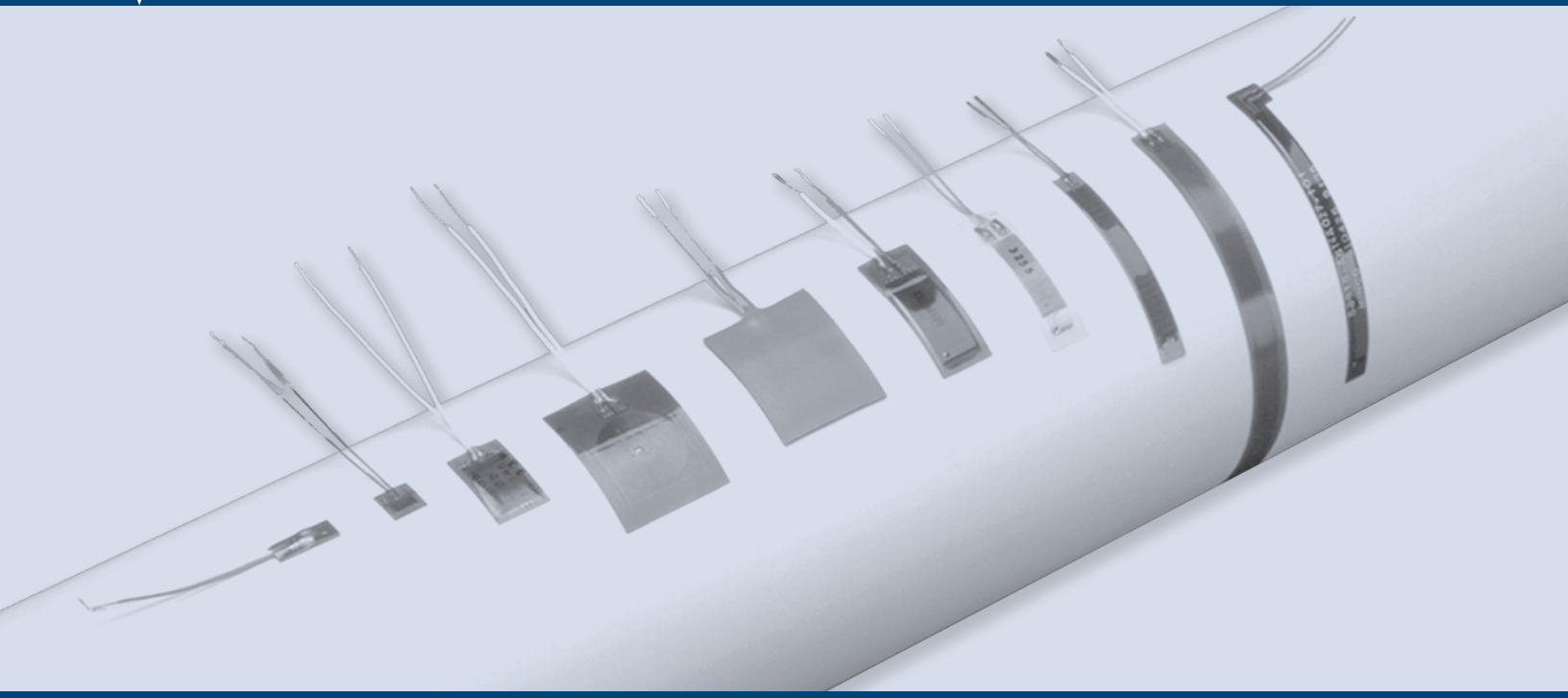

► SECTION 10: THERMAL-RIBBONS™

- Fast response surface sensing in aerospace, medical, and industrial devices
- Thin, flexible RTDs and thermocouples offer easy, non-invasive installation
- Rugged laminated construction for use in extreme environments
- Polyimide, silicone rubber, Mylar™ insulation

Thermal-Ribbons™ ..... 10-2 to 10-3
Thermal-Tabs™ ..... 10-2 to 10-3
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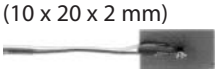
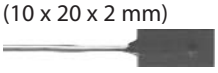
Thermal-Tab™ and Thermal-Ribbon™ Sensors

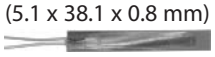
Install these compact sensors anywhere for accurate point sensing and fast response. All Thermal-Tab modules use a thin-film RTD element. All Thermal-Ribbon models conform to EN60751 Class B tolerance when ordered with a PD platinum element.

- Fast response surface sensing in aerospace, medical and industrial devices
- Rugged lamination construction
- Polyimide, silicone rubber or Mylar™ insulation
- All models are RoHS compliant

Thermal-Tab Specifications

Dimensions W x L x T_{max}	Element options	Insulation	Temperature range	Leadwires	Time constant*	Features	Model
0.20 x 0.50 x 0.08" (5 x 12 x 2 mm) 	PD, PF, PW	Polyimide with elastomer cover coat	-50 to 155°C -58 to 311°F	AWG 26, PTFE insulated	0.8 sec.	Stocked for immediate shipment	S665
0.20 x 0.60 x 0.08" (5 x 15 x 2 mm) 	PD, PF, PW, PS, NB, NA, NJ	Polyimide	-50 to 200°C -58 to 392°F	AWG 26, PTFE or polyimide insulated	1.0 sec.	Platinum models in stock	S17624
0.20 x 0.60 x 0.08" (5 x 15 x 2 mm) 	PD, PF, PW, PS	Polyimide film	-50 to 260°C -58 to 500°F	AWG 26, PTFE or polyimide insulated	0.4 sec.	Highest temperature capability	S100820
0.20 x 0.60 x 0.12" (5 x 15 x 3 mm) 	PD, PF, PW	Silicone rubber with elastomer cover and foil backing	-50 to 155°C -58 to 311°F	AWG 24, Silicone insulated	1.3 sec.	Waterproof; suitable for continuous immersion	S667
0.20 x 0.60 x 0.045" (5 x 15 x 1.15 mm) 	PD, PF, PW	Polyimide film	-50 to 200°C -58 to 392°F	AWG 26, PTFE or polyimide insulated	0.6 sec.	Thinnest profile	S100725
0.30 x 0.60 x 0.10" (7 x 15 x 2.5 mm) 	PD, PF, PW, PS, NB, NA, NJ	Polyimide film	-50 to 200°C -58 to 392°F	AWG 22, PTFE or polyimide insulated	1.2 sec.	Heavier leadwire for applications requiring ruggedized design	S100724
0.40 x 0.80 x 0.08" (10 x 20 x 2 mm) 	PD, PF, PW, PS, NB, NA, NJ	Polyimide film	-50 to 200°C -58 to 392°F	AWG 26, PTFE or polyimide insulated	0.9 sec.	Larger surface area for easier handling and maximum adhesive bond	S100723
0.40 x 0.80 x 0.08" (10 x 20 x 2 mm) 	PD, PF, PW, PS, NB, NA, NJ	Silicone rubber	-50 to 220°C -58 to 428°F	AWG 26, PTFE or polyimide insulated	1.5 sec.	High temperature rating, available with wide range of element options	S100721

Thermal-Ribbon Specifications

0.20 x 1.50 x 0.030" (5.1 x 38.1 x 0.8 mm) 	FA	Polyimide	-200 to 200°C -328 to 392°F	AWG 34, PTFE insulated	0.15 sec.	Wire-wound nickel-iron for high resistance in small package	S38
0.30 x 0.30 x 0.025" (7.6 x 7.6 x 0.7 mm) 	PD, PE	Polyimide with foil backing	-200 to 200°C -328 to 392°F	AWG 28, PTFE insulated	0.15 sec.	Wire-wound element	S651
0.75 x 0.75 x 0.04" (19 x 19 x 1.0 mm 	FA	Mylar	-200 to 150°C -328 to 302°F	AWG 30, PTFE insulated	0.3 sec.	Wire-wound nickel-iron flat element for high resistance	S25

*Notes: T_{max} is measured over the lead bulge.*Time constant is in water at 1 m/sec.*

Specifications, continued

Leadwire insulation codes	
S25, S38, S651, S665, S667	Leave blank
S17624, S100721, S100723, S100724, S100725, S100820	T = PTFE insulated wires K = Polyimide insulated wires

Specifications subject to change

Sensing elements

Sensing element specifications**	Code
Platinum (0.00385 TCR) (EN60751, Class B) 100 Ω ±0.12% at 0°C	PD
Platinum (0.00385 TCR) 100 Ω ±0.22% at 0°C	PE
Platinum (0.00385 TCR) 1000 Ω ±0.12% at 0°C	PF
Platinum (0.00375 TCR) 1000 Ω ±0.12% at 0°C	PW
Platinum (0.00385 TCR) 10,000 Ω ±0.12% at 0°C	PS
Nickel-iron (0.00518 TCR) 604 Ω ±0.26% at 0°C	FA
Nickel (0.00618 TCR) (DIN43760 NI100, Class B) 100 Ω ±0.22% at 0°C	NB
Nickel (0.00672 TCR) 120 Ω ±0.50% at 0°C	NA
Nickel (0.00618 TCR) (DIN43760 NI1000, Class B) 1,000 Ω ±0.22% at 0°C	NJ

*** See table on previous page for element options on each model.*

Specifications and order options

S17624	Model number from table
PD	Sensing element from table
Z	Number of leads: Y = 2 leads Z = 3 leads (N/A on S25, S38) X = 4 leads (N/A on S25, S38 or S665/S667)
T	Leadwire insulation code from table at left
24	Lead length in inches: S665/S667: 60" max.
A	Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA)
Stop here for all models except S665 or S667. For models S665 and S667, add:	
C	Compliancy: C = RoHS Compliance
S665PDY40AC = Sample part number	

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Waterproof model

Model S667 is waterproof and suitable for continuous immersion. Use it to monitor the temperature of water in a tank or container, or on equipment that must withstand wash-down or immersion.

Check with Minco for suitability in other liquids.

Custom Thermal-Ribbon designs

Minco can custom-wind Thermal-Ribbon elements in virtually any shape and size. We can profile sensing elements to provide increased sensitivity in selected zones, and provide packaging to perfectly fit your applications.

Contact Access: Minco Sales and Support today to discuss your application.

Specify and order products at: www.minco.com/sensors_config

STOCKED PARTS

Model #	Sensor Insulation	Temp. Range	Time Constant	Sensing Element	# of Leadwires	Leadwire Insulation	Lead Length	Pressure Sensitive Adhesive Backing	RoHS Compliant	Stock Part #
S665	Polyimide w/ Elastomer Cover Coat	-50 to 155° C -58 to 311° F	0.8 Sec	PD	2	PTFE	40″	No	Yes	S665PDY40AC
					3	PTFE	40″	No	Yes	S665PDZ40AC
					2	PTFE	40″	Yes	Yes	S665PDY40BC
					3	PTFE	40″	Yes	Yes	S665PDZ40BC
				PF	2	PTFE	40″	No	Yes	S665PFY40AC
						PTFE	40″	Yes	Yes	S665PFY40BC
S667	Silicone Rubber w/ Elastomer Cover and Foil Backing	-50 to 155° C -58 to 311° F	1.3 Sec	PD	3	Silicone	40″	No	Yes	S667PDZ40AC
					2	Silicone	40″	No	Yes	S667PDY40AC
					3	Silicone	40″	Yes	Yes	S667PDZ40BC
					2	Silicone	40″	Yes	Yes	S667PDY40BC
S17624	Polyimide	-50 to 200° C -58 to 392° F	1.0 Sec	PD	3	PTFE	40″	Yes	Yes	S17624PDZT40B
				PF	2	PTFE	40″	Yes	Yes	S17624PFYT40B
						PTFE	40″	No	Yes	S17624PFYT40A
				PD	2	PTFE	40″	Yes	Yes	S17624PDYT40B
						PTFE	40″	No	Yes	S17624PDYT40A
					3	PTFE	40″	No	Yes	S17624PDZT40A
S38	Polyimide	-50 to 200° C -58 to 392° F	0.15 Sec	FA	2	PTFE	36″	No	Yes	S38FAY36A
S651	Polyimide w/ Foil Backing	-50 to 200° C -58 to 392° F	0.15 Sec	PD	3	PTFE	24″	No	Yes	S651PDZ24A
					2	PTFE	24″	No	Yes	S651PDY24A
S25	Mylar	-50 to 200° C -58 to 392° F	0.3 Sec	FA	2	PTFE	36″	Yes	Yes	S25FAY36B

Note: Available up to 10 pieces or contact Minco Customer Service

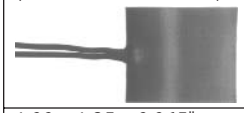
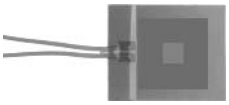
Specifications subject to change

Discoil™ Thermal-Ribbons

Overview

Install these compact sensors anywhere for accurate point sensing. Discoil™ RTD elements are wound on a single plane for faster time response.

Specifications

Dimensions W x L x T_{max}	Element options	Insulation	Temperature range	Leadwires	Time constant*	Features	Model
0.79 x 1.87 x 0.055" (20 x 47.5 x 1.4 mm) solder pad version shown 	PD, PE	Polyimide (clear polyester available)	-73 to 200°C -100 to 392°F	(Optional) AWG 24, PTFE insulated	0.10 sec.	Only 0.010" thick over element, fast time response, platinum PD accuracy available	S17422
1.00 x 1.25 x 0.090" (25.4 x 31.8 x 2.3 mm) 	PB11, PB22	Silicone rubber with polyimide backing	-62 to 220°C -80 to 428°F	AWG 24, silicone rubber insulated	0.2 sec.	High temperature rating, platinum PD accuracy available	S32
	PD12, PE22						S385
1.00 x 1.25 x 0.065" (25.4 x 31.8 x 1.7 mm) 	FA	Polyimide	-200 to 200°C -328 to 392°F	AWG 26, PTFE insulated	0.15 sec.	High resistance nickel-iron element	S39

Notes: T_{max} is measured over the lead bulge.

**Time constant is in water at 1 m/sec.*

Sensing elements

Sensing element specifications**		Code
Platinum (0.00391 TCR)	100 Ω ±0.5% at 0°C	PA
Platinum (0.00391 TCR)	100 Ω ±0.11% at 0°C	PB11
Platinum (0.00391 TCR)	100 Ω ±0.22% at 0°C	PB22
Platinum (0.00385 TCR) (EN60751, Class B)	100 Ω ±0.12% at 0°C	PD, PD12
Platinum (0.00385 TCR)	100 Ω ±0.36% at 0°C	PE (Discoil)
Platinum (0.00385 TCR)	100 Ω ±0.5% at 0°C	PE (Strip sensing)
Platinum (0.00385 TCR)	100 Ω ±0.22% at 0°C	PE22
Nickel-iron (0.00518 TCR)	604 Ω ±0.26% at 0°C	FA
Copper 427	10 Ω ±0.20% at 25°C	CA
Nickel 672	120 Ω ±0.3% at 0°C	NA

*** See table above for element options on each model.*

Specification and order options

S32	Model number from table
PB22	Sensing element from table
Z	Number of leads: Y = 2 leads Z = 3 leads X = 4 leads W = Solder pads (S17422 only)
36	Lead length in inches (Specify 0 for solder pads, option on S17422 only)
A	Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA)
S32PB22Z36A = Sample part number	

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Specify and order products at:

www.minco.com/sensors_config

Specifications subject to change

Strip Sensing Thermal-Ribbons™

Overview

These models average temperatures along their length to eliminate point measurement errors. Wrap them around cylinders or adhere them to flat surfaces.

Specifications

Dimensions W x L x T_{max}	Element options	Insulation	Temperature range	Lead-wires	Time constant*	Features	Model
0.50 x 1.25 x 0.050" (12.7 x 31.8 x 1.3 mm) 	PA, PE, CA, NA	Polyimide	-73 to 200°C -100 to 392°F	AWG 26, PTFE insu-lated	0.17 sec.	Easy motor installations	S3238
0.375 x 4.00 x 0.075" (9.5 x 101.6 x 1.9 mm) 	PB22	Silicone rubber w/ poly-imide backing	-62 to 220°C -80 to 428°F		0.6 sec.	Platinum PD accuracy	S34
	PD12 PE22						S386
0.375 x 4.00 x 0.065" (9.5 x 101.6 x 1.7 mm) 	FA	Polyimide	-200 to 200°C -328 to 392°F		0.2 sec.	Wire-wound nickel-iron for high resistance, thin element	S35
	FA	Mylar	-100 to 150°C -148 to 302°F		0.3 sec.	Wire-wound nickel-iron,low cost	S2

Notes: T_{max} is measured over the lead bulge.
**Time constant is in water at 1 m/sec.*
Refer to Sensing Elements Table on Page 10-4

Specification and order options

S34	Model number from table (except S3238)
PB22	Sensing element from table
Y	Number of leads: Y = 2 leads Z = 3 leads (required on CA) X = 4 leads (PD only)
36	Lead length in inches: 36" stocked (42" on S2)
A	Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA)
S34PB22Y36A = Sample part number	

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Model S3238

Model S3238 is specially designed to sense ***stator*** temperatures in motors and generators. An alternative to the "stick" sensors, the S3238 mounts on the end turns of stator windings and provides an easy way to add overtemperature protection when the stator is not being rewound.

S3238 specification and order options

S3238	Model number S3238
PA	Sensing element from table
Y	Number of leads: Y = 2 leads (not available on CA) Z = 3 leads X = 4 leads
T	Lead insulation: T = PTFE K = polyimide TS = SS braid over PTFE
36	Lead length in inches: 36" stocked
U	Lead configuration: T = Twisted U = Untwisted
A	Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA)
S3238PAYT36UA = Sample part number	

STOCKED PARTS

Model #	Sensor Insulation	Temperature Range	Time Constant	Sensing Element	# of Leadwires	Leadwire Insulation	Lead Length	Pressure Sensitive Adhesive Backing	Stock Part #
S3238	Polyimide	-73 to 200° C -100 to 392° F	0.17 Sec	PA	3	PTFE	96″	No	S3238PAZT96UA
							36″	No	S3238PAZT36UA
				NA	3	PTFE	96″	No	S3238NAZT96UA
				CA	3	PTFE	96″	No	S3238CAZT96UA
S34	Silicone Rubber with Polyimide Backing	-62 to 220° C -100 to 392° F	0.6 Sec	PB22	3	PTFE	36″	No	S34PB22Z36A
S386	Silicone Rubber with Polyimide Backing	-62 to 220° C -100 to 392° F	0.6 Sec	PD12	3	PTFE	36″	No	S386PD12Z36A
				PE22	2	PTFE	96″	No	S386PE22Y96A
S35	Polyimide	-200 to 200° C -328 to 392° F	0.2 Sec	FA	2	PTFE	36″	No	S35FAY36A

Note: Available up to 10 pieces or contact Minco Customer Service

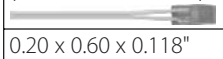
Specifications subject to change

Thermistor Thermal-Tab™

Overview

Model TS665 and TS667 offer extremely sensitive NTC thermistors for applications with small temperature changes. Model TS667 also features waterproof construction, making it suitable for continuous immersion.

Specifications

Dimensions W x L x T_{max}	Element options	Insulation	Temp. range	Leadwires	Time constant	Feature	Model
0.20 x 0.47 x 0.079" (5.0 x 12.0 x 2.0 mm) 	TF, TK	Polyimide with elastomer cover coat	-50 to 125°C (-58 to 257°F)	AWG 26, PTFE insulated	0.8 sec.	Small, low-cost	TS665
0.20 x 0.60 x 0.118" (5.0 x 15.2 x 3.0 mm) 		Silicone rubber with elastomer cover and foil backing		AWG 24, Silicone insulated	1.3 sec.	Waterproof, suitable for continuous immersion	TS667

*Notes: T_{max} is measured over the lead bulge. TS665 is suitable for the CT325 temperature controller (page 5-20). *Time constant is in water at 1 m/sec.*

Sensing elements

Sensing element specifications**		Code
NTC thermistor	50k Ω ±1% at 25°C	TF
NTC thermistor	10k Ω ±1% at 25°C	TK

*** See table above for element options on each model.*

Specify and order products

www.minco.com/sensors_config

Specification and order options

TS665	Model number from table	
TF	Sensing element from table	
Y	Number of leads:	Y = 2 leads
40	Lead length in inches:	40" stocked, 60" max.
A	Adhesive backing: A = No adhesive	B = Pressure-sensitive adhesive (PSA)
C	Compliancy: C = RoHS compliant	
TS665TFY40AC = Sample part number		

Note: PSA reduces temp. range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

STOCKED PARTS

Model #	Sensor Insulation	Temperature Range	Time Constant	Sensing Element	# of Leadwires	Leadwire Insulation	Lead Length	Pressure Sensitive Adhesive Backing	RoHS Compliant	Stock Part #
TS665	Polyimide w/ Elastomer Cover Coat	-50 to 125° C -58 to 257° F	0.8 Sec	TF	2	PTFE	40"	No	Yes	TS665TFY40AC
				TK	2	PTFE	40"	No	Yes	TS665TKY40AC
				TF	2	PTFE	40"	Yes	Yes	TS665TFY40BC
				TK	2	PTFE	40"	Yes	Yes	TS665TKY40BC

Note: Available up to 10 pieces or contact Minco Customer Service

Thermocouple Thermal-Ribbon™

Overview

TC40 is a patch-style thermocouple that adheres to all types of surfaces for quick and easy mounting.

Specifications

Dimensions W x L x T_{max}	0.75 x 0.75 x 0.065" (19.1 x 19.1 x 1.7 mm) 
Junction type	E, J, K, or T
Insulation	Polyimide
Temp. range	-200 to 200°C (-328 to 392°F)
Leadwires	AWG 24, solid PTFE insulated
Time constant	0.6 sec.
Features	Surface mounting
Model	TC40

Notes: T_{max} is measured over the lead bulge.
**Time constant is in water at 1 m/sec.*

Specification and order options

TC40	Model number
J	Junction type: E, J, K, or T
T	Covering over leadwires: T = PTFE only S = Stainless steel braid
36	Lead length in inches: 36" and 144" are stocked for type J, K, T
A	Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA)
TC40JT36A = Sample part number	

Note: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Thermal-Ribbon Installation and Accessories

Thermal-Ribbons lend themselves to a variety of installation methods. You should avoid repeated bending during the installation process, and Thermal-Ribbons should not flex in use unless they are specifically designed to do so. Take care to secure leadwires so they do not pull against sensor bodies. Leadwires should be routed along the sensed surface a short distance so that they do not sink heat away from the sensing element. Listed below are some standard installation methods.

Pressure sensitive adhesive

PSA (option B in part number) is the simplest mounting method, but it is restricted to flat surfaces and temperatures below 177°C (350°F). PSA is usually factory applied to the mounting surface of the Thermal-Ribbon. To install, just remove the backing paper and press in place.

#20 stretch tape

High temperature silicone rubber tape for mounting Thermal-Ribbons to pipes or other cylinders as shown above. It comes in 1" wide rolls, 6 or 36 feet long.

#6 RTV cement

Room temperature vulcanizing cement for mounting silicone rubber Thermal-Ribbons to flat or curved surfaces. It is available in 3 oz. (89 ml) tubes. Contact Minco for other adhesives usable with Kapton™ or Mylar™ Thermal-Ribbons.

Shrink bands

Minco shrink bands are pre-stretched plastic strips with adhesive at both ends. Use them to mount Thermal-Ribbons to cylinders. Simply wrap the band around the sensor and cylinder, secure the ends, and heat to shrink in place.
To order, specify band width and cylinder diameter.

#21 Polyimide tape

High temperature tape with silicone-based adhesive. Useful for quick mounting of Thermal-Ribbon or Thermal-Tab sensors to flat surfaces. Makes a strong but removable bond to most smooth and clean surfaces. Maximum operating temperature is 150°C. 0.5 inch wide x 108 ft. long roll.

Thermal Ribbons for pipe sensing

Thermal Ribbons make a practical, economical alternative to traditional immersed sensors for sensing fluid temperatures in pipes or tanks. They mount directly on pipe surfaces, so there is no need to tap and drain systems to install thermowells. If the Thermal-Ribbon is installed correctly, tests show that the thermal response is as quick and accurate as traditional invasive sensors. See page 9-7 for Thermal-Ribbons specially designed for pipe sensing.

Minco manufactures flexible Thermofoil™ etched-foil heaters for precision temperature control of critical applications. We can integrate heaters with Thermal-Ribbons and other sensors and controllers to provide complete turnkey thermal solutions.

Learn more about Thermofoil heater solutions at www.minco.com/heater/

Specifications subject to change

Non-Invasive Sensors Design Kit

Non-Invasive Sensors Design Kit

The Non-Invasive Sensors Design Kit will make you look at temperature sensing in a whole new way. Learn and develop new techniques for accurate and fast responding temperature measurement without disrupting the design integrity of your application.

The Design Kit provides products and instructions to accurately sense temperature in places that would otherwise be difficult with traditional invasive sensing methods.
Included in this kit:

- 2 - 100 ohm (Platinum 385) Thermal-Ribbons
- 1 - 100 ohm (Platinum 385) Thermal-Tab
- 1 - 100 ohm (Platinum 385) Bolt-on Sensor
- 1 - Temptran™ temperature transmitter, 4-20mA, 0-100°C span
- #20 Stretch Tape, 6' (1.8 m) roll
- Start-up Guide
- Precautions, Recommendations and Applications
- Technical Specifications
- Temperature vs. Resistance Tables
- Engineering Instructions
- Whitepaper - Resistance Thermometry

Model Number	TB-S1

Other Design Kits

Flexible Heaters Prototype Design Kit

The Flexible Heaters Prototype Design Kit allows you to easily test and prototype a heating concept before starting on a journey of custom-built-to-order product.

Filled with polyimide and silicone rubber Thermofoil™ heaters, instructions and technical data, this kit will help you move towards successfully integrating flexible heaters into your application.

Model Number	TB-H1

Flex Circuits Design Kit

The Flex Circuits Design Kit provides tools and information to help you go from inception to physical mock-up, while gaining the knowledge needed to successfully integrate different types of flex circuits into your application.

The kit contains comprehensive flex circuit training materials including a hard cover case of more than 25 flex circuit materials and finished circuits, and an offer for a FREE mechanical circuit sample.

Model Number	TB-F1