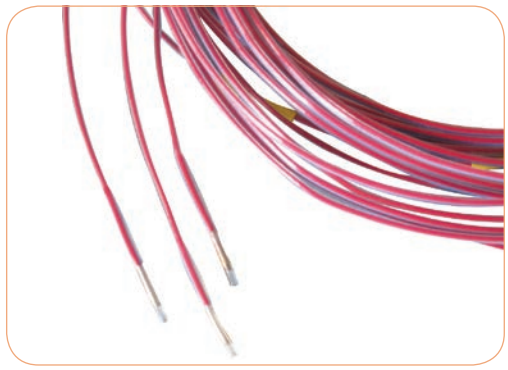
Thermocouples Overview



The accuracy of the complete validation system is critical to validating any process. Good Calibration Practices state that the accuracy of the standard or Validation system should be at least 4 times more accurate than the criteria defined to evaluate the process. The accuracy, repeatability and quality of the thermocouples sensor is a key component of the measurement process.

Kaye's Ultra-Premium Type T (Copper/Constantan) thermocouple wire and probes have been designed and manufactured to provide the highest purity and uniformity in the industry, while providing the robustness to survive hash conditions and physical abuses normally encountered in Validation. Type T wire and probes provide the highest level of accuracy when used from -200°C to 400°C. The Teflon coated wire is rated for continuous use at 200°C with a peak rating of 260°C, while our Kapton coated insulated wire will withstand use up to 400°C.

The accuracy and uniformity of thermocouple wire is dependent on the quality and purity of the metals they are made from. Using a process, we developed over 30 years ago, Kaye inspects the purity of each ingot of Copper and Constantan prior to being extruded to ensure it meets Kaye's stringent purity specifications.

Kaye's Ultra Premium grade wire and probes carry an accuracy of 0.25% at 121°C, 4 times better than standard commercial grade wire of 1°C.

The purity, and uniformity provide unmatched accuracy and most importantly provides a broad gap between measurement accuracy and your criteria, therefore greatly minimizing any risks of failed calibrations or /verifications due to the sensor.

Kaye Thermocouple Wire Specifications			
Wire Grade	Ultra - Premium		
	3- Strand	7-Strand	7-Strand Kapton®
Model	K0258	K0255	K0250
Gauge	27 AWG	22 AWG	22 AWG
Accuracy @ 121°C @ 300°C	±0.3°C	±0.25°C	 ±1.2°C
Maximum variation within group for all wire:			
@ 40°C	±0.05°C maximum; ±0.03°C typical		
@ 121°C	±0.1°C maximum; ±0.05°C typical		
@ 300°C	±0.3°C maximum; ±0.15°C typical		
Size Oval	3-strand 0.042" (1.1mm) minor 0.074" (1.9mm) major 7-strand 0.095" ((2.4mm) minor 0.120" (3,0mm) major		

Multi-Stranded Construction

Thermocouple wire and probes are typically subjected to significant handling and stress due to the nature of their use during validation. They are dropped, wound up, tied, stepped rolled over and bent. Repeated bending or cold working of a thermocouple wire can generate stress and distortion of the materials crystalline structure resulting in potential measurement errors.

Kaye thermocouple wire is a multi-strand construction utilizing 7 strands of 30-gauge wire twisted together to provide maximum pliability, strength and therefore durability to minimize the risk of any cold working.

If the wire is stressed from cold working, then the purity and uniformity of the wire will significantly minimize or eliminate any potential measurement errors.

Thermocouple Probe Tips

Kaye thermocouple probes are provided with an argon welded bead at the tip to provide a strong robust junction. The tips are then encapsulated with a dual heat shrinkable sealed Teflon tip to protect the tip from damage as well as minimize any moisture from being pulled thru the probe during sterilization thus prolonging the life of the probe.

Sensor Risk Assessment

The success of validation studies is primarily based on the accurate measurement and verification of critical process parameters such as temperature. One of the major contributing factors to the accuracy of the data is the proper selection and use of the sensor themselves.

While quality thermocouple wire may cost more than conventional wire the added costs is negligible when one considers the investment in people, validation equipment and time during Validation.

The costs of one failed qualifications or calibration verifications in time, productivity and downtime, will more than compensate for the investment in high quality thermocouple wire.

Don’t take unnecessary risk, trust Kaye Ultra Premium Grade Thermocouple wire and probes to provide the accuracy, and robustness to assure the success of your Validation efforts.

Ultra-Premium Autobond Type T Thermocouple Probes

Designed Specifically for Autoclaves to Eliminate Leakage

The Autobond wire and probes were designed specifically for Autoclave and SIP applications, to eliminate wicking of water or steam in the thermocouple probe. The wire and probes are manufactured using our Ultra-Premium grade wire providing an accuracy of 0.25°C @ 121°C.

The Teflon coated wire is rated for continuous use from -196°C to 200°C. Each probe includes an argon welded tip with dual shrink tubing to protect the tip from damage and moisture. Each probe is leak tested and verified for accuracy at 121°C.

The Autobond probes design eliminates the clear outer Teflon jacket which is where 90% of the moisture creep occurs. The inner Teflon coating is more of a mold which fills in the inner air pockets created by the stranded wire, thus blocking any moisture creep.

Benefits:

- No more need for drip cuts or dealing with puddles of water
- Extended probe life due to reduced moisture and oxidation of wires
- Eliminates the risk of getting moisture in your Validator and rusting out SIMS or damaging electronics
- Reduced diameter (no outer sleeve) easier to deal with and more T/C in baths
- Ultra-Premium grade wire provides same level of accuracy and uniformity
- Compatible with existing Sims, Feedthru's and Bath Inserts

The Ultra-Premium Autobond wire carries the same accuracy and uniformity specifications as our standard Kaye Ultra-Premium wire and comes in 2 diameters; standard 22 AWG 7-strand wire and 26 AWG smaller 7-strand wire.

Typical Applications

- Autoclaves
- SIP
- All applications from -196°C to 200°C

Technical Specifications

- Thermocouple tips with 1.8mm or 3mm diameter
- Temperature range from -196°C to 200°C
- Accuracy of 0.25°C @ 121°C
- Ideal for wet applications
- Continuous use up to 200°C with a short peak of 250°C
- Available as 3 or 7-strand wire
- Available also with Labels
- Standard length of 6-8-10-12 m (EMEA)
- Standard length of 20-25-30-35-40-50 feet (US)

Ordering Information Autobond TC's

Part Number	Description
AL-7ST1WN-20	AUTOBOND Teflon Probe 7-strand 1" Tip 20 ft 22AWG (6 meter)
AL-7ST1WN-25	AUTOBOND Teflon Probe 7-strand 1" Tip 25 ft 22AWG
AL-7ST1WN-27	AUTOBOND Teflon Probe 7-strand 1" Tip 27 ft 22AWG (8 meter)
AL-7ST1WN-30	AUTOBOND Teflon Probe 7-strand 1" Tip 30 ft 22AWG
AL-7ST1WN-33	AUTOBOND Teflon Probe 7-strand 1" Tip 33 ft 22AWG (10 meter)
AL-7ST1WN-40	AUTOBOND Teflon Probe 7-strand 1" Tip 40 ft 22AWG (12 meter)
AL-7ST1WN-50	AUTOBOND Teflon Probe 7-strand 1" Tip 50 ft 22AWG
AS-7ST1WN-20	AUTOBOND Teflon Probe 7-strand 1" Tip 20 ft 26AWG (6 meter)
AS-7ST1WN-25	AUTOBOND Teflon Probe 7-strand 1" Tip 25 ft 26AWG
AS-7ST1WN-27	AUTOBOND Teflon Probe 7-strand 1" Tip 27 ft 26AWG (8 meter)
AS-7ST1WN-30	AUTOBOND Teflon Probe 7-strand 1" Tip 30 ft 26AWG
AS-7ST1WN-33	AUTOBOND Teflon Probe 7-strand 1" Tip 33 ft 26AWG (10 meter)
AS-7ST1WN-40	AUTOBOND Teflon Probe 7-strand 1" Tip 40 ft 26AWG (12 meter)
AS-7ST1WN-50	AUTOBOND Teflon Probe 7-strand 1" Tip 50 ft 26AWG

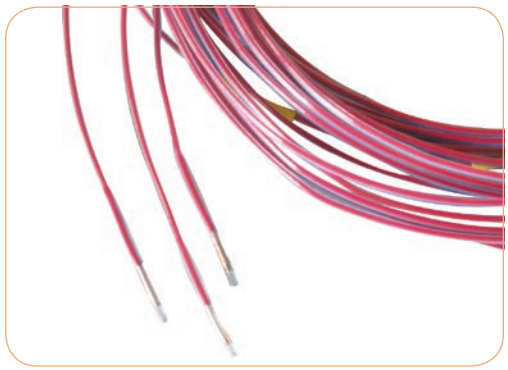
Ultra-Premium Type T Teflon® Insulated Thermocouples

For over 30 years Kaye's Ultra-Premium Type T Teflon thermocouple probes have been the standard for critical validation applications. The wire and probes are manufactured using our Ultra-Premium grade wire providing an accuracy of 0.25°C @ 121°C.

The Teflon coated wire is rated for continuous use from -196°C to 200°C. Each probe includes an argon welded tip with dual shrink tubing to protect the tip from damage and moisture. Each probe is individually leak tested and verified for accuracy at 121°C.

The probes contain an inner Teflon sleeve surrounding each wire as well as a clear outer Teflon coating providing maximum strength and protection.

The probes are available in our standard 7 strand configuration or as 3 strand for application where space is at a minimum.



Typical applications

- All applications from -196°C to 200°C

Technical Details

- Thermocouple tips with 1.8 mm or 3 mm diameter
- Temperature range from -196°C to 200°C
- Accuracy of 0.25°C @121°C
- Ideal for wet applications
- Continuous use up to 200°C with a short time peak of 250°C
- Available as 3- or 7-strand wire
- Available also with Labels
- Standard length of 6-8-10-12 m (EMEA)
- Standard length of 30-35-40-45-50 feet (US)

Standard Part Numbers

USA/Asia

7ST 1WN-20	Teflon Probe, 7-stranded, 1'' Tip, 20 feet
7ST 1WN-25	Teflon Probe, 7-stranded, 1'' Tip, 25 feet
7ST 1WN-30	Teflon Probe, 7-stranded, 1'' Tip, 30 feet
7ST 1WN-40	Teflon Probe, 7-stranded, 1'' Tip, 40 feet
3ST 1WN-20	Teflon Probe, 3-stranded, 1'' Tip, 20 feet
3ST 1WN-30	Teflon Probe, 3-stranded, 1'' Tip, 30 feet
3ST 1WN-35	Teflon Probe, 3-stranded, 1'' Tip, 35 feet
3ST 1WN-40	Teflon Probe, 3-stranded, 1'' Tip, 40 feet

Europe

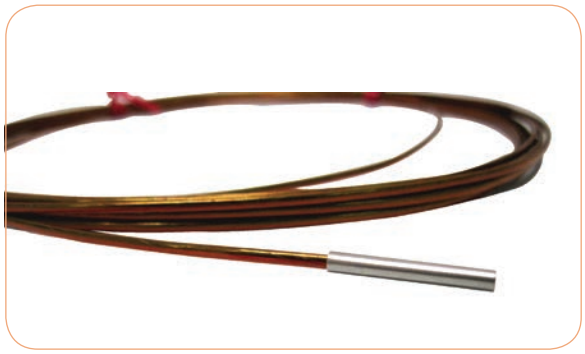
7ST1W-20N	Teflon Probe, 7-stranded, 1'' Tip, 6 m
7ST1W-27N	Teflon Probe, 7-stranded, 1'' Tip, 8 m
7ST1W-33N	Teflon Probe, 7-stranded, 1'' Tip, 10 m
7ST1W-40N	Teflon Probe, 7-stranded, 1'' Tip, 12 m
3ST1W-20N	Teflon Probe, 3-stranded, 1'' Tip, 6 m
3ST1W-27N	Teflon Probe, 3-stranded, 1'' Tip, 8 m
3ST1W-33N	Teflon Probe, 3-stranded, 1'' Tip, 10 m
3ST1W-40N	Teflon Probe, 3-stranded, 1'' Tip, 12 m

Ultra-Premium Type T Kapton® Thermocouples

The Kapton probes were specifically designed for extreme temperature in dry applications such as Depyrogenation Tunnels and high temperature ovens. The wire and probes are manufactured using our Ultra-Premium grade wire providing an accuracy of 1.2°C @ 300°C.

The Kapton insulated probes are rated for use up to 360°C. The life expectancy of the Kapton insulation is rated for 3 months continuous use at 260°C and 6 days continuous use at 360°C. Each probe includes an argon welded tip encapsulated in a 3 mm stainless tip.

The probes contain an inner Teflon sleeve surrounding each wire which is then wrapped with a Kapton outer jacket. The Kapton probes cannot be used in moist applications and are really designed specifically for high temperature dry applications. The probes are available in our standard 7 strand configuration.



Typical applications

- Dry heat tunnels
- Ovens

Technical Details

- Stainless Steel tips - 3 mm diameter and Kapton® wire
- Accuracy of 1.2°C @ 300°C
- Max. Temperature 350°C for 6 days
- Continuous use up to 260°C for 3 months
- NO wet applications
- Available only as 7-stranded wire
- Available also with metal Labels
- Standard length of 6-8-10-12 m (EMEA)
- Standard length of 20-25-30-35-40 feet (US)

Standard Part Numbers

USA/Asia	
KW-20	Kapton Probe, 7 stranded, 20 feet
KW-25	Kapton Probe, 7 stranded, 25 feet
KW-30	Kapton Probe, 7 stranded, 30 feet
KW-40	Kapton Probe, 7 stranded, 40 feet
KW-60	Kapton Probe, 7 stranded, 60 feet

Europe	
KW-20	Kapton Probe, 7 stranded, 6 m
KW-27	Kapton Probe, 7 stranded, 8 m
KW-33	Kapton Probe, 7 stranded, 10 m
KW-40	Kapton Probe, 7 stranded, 12 m
KW-47	Kapton Probe, 7 stranded, 14 m

Thermocouples: Stainless Steel

Type T - Stainless Steel Mineral Insulated Thermocouple

Type T Thermocouple – Class A with temperature range of -200°C to 400°C with a 1 mm diameter for the stainless steel and a Teflon connection cable which allows maximum 100°C. The connection point of this thermocouple cannot be in the autoclave – only the stainless steel part of the Thermocouple is allowed in the autoclave.

Typical Applications:

- Freeze Dryer, Freezers, Liquid Nitrogen tanks
- Incubators, Autoclaves, Raining autoclaves

Technical Details

- Thermocouples with 1 mm diameter
- Temperature range from -200°C to 400°C
- Type T - Class 1 Quality
- Accuracy of ±0.5 between –40°C and 125°C
- ±0.004×T between 125°C and 350°C

Standard Part Numbers

Global Part Numbers:

KG-1SST-6-2-8M

Stainless Steel mineral insulated Thermocouple Type T

6m sensor / 2m cable / 8 m total length

1mm diameter / -200°C to 400°C / Class 1

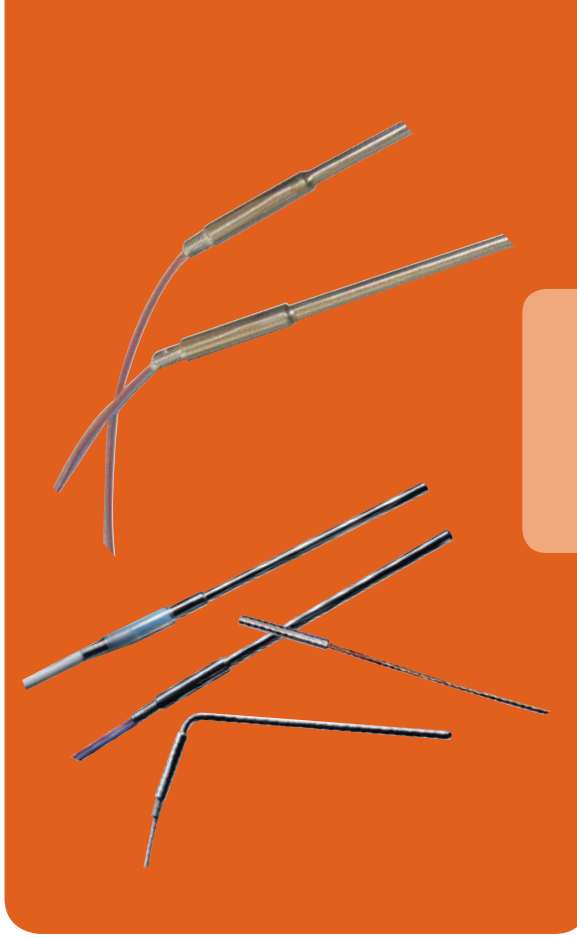
KG-1SST-6-6-12M

Stainless Steel mineral insulated Thermocouple Type T

6m sensor / 6m cable / 12 m total length

1mm diameter / -200°C to 400°C / Class 1

Thermocouples with Stainless Steel Tip



Type T - Stainless Steel Thermocouple Tips

The stainless steel probes are available in straight or right angle configurations with rounded or pointed tips, and are available in any length with diameters of 3.2 or 4.8 mm. Kaye probes are constructed of one continuous length of our Ultra-Premium wire, providing superior accuracy and eliminating errors inherent in other probes which have a wire transition between the stainless steel stem and the thermocouple extension.

Technical Details

- Thermocouple tips with 3.2 or 4.8 mm diameter
- Temperature range from -100°C to 200°C
- Accuracy of 0.25°C @ 121°C
- Straight or right angle stainless steel sensor
- Available as 3-stranded or 7-stranded wire

STAINLESS STEEL TEFLON PROBE

Part Number Matrix 7ST-20-L-S-4-P-W-Y

- Wire Length in feet
- Y for labels
N for no labels
- C for connector (EO739)
W for with out connector
V for mini conn. (E0749)
- P for pointed tip
F for flat tip
- Tip length in inches
- S for straight probe
B for 90 degree bend
- S for 1/8 inch dia. SS probe tube
- L for 3/16 inch dia. SS probe tube
- 7ST for Ultra Premium
7 Stranded K0255
- P7ST for Premium
7 Stranded K0254
- 3ST for Ultra Premium
3 Stranded (K0258)

Thermocouples Accessories

Thermocouple Wire Spools

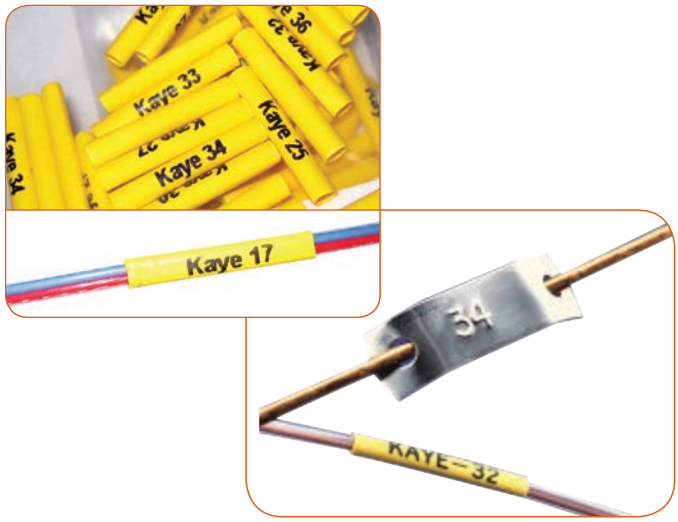
Kaye offers 1000 ft and 2000 ft spools of our Teflon, Autobond, and Kapton wire for those who wish to make probes themselves. The part numbers below show the available gauge and strand configurations. Each spool includes a Certificate of Conformance – your guarantee that it meets our accuracy specifications.

Global Part Numbers:

K0255-1	7-Stranded Premium Thermocouple Wire 1000 Spool
K0255-2	7-Stranded Premium Thermocouple Wire 2000 Spool
K0258-1	3 Stranded Premium Thermocouple Wire 1000 Spool
K0258-2	3 Stranded Premium Thermocouple Wire 2000 Spool
K0259-1	AUTOBOND 22 AWG Ultra Premium 7-strand wire in 1000 ft spool
K0259-2	AUTOBOND 22 AWG Ultra Premium 7-strand wire in 2000 ft spool
K0263-1	AUTOBOND 26 AWG Ultra Premium 7-strand wire in 1000 ft spool
K0263-2	AUTOBOND 26 AWG Ultra Premium 7-strand wire in 2000 ft spool
K0250-1000	Kapton Copper Wire Spool
K0250-2000	Kapton Copper Wire Spool

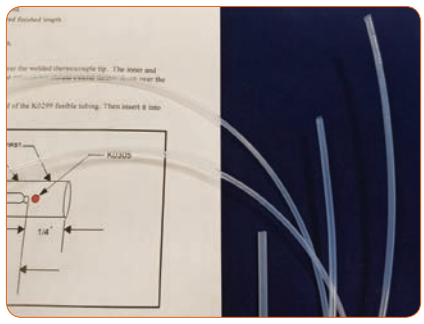
Thermocouple Labels

These labels make it easy to identify each thermocouple and document the qualification of chambers easily. You just add them on the Teflon®-Thermocouple and use a heat gun to shrink them onto the thermocouple cable. Set of 48 TCs - 2 numbers each.



Thermocouple Tip Kits

Extend the life of yourself welded thermocouples by encapsulating the tip in a sealed PTFE sleeve. The kit is available for 3- and 7-stranded Type T Teflon Thermocouple wire. Each kit provides material to make between 45 and 60 sensor tips.



Feedthru

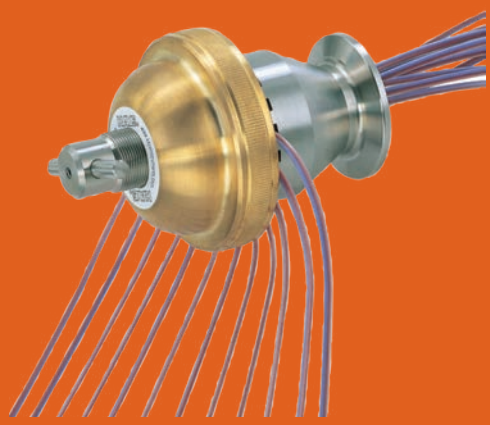
Feedthru for Autoclave Applications

Easy way to seal the autoclave port when introducing thermocouples into the chamber. Standard 1.5” TRI-CLAMP® process connection. Installation is simple with out the need of any tools, fitted with safety release mechanism.

Stainless steel thermocouple feedthru:

- Allows up to 18 thermocouples to be introduced into the validated chamber.
- Standard 1.5” TRI-CLAMP® process connection
- Fitted with safety release mechanism
- TÜV approved for up to 5 bar steam pressure
- Delivered with special gasket for great seal
- Improved design for use with autoclave
- Temperature up to 140°C

Part Number USA/Asia:	K0440
Part Number Europe:	KG-150

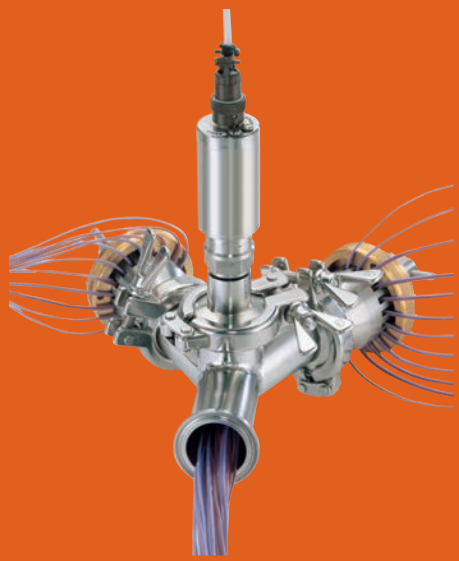


Feedthru-Kit for TCs and Pressure Sensor

This Feedthru-KIT is an ideal set if you have to qualify an autoclave which has for example only one 1.5” TRI-CLAMP® validation port but you need to use more than 18 thermocouples or you want to connect a pressure sensor as well to the autoclave. Simple installation is all you need to perform the work.

Feedthru kit contains the following parts:

- One 1 ½” Kaye Feedthru including gasket seals
- Stainless Steel Y-piece with 4 x 1.5” TRI-CLAMP® process connection
- TÜV approved for up to 5 bar pressure
- Delivered with 4 x TRI-CLAMPs®
- Delivered with 4 high temperature gaskets for autoclave
- Include as well 2 stainless steel lids for 1.5” TRI-CLAMP®
- Kit is delivered in a transport case



Part Number USA/Asia:	V2845
Part Number Europe:	KG-144

Y-Piece for Autoclave Applications

Ideal part if you have to qualify an autoclave which has only one 1.5” TRI-CLAMP® validation port but you need to use more than 1 feedthru or you want to connect a pressure transducer as well to the autoclave.

STAINLESS STEEL Adapter Y-Piece:

- Allows connecting of 2 Feedthru’s and a Pressure Transducer
- 4 x Standard 1.5” TRI-CLAMP® process connection
- Pressure tested up to 8 bar
- Leakage tested helium-vacuum-leak-detector (< 10-7 mbarl/s)

Part Number USA/Asia:	K0442
Part Number Europe:	KG-148

Smart Clamps and Smart Gaskets:

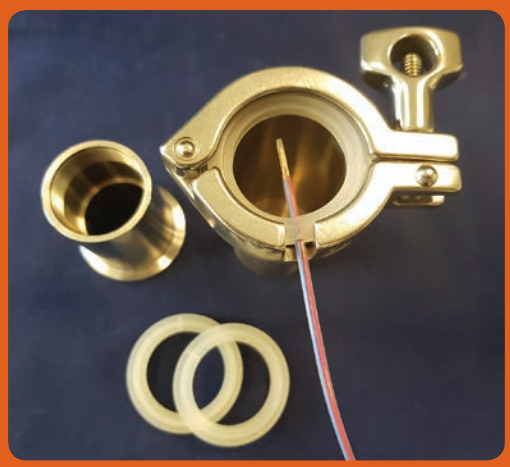
Smart Clamps

Part Number: K0448-1.5-2
Tri-Clamp with Dual Port for 1 & 1 ½“ sanitary fitting (50.5mm)

Smart Gaskets

Part Number: M1989-1.5-1
Gasket Silicone with Single Port for 1 ½“ sanitary fitting (50.5mm)

Part Number: M1989-1.5-2
Gasket Silicone with Dual Port for 1 ½“ sanitary fitting (50.5mm)



Pressure Transducer for Autoclaves

Comply with current standards to measure pressure in parallel to temperature when qualifying autoclaves. The pressure sensor is optimized to work with autoclaves and the Validator AVS or Validator 2000 - no power supply required.

Kaye Autoclave Pressure Transducer

- Media temperature -20°C to 140°C
- Accuracy of 10 mbar @ 121°C
- Pressure range 0 to 4 bar absolute
- Including cable to connect directly to Kaye Validator®
- Delivered in a protective carry case
- No power supply required
- Pressure value can be handled directly by the Validator®
- 1.5 inch TRI-CLAMP® Connector to install directly to the autoclave port
- Improved design for use with autoclave (temperature-compensated)
- New units delivered with certificate @ 23°C and 121°C

Global Part-Number: KG-075