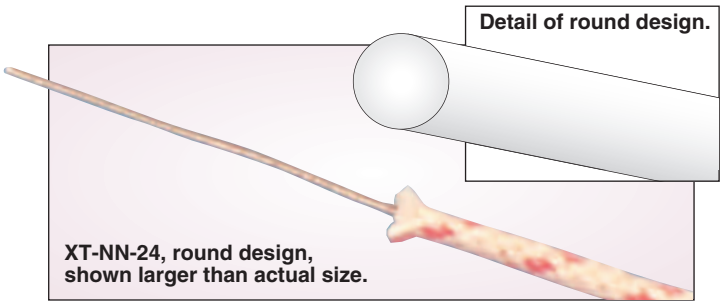
Fuel cell designs contain various configurations of anode, cathode and electrolyte materials to electrochemically convert a fuel into an electrical current. The power generation of these devices range from milliwatt to megawatts and the performance is dependent upon various factors of efficiency and voltage output of the design itself. Additional factors include the physical configuration including the interconnection or wiring of the cells in a combination of series and parallel circuits.



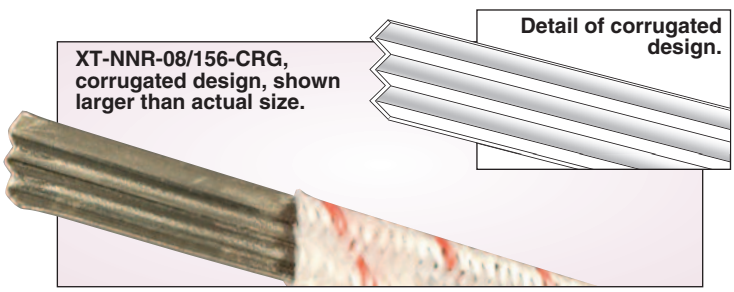
The interconnection or interconnect as referred to in fuel cell terminology is an extremely critical consideration and component in the design since the interconnect itself is the electrical connection from the fuel cell and transfers the created energy to the load.

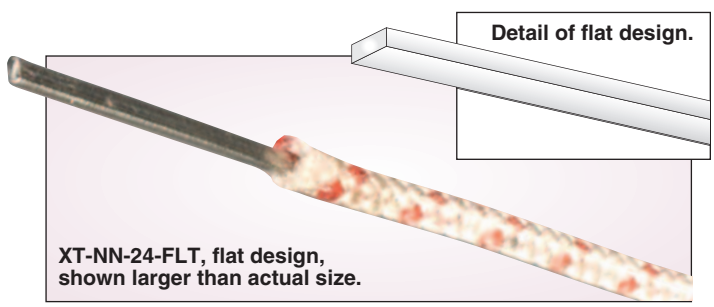
A critical factor involving the interconnect materials is the power or wattage generated by a fuel cell is commonly proportional to the operational temperature of the device. One of the most powerful and efficient designs at this time are high temperature solid oxide fuel cells. These designs have megawatt power generation capabilities, and have achieved 60% plus energy efficiency. They also have the ability to work with various input fuels and are clean energy technology.

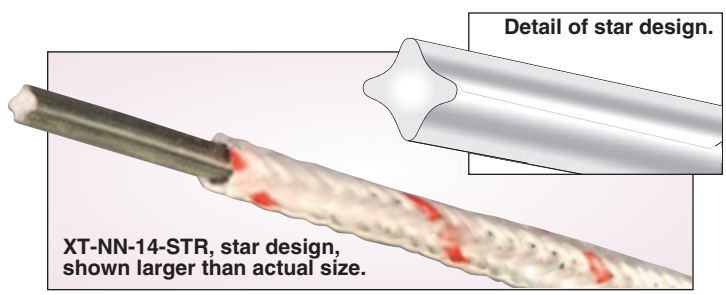
In the planar or stack style high temperature Solid Oxide Fuel Cell (SOFC) design the interconnect materials are constantly exposed to both oxidizing and reducing conditions, along with temperature gradients and operational temperatures up in the 850 to 1100°C range (1562 to 2012°F). Not only must the interconnect materials perform reliably in these extreme conditions, the interconnect wiring itself must possess the ability to efficiently carry and transfer the generated electricity.



In consideration of the fuel cell operational environments combined with OMEGA's long term experience in servicing this industry the following anode and interconnect insulated wire, along with braided XC sleeving and our Super OMEGACLAD XL® temperature sensors are outlined in following pages as proven high performance product solutions for fuel cell and other advanced power generation related applications.



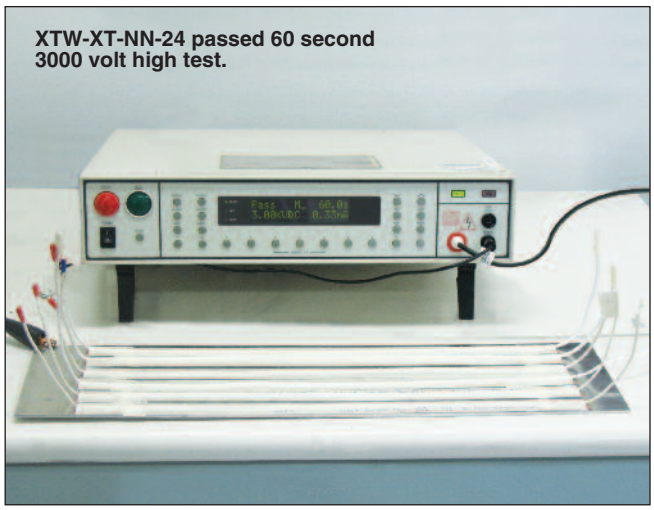




H

Custom Wire and Sleeving for Fuel Cell Applications

- **Braided and Wrapped Insulated Wire Designs**
- **3000 Volt Performance**
- **Multi-Conductor Designs**
- **High Temperature Wire Harness and End Connection Sleeving 1.57 to 12.7 mm (1/16 to 1/2")**

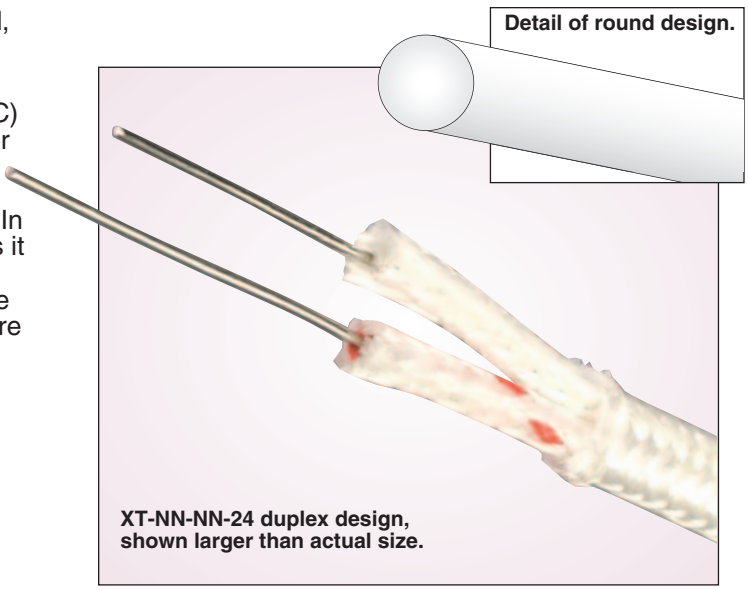


XTW-XT-NN-24 passed 60 second 3000 volt high test.

Fuel cells like any other power generation device require very high levels of reliability, the design itself including the materials utilized in the device is an extremely critical factor in achieving the expected performance. This is especially true in high powered, high temperature based fuel cells.

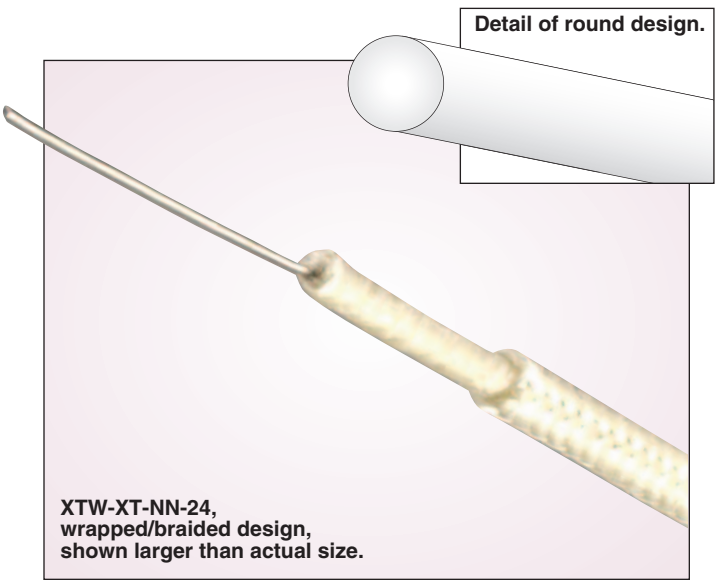
In the high temperature Solid Oxide Fuel Cell (SOFC) there are 2 primary designs at this time. The stack or planar orientation is one design where the cells are arranged as stack of plates to form a cube. In the tubular design the cells are multiple layers of tubes. In both cases as the electricity is created from the cells it is necessary to transfer the power from each cell through high temperature insulated interconnect wire and to bundle the multiple wires in a high temperature harness at specific locations or connection points.

OMEGA® XT or XC duplex insulated wire along with the XC braided sleeving has provided the answer to these requirements, and now the new XTW-XT wire design provides the capabilities 3000 volt performance. This new design is a combination of OMEGA's proprietary wrapping, braiding and other insulation capabilities.



Detail of round design.

XT-NN-NN-24 duplex design, shown larger than actual size.



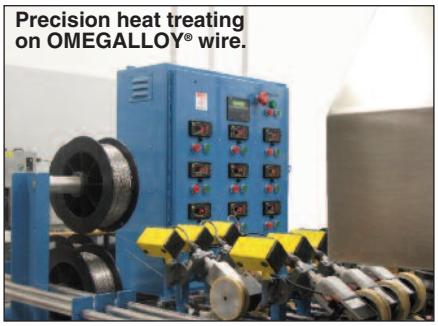
Detail of round design.

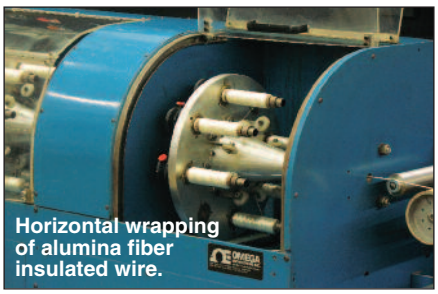
XTW-XT-NN-24, wrapped/braided design, shown larger than actual size.

XC-38, sleeving design, shown larger than actual size.

Custom Wire and Sleeving for Fuel Cell Applications

- **Extensive In-House Product Development and Manufacturing Capabilities**
- **Wire Processing Includes Braiding, Wrapping, Forming, Heat Treating and other Technologies**
- **Electrical High Pot and CE Testing**
- **Long Term and Cycling Temperature Testing**
- **ISO Approved Precision Calibration**


Precision heat treating on OMEGALLOY® wire.


Horizontal wrapping of alumina fiber insulated wire.


Vertical wrapping insulation process.

OMEGA's extensive manufacturing and product development capabilities provide ongoing solutions to fuel cells currently in operation along with those in various stages of development and refinement. The industry utilizes both OMEGA's high volume capacity and technological capabilities to move fuel cell towards a source of competitive, reliable and clean power generation opportunities. The implementation of OMEGA's product run the full spectrum of fuel cells including PEMFC (Proton Exchange Mechanism), PAFC (Phosphoric Acid), MCFC (Molten Carbonite) SOFC (Solid Oxide) utilized in transportation, military and stationary type power generation and other applications.

AVAILABLE FOR FAST DELIVERY!

To Order ***(Specify Model Number)***

Model Number	Insulation Configuration	Conductor Material**	Conductor Configuration	Conductor Dimensions	Overall Dimensions
XT-NN-24-*	Braided Nextel®	OMEGA N®	Single round formed wire	0.5 mm 24 AWG (0.020 round)	1.77 mm (0.070)
XT-NN-24-FLT-*	Braided Nextel	OMEGA N	Single flat formed wire	0.25 thick x 0.76 mm wide (0.010 x 0.030)	1 x 1.5 mm (0.040 x 0.060)
XT-NN-14-STR-*	Braided Nextel	OMEGA N	Single star formed wire***	2.56 major x 1 mm minor (0.101 x 0.042)	2.9 to 3 mm (0.115 to 0.120)
XT-NNR-008/156-CRG-*	Braided Nextel	OMEGA N	Single corrugated formed wire	0.017 thick x 3.2 wide x 1.3 mm high (0.007 x 0.128 x 0.051)	3.9 x 2.3 mm (0.153 x 0.091)
XTW-XT-NN-24-*	Wrapped and Braided Nextel 3000V High Pot Performance Test	OMEGA N	Single round formed wire	0.5 mm (0.020)	2.5 mm (0.100)
XT-NN-NN-24-*	Individually Nextel Braided Wires and Nextel Overbraid	OMEGA N	Two individual round formed wires	0.5 mm (0.020)	2.2 x 3.3 mm (0.088 x 0.132)
XC-116	Braided Nextel Sleeving	No Wire	No wire	No wire	1.57 ID x 2.3 mm OD (0.062 x 0.91)
XC-38	Braided Nextel Sleeving	No Wire	No wire	No wire	9.5 ID x 10.6 mm OD (0.375 x 0.420)

** Minimum 100 foot order required for the wire based products, long continuous lengths available as well.*

Ordering Example: XT-NN-24-1000 *single layer of braided Nextel insulation on a 24 gage Omega N® round bare wire—Consult Sales Engineering for pricing.*

*Additional conductor diameter and configurations available—replace the wire size number designation with the desired wire gage—for example replace the number **"24"** in XT-NN-24-1000 with the number **"20"** to create a 20 AWG - 0.8 mm (0.032 diameter) wire.*

*** Additional conductor materials available—replace the Omega N® NN with appropriate alloy designation—for example NP for Omega P® alloy, or CSS for a custom stainless steel alloy designed for high temperature fuel cells, or PLN for a nickel core platinum coated alloy. Consult sales engineering for details.*

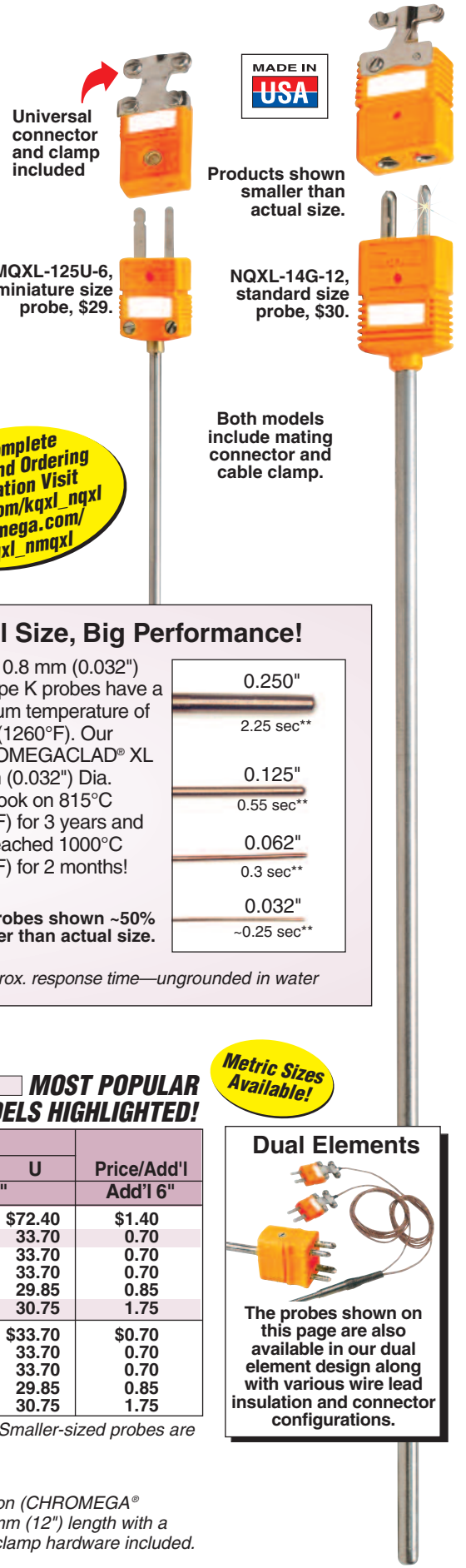
**** Note the STR configuration wire cannot be reduced in diameter, it can be increased. Consult sales engineering for details.*

Sleeving is available in addition diameters and is stocked in 10, 25, 50 and 100 ft lengths, long continuous lengths are available.

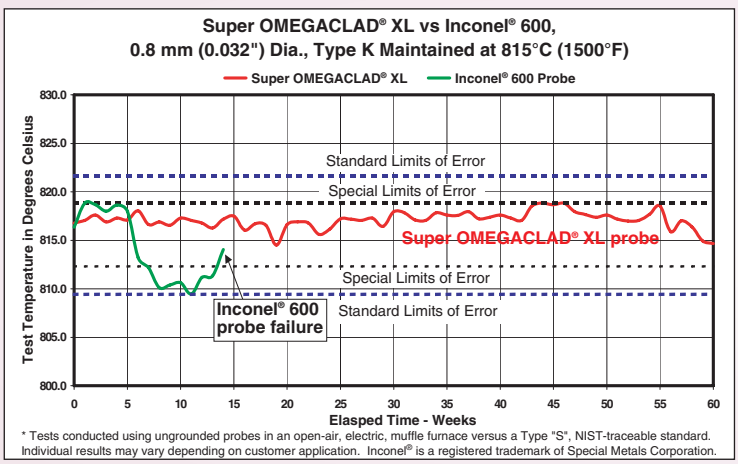
Super OMEGACLAD® XL Probes

- Super OMEGACLAD XL Thermocouple Probes
- Technological Advance in Temperature Measurement
- High Temperature Utilization up to 1335°C (2440°F)
- Proven Long Term Stability–Low Temperature Drift
- Small Diameters Sensors with Large Diameter Performance
- Custom and Stock Designs
- K and OMEGALLOY® N Thermocouple Calibrations

Omega brings you the Super OMEGACLAD XL Thermocouple sensor family of products, an exclusive development and manufacturing innovation in thermocouple technology. These temperature sensors created with OMEGA's state of the art proprietary processes for mineral insulated (MI) thermocouple cable and automated sensor manufacturing techniques is an industry leading solution for the high temperature and low drift performance expected in many fuel cell applications. This performance includes increasing the temperature and durability to levels never previously achieved in the fast responding small diameter thermocouple probes.



For Complete Details and Ordering Information Visit omega.com/kqxl_nqxl and omega.com/kmqxl_nmqxl



* Tests conducted using ungrounded probes in an open-air, electric, muffle furnace versus a Type "S", NIST-traceable standard. Individual results may vary depending on customer application. Inconel® is a registered trademark of Special Metals Corporation.

Small Size, Big Performance!

Typical 0.8 mm (0.032") Dia. Type K probes have a maximum temperature of 700°C (1260°F). Our Super OMEGACLAD® XL 0.8 mm (0.032") Dia. probe took on 815°C (1500°F) for 3 years and even reached 1000°C (1832°F) for 2 months!

Probes shown ~50% smaller than actual size.

*** Approx. response time—ungrounded in water*

Metric Sizes Available!

MOST POPULAR MODELS HIGHLIGHTED!

Standard Dimension—Quick-Connect Probes

Alloy/ANSI Color Code	Sheath Dia. inches	Model Number ANSI Color Code	Junction Type G/E (6")	Junction Type U (6")	Junction Type G/E (12")	Junction Type U (12")	Price/Add'l
MINIATURE CONNECTOR							Add'l 6"
CHROMEGA®-ALOMEGA® XL Sheath K	0.010"	KMQXL-010[*]-[**]	$51.00	$71.00	$52.40	$72.40	$1.40
	0.020"	KMQXL-020[*]-[**]	31.00	33.00	31.70	33.70	0.70
	0.032"	KMQXL-032[*]-[**]	31.00	33.00	31.70	33.70	0.70
	0.040"	KMQXL-040[*]-[**]	31.00	33.00	31.70	33.70	0.70
	0.062"	KMQXL-062[*]-[**]	27.00	29.00	27.85	29.85	0.85
	0.125"	KMQXL-125[*]-[**]	27.00	29.00	28.75	30.75	1.75
OMEGA-P®-OMEGA-N® XL Sheath N	0.020"	NMQXL-020[*]-[**]	$31.00	$33.00	$31.70	$33.70	$0.70
	0.032"	NMQXL-032[*]-[**]	31.00	33.00	31.70	33.70	0.70
	0.040"	NMQXL-040[*]-[**]	31.00	33.00	31.70	33.70	0.70
	0.062"	NMQXL-062[*]-[**]	27.00	29.00	27.85	29.85	0.85
	0.125"	NMQXL-125[*]-[**]	27.00	29.00	28.75	30.75	1.75

Note: *Probes with 0.032" diameter and larger are supplied with molded transition joints. Smaller-sized probes are supplied with stainless steel transition joints. Stripped leads standard.*
*[*]Specify junction type: **"G"** (Grounded), **"E"** (Exposed) or **"U"** (Ungrounded).*
*[**]Specify length in inches: **"6"**, **"12"**, **"18"** or **"24"**.*
Ordering Example: KMQXL-032U-12, *Super OMEGACLAD® sheathing type K calibration (CHROMEGA® ALOMEGA®) 0.08 mm (0.032") diameter ungrounded junction thermocouple probe 300 mm (12") length with a miniature Quick–Connect SMPW male connector attached. Female connector and wire clamp hardware included.*

Dual Elements

The probes shown on this page are also available in our dual element design along with various wire lead insulation and connector configurations.

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• Flow and Level

Air Velocity Indicators, Doppler Flowmeters, Level Measurement, Magnetic Flowmeters, Mass Flowmeters, Pitot Tubes, Pumps, Rotameters, Turbine and Paddle Wheel Flowmeters, Ultrasonic Flowmeters, Valves, Variable Area Flowmeters, Vortex Shedding Flowmeters

• pH and Conductivity

Conductivity Instrumentation, Dissolved Oxygen Instrumentation, Environmental Instrumentation, pH Electrodes and Instruments, Water and Soil Analysis Instrumentation

• Data Acquisition

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Displacement Transducers, Dynamic Measurement Force Sensors, Instrumentation for Pressure and Strain Measurements, Load Cells, Pressure Gauges, Pressure Reference Section, Pressure Switches, Pressure Transducers, Proximity Transducers, Regulators, Strain Gages, Torque Transducers, Valves

• Heaters

Band Heaters, Cartridge Heaters, Circulation Heaters, Comfort Heaters, Controllers, Meters and Switching Devices, Flexible Heaters, General Test and Measurement Instruments, Heater Hook-up Wire, Heating Cable Systems, Immersion Heaters, Process Air and Duct, Heaters, Radiant Heaters, Strip Heaters, Tubular Heaters

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