Move into the future with reliable measurements

KYOWA

Encapsulated Gages

Strain Measurement in High Temperature Environment

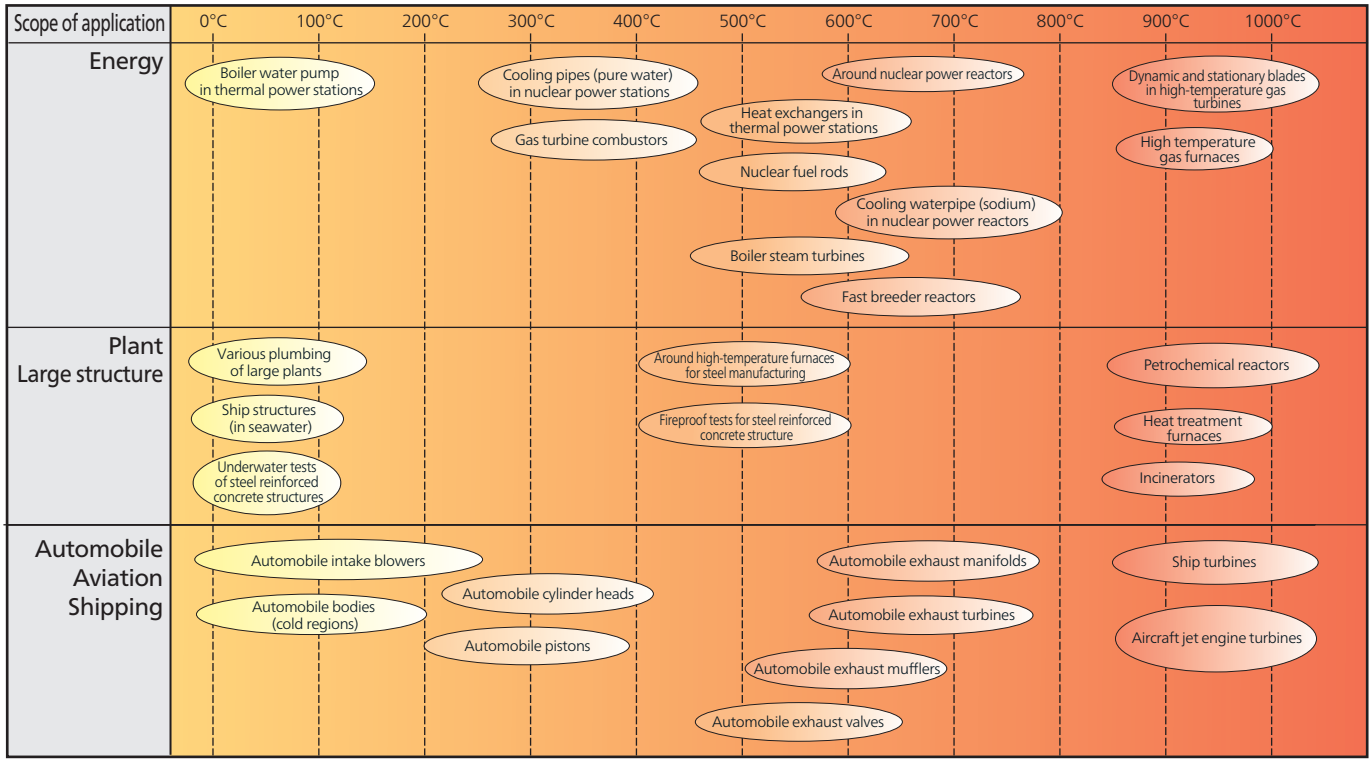
KVALITEST INDUSTRIAL

Encapsulated gage is a welded type strain gage with completely airtight structure. The product consists of a sensing part and a cable for outputting the signal output from the sensing part.
Sensing part is comprised of a flange and an environmentally resistant metallic tube with encapsulated gage and insulator. The sensing part can be fixed to the measurement material by spot welding.
Cables are made with an inorganic insulated MI cable (Mineral Insulated metal sheathed cable) in which a metal sheath is filled with heat resistant insulating material powder and a conductor is embedded inside.
Using the high-temperature model, strain measurement can be conducted even at harsh environment involving high temperature, high pressure, and high humidity.

Types and Typical Applications

Model	KHC	KHCM	KHCS	KHCR	KHCV	KHCX
Max. oprg. temp.*1	500°C/550°C	650°C	750°C	750°C	800°C	**950°C**
Temp. comp.*2	Yes				No	Yes
Measuring strain	Static/Dynamic				Dynamic	Static/Dynamic

*1 Max. oprg. temp.: Max. operating temperature
*2 Temp. comp.: Temperature compensation



Features of High-temperature Encapsulated Gages

Available for measurement under high-temperature and high pressure environments

The strain gage element is made by using heat-resistant special alloys.
The gage and lead wires are integrated in a hermetically sealed construction, allowing measurement in high-temperature, high-pressure, and seawater environments.

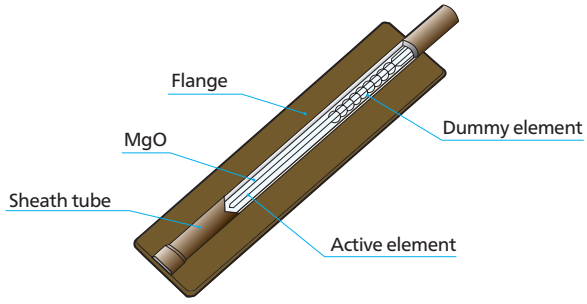
Able to be welded and easy handling at the measurement site

The gage can be mounted easily to the measurement material using spot welding, enabling measurement to be started immediately after installation

Highly accurate measurements can be undertaken

Thermally-induced apparent strain is virtually eliminated by the use of active-dummy system with a temperature-compensating dummy gage inside the sensing part, a sensing part with linear expansion coefficient suitable for the measurement material, and a temperature-compensating resistor that compensates for the apparent strain generated by the linear expansion coefficient of the lead-wire cable in the measurement temperature range. Highly accurate measurements can be undertaken.

*1 KHCV is designed specifically for dynamic strain, and does not have a temperature compensation function.
*2 KHCX comes in 11 and 13×10^{-6}/°C only.



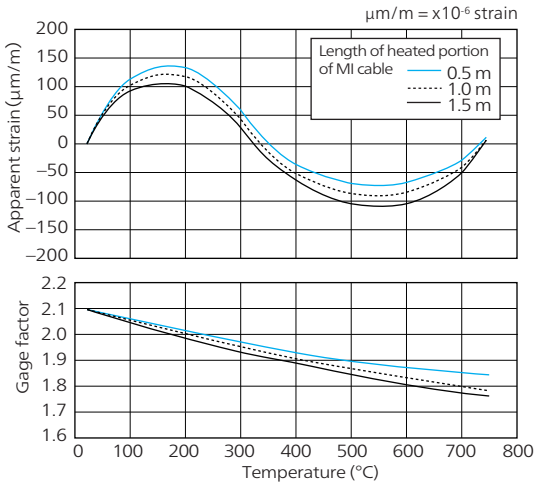
Gages with bridge adapter save labor and ensure high reliability

Eliminating the need for wiring to the temperature-compensating resistor.

Full-featured test data sheet

The test data sheet provided with the product includes resistance data to compensate for the temperature and zero point (bridge balance). If a temperature range and the length of the heated portion of the MI cable are other than specifications shown in the graph below, submit your requirement and we can provide estimated data and graphs on the change in thermally-induced apparent strain and the gage factor.

*KHCV: only the gage factor is changed.

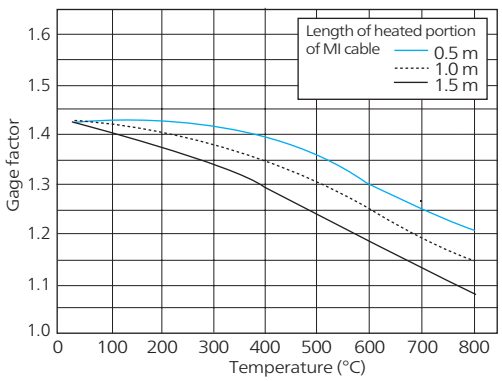


Estimated thermally-induced apparent strain and gage factor change (Example)

Approximately 50% improvement in gage factor (KHCV)

This is made possible through improved spot welding method and use of low resistance MI cable. We also achieved the gage resistance of 120 Ω at a gage length of 5 mm.

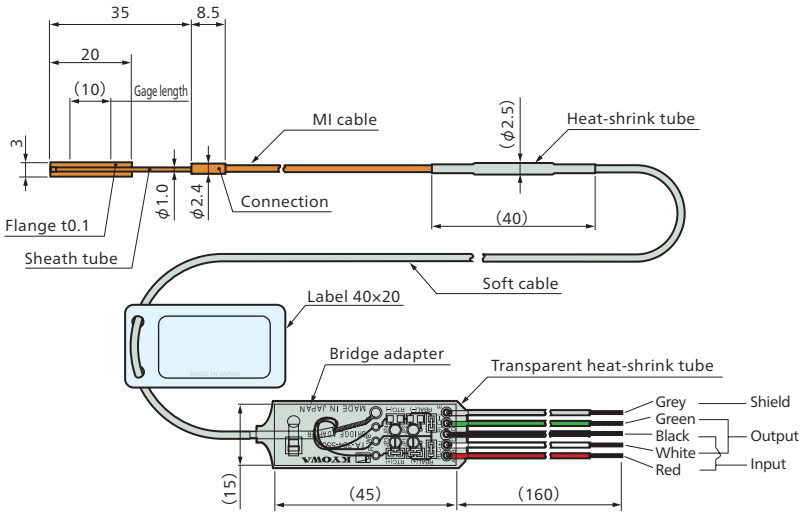
*In-house comparison



Thermally-induced gage factor change (Example)

KHCX

Static and Dynamic Up to 950°C High-temperature Encapsulated Gages



Specifications

Model For common steel	KHCX-10-120-G13-11 C2MV
For NCF 600 (Equivalent)	KHCX-10-120-G13-13 C2MV
Gage Length	10 mm
Gage Resistance	Approx. 120 Ω
Gage Type	Uniaxial 2-element temperature-compensation type
Gage Factor	Approx. 1.7 (Normal temperature)
(Sensing part only)	Approx. 1.5 (950°C)
Materials	
Resistive Element	Heat-resistant special alloy
Flange	NCF600 (Equivalent)
Sheath Tube	NCF600 (Equivalent)
Connection	NCF600 (Equivalent)
Lead-wire Cable	
MI Cable	ϕ1.6 mm×2 m, 3-Ni-conductor cable, NCF600-sheathed
Soft Cable	ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable
Applicable Linear Expansion Coefficients	11.7×10^{-6}/°C (KHCX...-11)
	12.6×10^{-6}/°C (KHCX...-13)
Operating Temperature	-196 to 950°C
Compensated Temperature	25 to 950°C
Thermally-induced Apparent Strain	The estimated curve is shown on the test data sheet.
Insulation Resistance	1000 MΩ or more (Normal temperature)
Maximum Safe Current	50 mA
Drift (Reference value)	Within ±20 μm/m/h (950°C)
Fatigue Life (Reference value)	1×10^{5} times (±100 μm/m, 950°C)
Minimum Installable Radius of Curvature	75 mm
Gage Installation Method	Spot welding
Compliance	2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following resistors are additionally provided.
- Temperature-compensation resistor
- Bridge-balance resistor

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

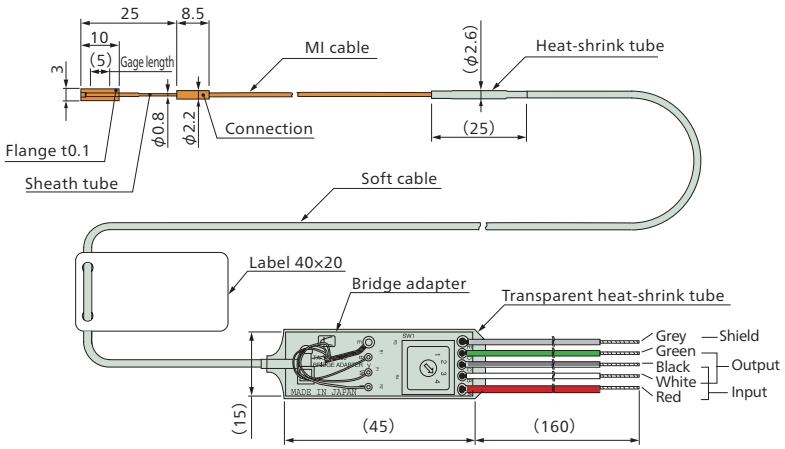
- Dynamic and stationary blades in high-temperature gas turbines
- Aircraft jet engine turbines
- Incinerators and heat treatment furnaces
- Petrochemical reactors
- Measuring physical characteristics of heat-resistant alloys, etc.

Precautions

- When equipped with a bridge adapter, the bridge adapter cord can be connected directly to the UCAM-550A terminal block. However, for CDV card of EDX etc., optional input cable must be used for connection.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.
- When attaching the sensing part, avoid excessive force applied to the sensing part. Do not bend the sensing part.
- We recommend measuring instrument with constant direct current. (UCAM-550A, CDV etc.)

KHCV

Dynamic Up to 800°C
High-temperature Encapsulated Gages



Specifications

Model	KHCV-5-120-G17 C2MV
Gage Length	5 mm
Gage Resistance	Approx. 120 Ω
Gage Type	Uniaxial 1-element
Gage Factor	Approx. 1.5 (Normal temperature)
(Sensing part only)	Approx. 1.2 (800°C)
Materials	
Resistive Element	Heat-resistant special alloy
Flange	NCF600 (Equivalent)
Sheath Tube	NCF600 (Equivalent)
Connection	NCF600 (Equivalent)
Lead-wire Cable	
MI Cable	ϕ1.0 mm×2 m, 3-Ni-conductor cable, NCF600-sheathed
Soft Cable	ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable
Applicable Linear Expansion Coefficients	-
Operating Temperature	25 to 800°C
Compensated Temperature	-
Thermally-induced Apparent Strain	-
Insulation Resistance	1000 MΩ or more (Normal temperature)
Maximum Safe Current	50 mA
Drift (Reference value)	-
Fatigue Life (Reference value)	1×10^6 times (±500 μm/m, 800°C)
Minimum Installable Radius of Curvature	15 mm
Gage Installation Method	Spot welding
Compliance	2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following parts are additionally provided.
- Capacitors (1, 2.2, 10 μF)
- Resistor (10 kΩ)

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

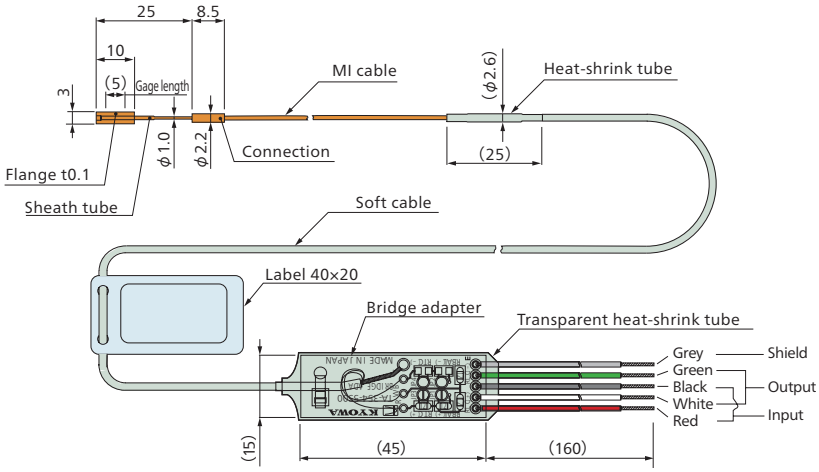
- Around nuclear power reactors
- Cooling waterpipe (Sodium) in nuclear power reactors
- Fast breeder reactors
- Automobile exhaust manifolds
- Automobile exhaust turbines

Precautions

- The KHCV is dedicated to dynamic strain measurements. Do not use it for static measurements.
- Use the DC-excited CDV signal conditioner as the measuring instrument.
- Models with bridge adapter can be connected by using the optional input cable.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.

KHCR

Static and Dynamic Up to 750°C High-temperature Encapsulated Gages



Specifications

Model	For common steel	KHCR-5-120-G16-11 C2MV
	For NCF 600 (Equivalent)	KHCR-5-120-G16-13 C2MV
	For stainless steel	KHCR-5-120-G16-16 C2MV
Gage Length		5 mm
Gage Resistance		Approx. 120 Ω
Gage Type		Uniaxial 2-element temperature-compensation type
Gage Factor (Sensing part only)		Approx. 1.5 (Normal temperature) Approx. 1.2 (750°C)
Materials		
Resistive Element		Heat-resistant special alloy
Flange		NCF600 (Equivalent)
Sheath Tube		NCF600 (Equivalent)
Connection		NCF600 (Equivalent)
Lead-wire Cable		
MI Cable		ϕ1.0 mm×2 m, 3-Ni-conductor cable, NCF600-sheathed
Soft Cable		ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable
Applicable Linear Expansion Coefficients		11.7×10^{-6}/°C (KHCR...-11) 12.6 ×10^{-6}/°C (KHCR...-13) 16.2 ×10^{-6}/°C (KHCR...-16)
Operating Temperature		25 to 750°C
Compensated Temperature		25 to 750°C
Thermally-induced Apparent Strain		The estimated curve is shown on the test data sheet.
Insulation Resistance		1000 MΩ or more (Normal temperature)
Maximum Safe Current		50 mA
Drift (Reference value)		Within ±20 μm/m/h (750°C)
Fatigue Life (Reference value)		1×10^{6} times (±500 μm/m, 750°C)
Minimum Installable Radius of Curvature		15 mm
Gage Installation Method		Spot welding
Compliance		2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following resistors are additionally provided.
- Temperature-compensation resistor
- Bridge-balance resistor

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

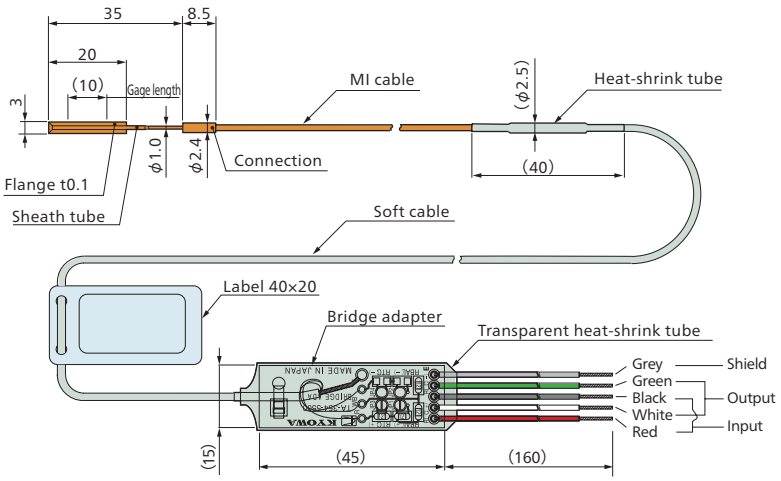
- Around nuclear power reactors
- Fast breeder reactors
- Automobile exhaust manifolds
- Automobile exhaust turbines
- Automobile exhaust mufflers

Precautions

- When equipped with a bridge adapter, the bridge adapter cord can be connected directly to the terminal block of the static strain measuring instrument such as UCAM.
  However, for dynamic strain measuring instrument such as EDX, optional input cable must be used for connection.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.

KHCS

Static and Dynamic Up to 750°C High-temperature Encapsulated Gages



Specifications

Model	For common steel	KHCS-10-120-G12B-11 C2MV
	For NCF 600 (Equivalent)	KHCS-10-120-G12B-13 C2MV
	For stainless steel	KHCS-10-120-G12B-16 C2MV
Gage Length		10 mm
Gage Resistance		Approx. 120 Ω
Gage Type		Uniaxial 2-element temperature-compensation type
Gage Factor (Sensing part only)		Approx. 2.1 (Normal temperature) Approx. 1.7 (750°C)
Materials		
Resistive Element		Heat-resistant special alloy
Flange		NCF600 (Equivalent)
Sheath Tube		NCF600 (Equivalent)
Connection		NCF600 (Equivalent)
Lead-wire Cable		
MI Cable		ϕ1.6 mm×2 m, 3-Ni-conductor cable, NCF600-sheathed
Soft Cable		ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable
Applicable Linear Expansion Coefficients		11.7×10^{-6}/°C (KHCS...-11) 12.6 ×10^{-6}/°C (KHCS...-13) 16.2 ×10^{-6}/°C (KHCS...-16)
Operating Temperature		-196 to 750°C
Compensated Temperature		25 to 750°C
Thermally-induced Apparent Strain		The estimated curve is shown on the test data sheet.
Insulation Resistance		1000 MΩ or more (Normal temperature)
Maximum Safe Current		50 mA
Drift (Reference value)		Within ±10 μm/m/h (750°C)
Fatigue Life (Reference value)		1×10^{6} times (±500 μm/m, 750°C)
Minimum Installable Radius of Curvature		20 mm
Gage Installation Method		Spot welding
Compliance		2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following resistors are additionally provided.
- Temperature-compensation resistor
- Bridge-balance resistor

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

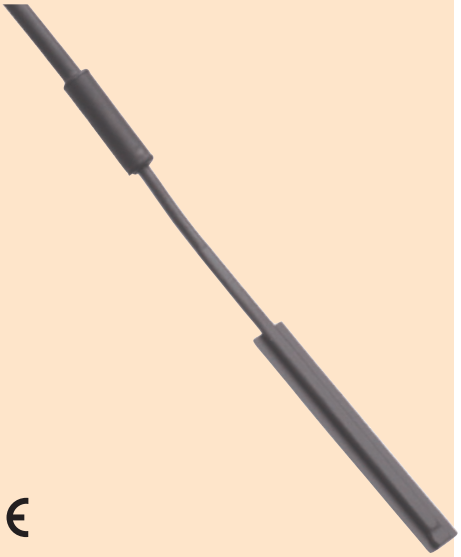
- Around nuclear power reactors
- Fast breeder reactors
- Automobile exhaust manifolds
- Automobile exhaust turbines

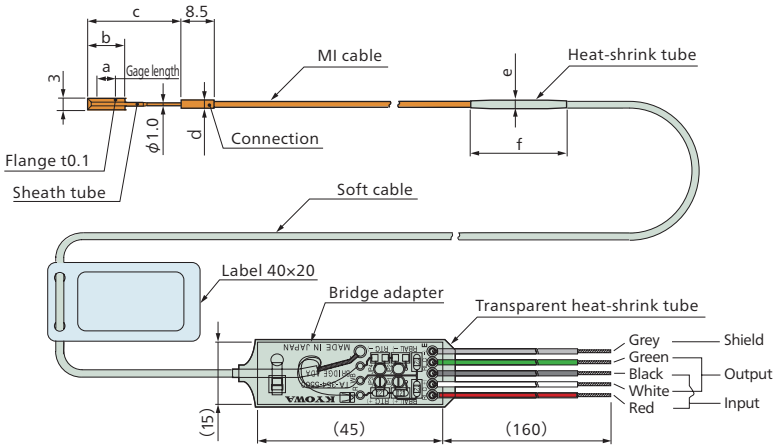
Precautions

- When equipped with a bridge adapter, the bridge adapter cord can be connected directly to the terminal block of the static strain measuring instrument such as UCAM.
  However, for dynamic strain measuring instrument such as EDX, optional input cable must be used for connection.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.

KHCM

Static and Dynamic Up to 650°C High-temperature Encapsulated Gages





Type	a	b	c	d	e	f
KHCM-10	(10)	20	35	ϕ2.4	(ϕ2.5)	(40)
KHCM-5	(5)	10	25	ϕ2.2	(ϕ2.6)	(25)

Specifications

		KHCM-10	KHCM-5
Model	For common steel	KHCM-10-120-G15-11 C2MV	KHCM-5-120-G15-11 C2MV
	For NCF 600 (Equivalent)	KHCM-10-120-G15-13 C2MV	KHCM-5-120-G15-13 C2MV
	For stainless steel	KHCM-10-120-G15-16 C2MV	KHCM-5-120-G15-16 C2MV
Gage Length		10 mm	5 mm
Gage Resistance		Approx. 120 Ω	
Gage Type		Uniaxial 2-element temperature-compensation type	
Gage Factor		Approx. 2.1 (Normal temperature)	Approx. 1.5 (Normal temperature)
(Sensing part only)		Approx. 1.8 (650°C)	Approx. 1.4 (650°C)
Materials			
Resistive Element		Heat-resistant special alloy	
Flange		NCF600 (Equivalent)	
Sheath Tube		NCF600 (Equivalent)	
Connection		NCF600 (Equivalent)	
Lead-wire Cable			
MI Cable		ϕ1.6 mm×2 m, 3-Cu-conductor cable, NCF600-sheathed	ϕ1.0 mm×2 m, 3-Cu-conductor cable, NCF600-sheathed
Soft Cable		ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable	
Applicable Linear Expansion Coefficients		11.7×10^{-6}/°C (KHCM...-11)	
		12.6 ×10^{-6}/°C (KHCM...-13)	
		16.2 ×10^{-6}/°C (KHCM...-16)	
Operating Temperature		-196 to 650°C	
Compensated Temperature		25 to 650°C	
Thermally-induced Apparent Strain		The estimated curve is shown on the test data sheet.	
Insulation Resistance		1000 MΩ or more (Normal temperature)	
Maximum Safe Current		50 mA	
Drift (Reference value)		Within ±10 μm/m/h (650°C)	Within ±20 μm/m/h (650°C)
Fatigue Life (Reference value)		1×10^{6} times (±500 μm/m, 650°C)	
Minimum Installable Radius of Curvature		20 mm	15 mm
Gage Installation Method		Spot welding	
Compliance		2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)	

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following resistors are additionally provided.
- Temperature-compensation resistor
- Bridge-balance resistor

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

- Thermal power plant heat exchangers
- Nuclear fuel rods
- Boiler steam turbines
- Around high-temperature furnaces for ironmaking
- Automotive exhaust valves
- Reinforced structure fire resistance tests

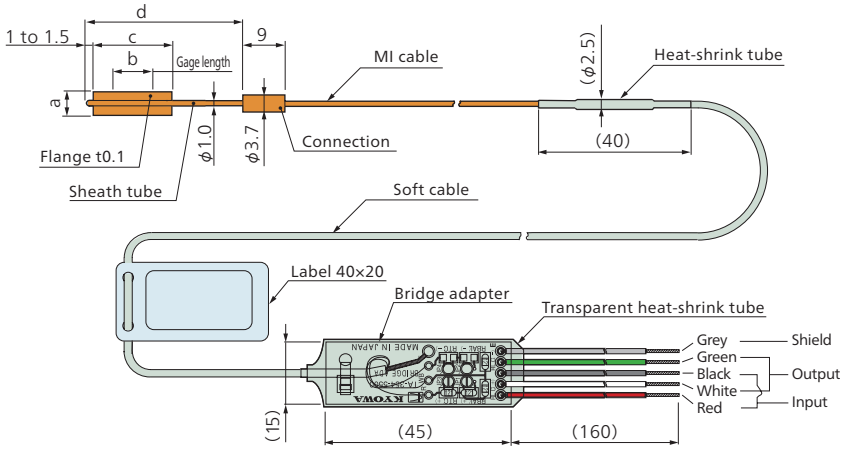
Precautions

- When equipped with a bridge adapter, the bridge adapter cord can be connected directly to the terminal block of the static strain measuring instrument such as UCAM.
  However, for dynamic strain measuring instrument such as EDX, optional input cable must be used for connection.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.

KHC

Static Up to 500°C and Dynamic Up to 550°C High-temperature Encapsulated Gages

CE



Type	a	b	c	d
KHC-20-120-G9	5	(20)	30	46
KHC-20-120-G8	4	(20)	30	46
KHC-10-120-G9	5	(10)	16.5	31.5
KHC-10-120-G8	4	(10)	16.5	31.5

Specifications

		KHC-20	KHC-10
Model	For common steel	KHC-20-120-G8-11 C2MV	KHC-10-120-G8-11 C2MV
	For NCF 600 (Equivalent)	KHC-20-120-G9-11 C2MV	KHC-10-120-G9-11 C2MV
	For stainless steel	KHC-20-120-G8-13 C2MV	KHC-10-120-G8-13 C2MV
		KHC-20-120-G9-13 C2MV	KHC-10-120-G9-13 C2MV
		KHC-20-120-G8-16 C2MV	KHC-10-120-G8-16 C2MV
		KHC-20-120-G9-16 C2MV	KHC-10-120-G9-16 C2MV
Gage Length		20 mm	10 mm
Gage Resistance		Approx. 120 Ω	
Gage Type		Uniaxial 2-element temperature-compensation type	
Gage Factor		Approx. 2.0 (Normal temperature)	Approx. 1.6 (Normal temperature)
(Sensing part only)		Approx. 1.85 (500°C)	Approx. 1.5 (550°C)
Materials			
Resistive Element		Heat-resistant special alloy	
Flange		NCF600 (Equivalent)(G8), SUS321(Equivalent)(G9)	
Sheath Tube		NCF600 (Equivalent)(G8), SUS321(Equivalent)(G9)	
Connection		NCF600 (Equivalent)(G8), SUS321(Equivalent)(G9)	
Lead-wire Cable			
MI Cable		ϕ1.6 mm×2 m, 3-Cu-conductor cable, NCF600-sheathed (G8)	
		ϕ1.6 mm×2 m, 3-Cu-conductor cable, SUS347-sheathed (G9)	
Soft Cable		ϕ1.7 mm×0.5 m, ETFE-coated 3-conductor shielded cable	
Applicable Linear Expansion Coefficients		11.7×10^{-6}/°C (KHC...-11)	
		12.6 ×10^{-6}/°C (KHC...-13)	
		16.2 ×10^{-6}/°C (KHC...-16)	
Operating Temperature		Static strain: 25 to 500°C, Dynamic strain: -196 to 550°C,	
Compensated Temperature		25 to 500°C	
Thermally-induced Apparent Strain		The estimated curve is shown on the test data sheet.	
Insulation Resistance		1000 MΩ or more (Normal temperature)	
Maximum Safe Current		30 mA	
Drift (Reference value)		Within ±20 μm/m/h (500°C)	
Fatigue Life (Reference value)		4×10^{5} times (±1000 μm/m, 25°C)	
Minimum Installable Radius of Curvature		25 mm	20 mm
Gage Installation Method		Spot welding	
Compliance		2011/65/EU,(EU)2015/863(10 restricted substances)(RoHS)	

(Reference value): The specifications are for reference purpose only. Actual values may vary depending on operating conditions including temperatures.

*Models with no bridge adapter are also available. Inquiries are welcome.

Standard Accessories

- MI cable fixing metal belt (Length: 100 mm, × 2)
- Metal piece for welding test (Length: 30 mm, × 2)
- Test data sheet
- Instruction manual
  For models with no bridge adapter, the following resistors are additionally provided.
- Temperature-compensation resistor
- Bridge-balance resistor

Options

- Bridge adapter (P. 9)
- Compression fitting (P. 9)
- MI cable (P. 10)

Optional Accessories

- Bridge box (P. 10)
- Compact spot welder GW-3C (P. 11)

Example Applications

- Nuclear power plant cooling pipes (Pure water)
- Gas turbine combustors
- Automotive cylinder heads
- Automotive pistons
- Automobile bodies (Cold regions)

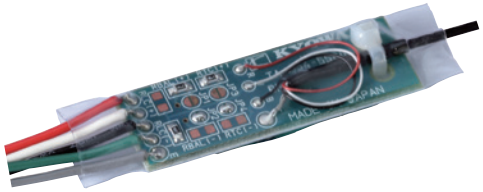
Precautions

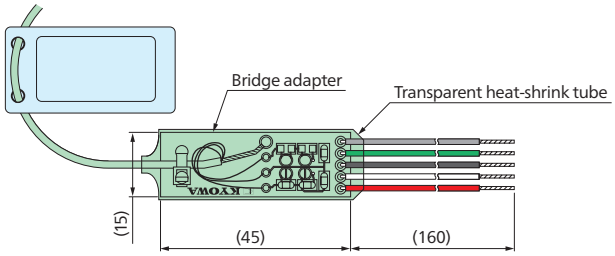
- When equipped with a bridge adapter, the bridge adapter cord can be connected directly to the terminal block of the static strain measuring instrument such as UCAM.
  However, for dynamic strain measuring instrument such as EDX, optional input cable must be used for connection.
- Models with no bridge adapter require an optional bridge box DB-120A (P. 10).
- Prior to use, "Features of High-temperature Encapsulated Gages" (P. 2) must be studied and items stated in “In Order to Use Encapsulated Gages Correctly” (P. 12) must be observed.

Options

Half Bridge Adapter

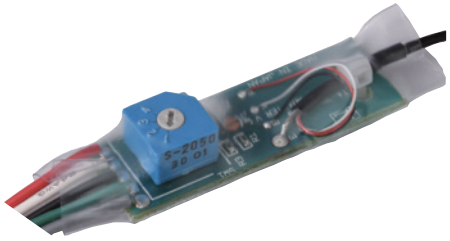
A temperature-compensated resistor suitable for the operating temperature range is mounted on the circuit board.
For prevent miswiring and to save labor, it is mounted to the soft cable then provide.

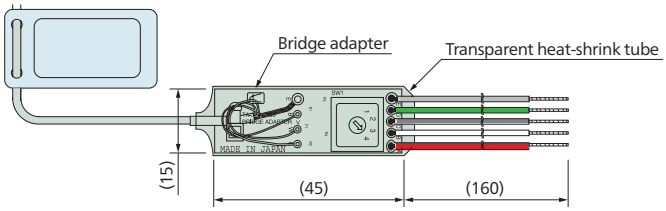




Quarter Bridge Adapter

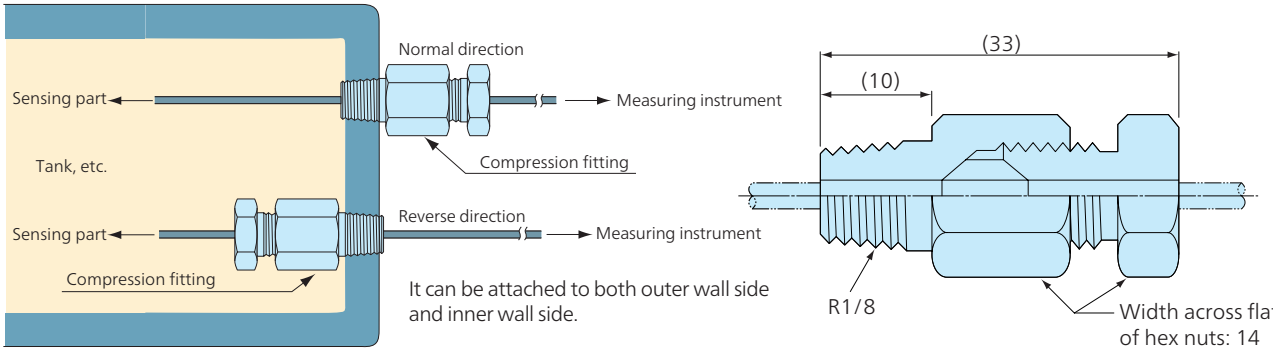
The dedicated bridge adapter for KHCV allows for easy selection of cut-off frequency (1.6, 7.23, 16 Hz, FLAT).
Able to be connected easily to the measuring instrument.





Compression Fitting

Upon your request, we will add compression fitting for attaching the MI cable.
Please let us know when ordering.



MI Cable

When ordering, specify the model number together with the code of the desired MI cable length, suffixed with a space in between. The suffix may include codes of the optional bridge adapter and compression fitting. (See below). In all cases, the length of the soft cable is 50 cm.
(For extension, contact us.)

Examples
- For KHCS with 5 m long MI cable
  KHCS-10-120-G12B-11 C5M
- For KHCS with 2 m long MI cable and bridge adapter pre-attached
  KHCS-10-120-G12B-11 C2MV

MI Cable Length	Code	With Bridge Adapter ①	With Compression Fitting ②	①+②
1 m	C1M	C1MV	C1MF	C1MFV
2 m (Standard)	C2M	C2MV	C2MF	C2MFV
3 m	C3M	C3MV	C3MF	C3MFV
4 m	C4M	C4MV	C4MF	C4MFV
5 m	C5M	C5MV	C5MF	C5MFV
6 m	C6M	C6MV	C6MF	C6MFV
8 m	C8M	C8MV	C8MF	C8MFV
10 m	C10M	C10MV	C10MF	C10MFV

Optional Accessories

Bridge Box DB-120A, DB-120L

Designed to configure a wheatstone bridge circuit with the encapsulated gage connected.

Products	Models	Channels	Sensor Connection Measuring Instrument Connection	Dimensions Weight
	DB-120A	1	Soldering, screwing Cable length: 5 m, terminated with a connector plug P12-7	Dimensions: 60 W × 42 H × 25 D mm Weight: Approx. 600 g (Including cable)
	DB-120L	1	Soldering Cable length: 5 m, terminated with a connector plug P12-7	Dimensions: 60 W × 22 H × 20 D mm Weight: Approx. 60 g (Excluding cable, etc.)

Compact Spot Welder GW-3C

Developed to install encapsulated gages and to fix high-temperature lead wires and thermocouples, the GW-3C is an easy-to-use welder allowing continuously variable setting of welding energy.

CE GW-3C: CE compliant models

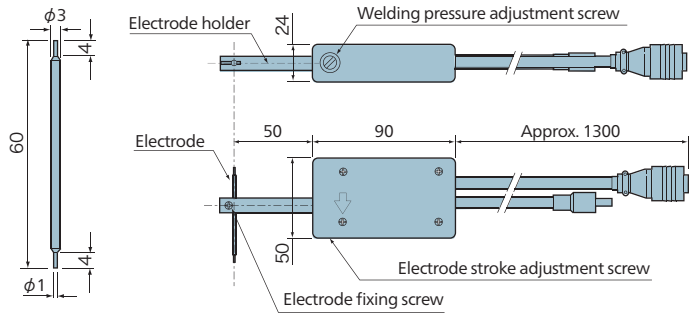
Features

- Welding current output is suitable for stainless steel, enabling welding of 0.3 mm thick stainless steel sheets.
- The electrode is 1 mm diameter at both ends.
- To enable optimum welding, energy is switchable between high and low ranges and is continuously variable in each range.
- An aluminum trunk is optionally available for transportation and storage.

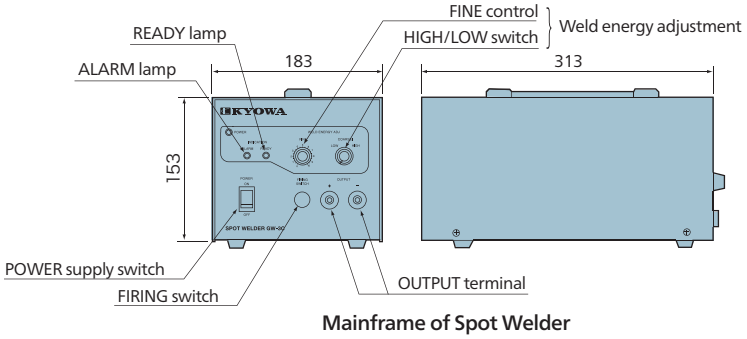
Specifications

Welding Energy	LOW: 0 to 25 Ws
	HIGH: 0 to 50 Ws
Welding Speed	1 Ws: 150 times/min. 5 Ws: 120 times/min. 10 Ws: 80 times/min.
	20 Ws: 60 times/min. 50 Ws: 30 times/min.
Operating Temperature	0° to 40°C
Operating Humidity	85% or less (Non-condensing)
Storage Temperature	-10° to 60°C
Power Supply	GW-3C: 100 VAC, 200 VA or less
	GW-3C M9: 220 VAC, 200 VA or less
	*115 VAC and 240 VAC models are available.
Dimensions	183 W × 153 H × 313 D mm (Excluding protrusions)
Weight	Approx. 9 kg (Main body)
Compliance	Directive 2014/30/EU (EMC)
	Directive 2014/35/EU (LVD)
	Directive 2011/65/EU, (EU)2015/863
	(10 restricted substances) (RoHS)

Dimensions



Electrode　　Square Welding Head



Mainframe of Spot Welder

Standard Accessories

- Square welding head (With cable approx. 1.3 m long)
- Grounding clip (With cable approx. 1.3 m long)
- Electrode (GW-02)
- Metal file
- Fuse (5 A)
- Hexagon wrench
- Instruction manual

Optional Accessories

- Aluminum trunk (GW-01)

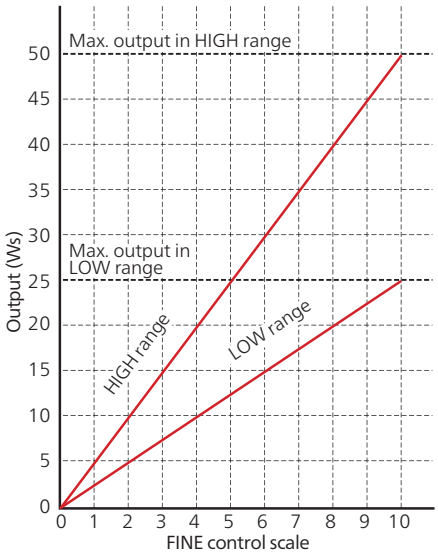
Precautions

Items stated in "In Order to Use Encapsulated Gages Correctly" (P. 12) must be observed.

Stainless steel sheet thickness and FINE control setting reference values

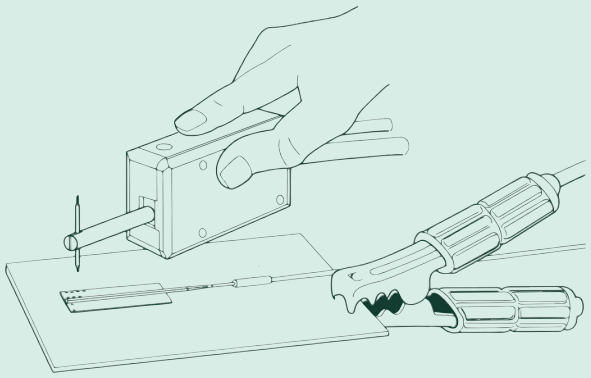
Stainless Steel Sheet Thickness (mm)	COARSE Range LOW	COARSE Range HIGH	Welding Energy (Ws)
	FINE Control		
0.1	2	1	5
0.2	6	3	15
0.3	—	6	30

Welding capability



Max. continuous usage shall not exceed the following:
- HIGH range and FINE5: 4 minutes continuous at 1 second interval using.
- LOW range and FINE10: 10 minutes continuous at 1 second interval using.

In Order to Use Encapsulated Gages Correctly



- To purchase an encapsulated strain gage, you must fill out the Encapsulated Strain Gage Measurement Conditions Confirmation and Order Approval Request Form.
- Be sure to read the instruction manual before use.
- Spot welding can be performed on ferrous materials, but cannot be performed on aluminum, copper, or ceramic materials.
- Surface treatment: Remove rust and paint from the surface of the measuring point by polishing with sandpaper (Around #320). Wipe away dirt and oil with a solvent such as acetone. While the flange is cleaned by sand-blasting at the factory, degrease it with acetone or something similar as required.
- Be sure not to cut the MI cable or make any hole on it. The insulating material filled in the cable may absorb moisture through a hole, thereby disabling measurement.
- To prevent the sensing part from any damage due to tension or twisting caused by the weight or handling of the MI cable, fix the connection between the sensing part and MI cable, and the MI cable at proper intervals using accessory metal belts. Then, spot-weld the flange. (Fig. 1)
- Apparent strain is generated when external pressure is applied.

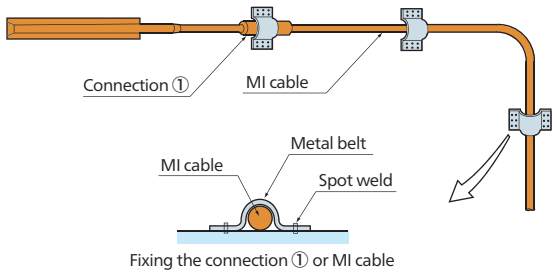


Fig. 1

- Spot-welding the flange: It is recommended to use Kyowa GW-3C compact spot welder.
  When spot welding the flange, temporarily weld the center point and then perform welding in the order shown in the figure. Standard welding conditions are as follows:
  Tip of electrode: 0.8 mm diameter
  Welding energy: Approx. 10 Ws
  Electrode pressing force: Approx. 10 N (Fig. 2)

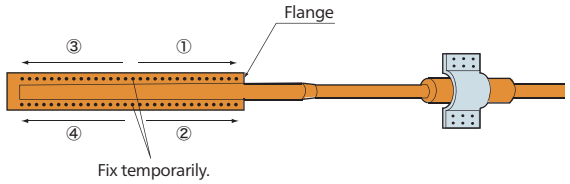
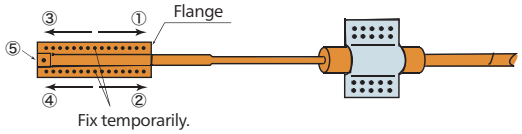


Fig. 2

Note) For KHCV, KHCR and KHCM-5, also spot weld the center tip. (Fig. 3)



Temporarily fix the flange at the center and then spot-weld it in order of ① to ⑤.
*⑤: For KHCV, KHCR and KHCM-5 only.

Fig. 3

- Spot-welding the flange to a curved surface:
  Before spot welding the flange, bend the flange along another curvature, such as a pipe, having the same radius of curvature as the material location. (Fig. 4)
  If the curvature radius and curved direction are specified when ordering, the gage will be delivered with the specified shape.

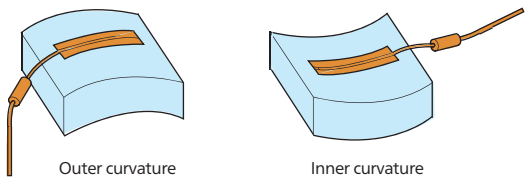
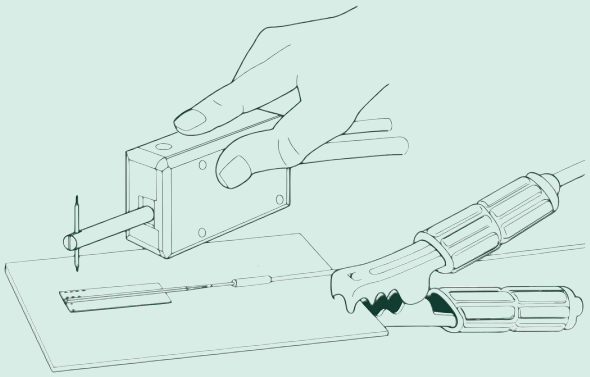


Fig. 4

Performing a Preliminary Test

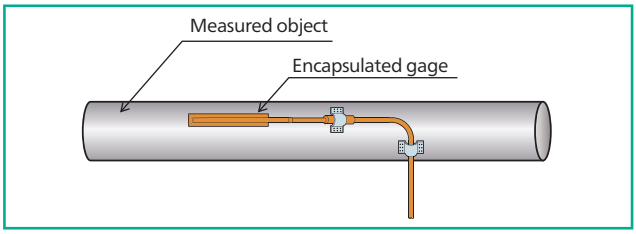


In order to improve accuracy of measurements, we recommend a preliminary test using the actual device followed by a calibration using the preliminary test result.

[Test example]

●Attaching the encapsulated gage

Follow the instruction manual to attach the encapsulated gage to the measured object.

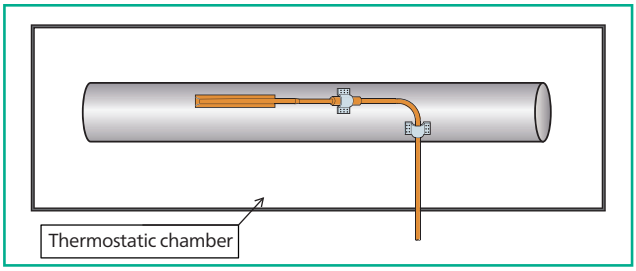


●Checking the zero temperature effect

Using a thermostatic chamber, check the apparent strain at the temperature of the actual test.

〈Precautions〉

When the encapsulated gage is welded to the measured object is subjected to the temperature rise and fall cycle, the state of attachment and/or spot welding may affect the output. This may result in fluctuation between the temperature rise and fall cycles or between the first cycle and second cycle onwards. The process may also produce residual output after the temperature returns to normal temperature. Although this thermal hysteresis generally decreases gradually through repetitive temperature cycles, the temperature drift may affect the output of the encapsulated gage itself through increase in the number of repetitive temperature cycles.



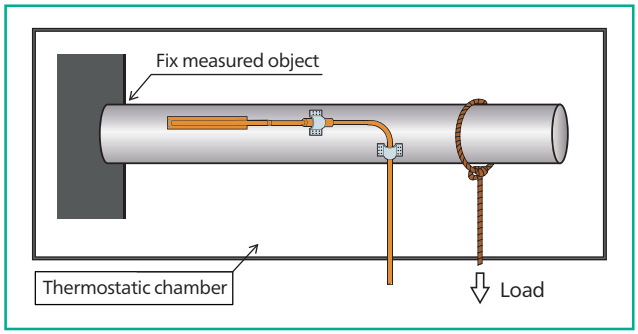
●Checking the gage factor

Check the output of the encapsulated gage against the strain of the measured object placed under load. Using a thermostatic chamber set to the temperature to be used in the actual test, the output of the encapsulated gage under load must be tested. The thermostatic chamber must be able to withstand the applied load.

The applied load should be appropriate for the deformation mode. A simulation must be performed in advance to estimate the deformation mode of the actual test.

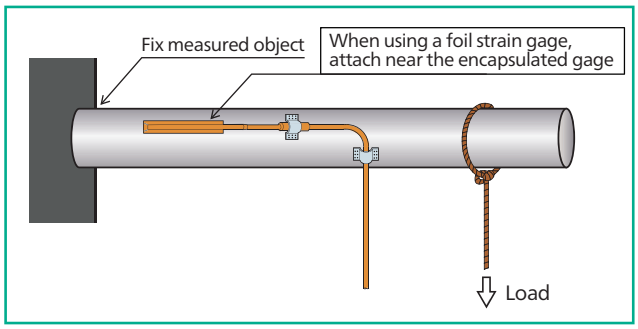
〈Precautions〉

Since the thickness of the measured object affects the measurement value, a calibration must be performed. At the measurement of bending strain, the measured value becomes larger than that of the actual strain. Thinner object has larger influence. In addition, the size of the measured object must be accounted for. This is due to the rigidity of the encapsulated gage itself losing its negligibility when the size the measured object is small. Under such condition, the surface strain of the area where the gage is attached can be affected because of the neutral axis of the measured object is shifted.



(Reference) Checking the gage factor at normal temperatures

When the above procedure for checking the output of the encapsulated gage under the load at the temperature of the actual test cannot be performed, first check the gage factor at normal temperature and then use the table on the test data sheet to estimate the gage factor at the temperature of the actual test. Alternatively, a foil strain gage can be used as a reference tool to check the gage factor at normal temperature. When a foil strain gage is used to check the gage factor, ensure the foil strain gage is removed before placing the measured object in the high temperature of the actual test.



●Checking apparent strain caused by pressure

When the ambient pressure of the actual test differs greatly from the atmospheric pressure, we recommend that the calibration of the gage meets the apparent strain caused by pressure. To perform this calibration, first remove the load applied to the measured object and then apply only the ambient pressure to check the apparent strain caused by pressure.

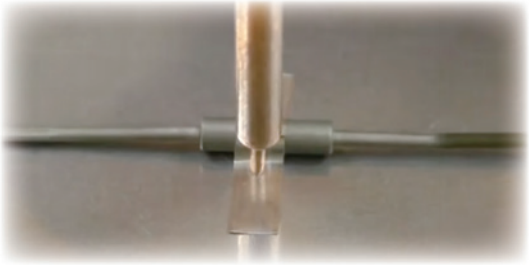
●Undertaking the actual test

After undertaking the actual test, perform calibration of the measurement data using the "zero temperature effect", "gage factor" and "apparent strain caused by pressure", which were obtained in the preliminary test.

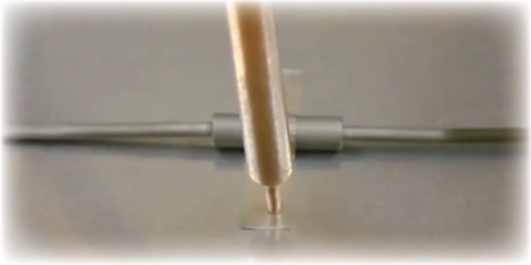
How to Secure Encapsulated Gage

Step 1 Secure the connector

●Push the electrode against the metal band and spot weld it

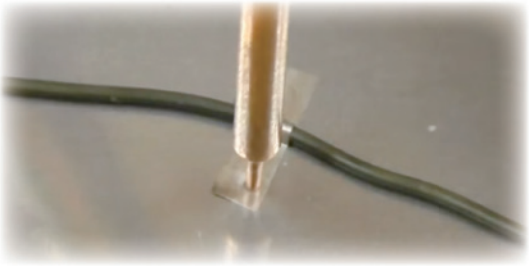


●Spot weld multiple locations to ensure that the connector does not move

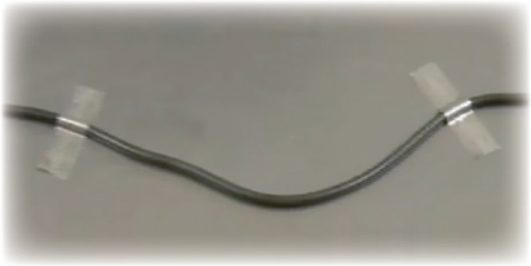


Step 2 Secure the MI cable

●Spot weld the curved metal band near the MI cable

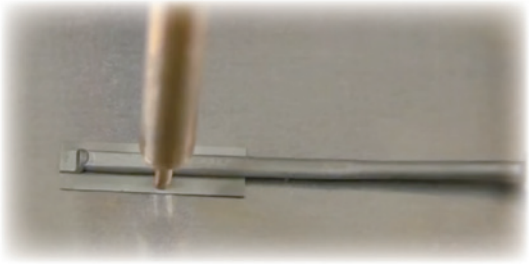


●Secure the S-shaped processed MI cable in multiple locations

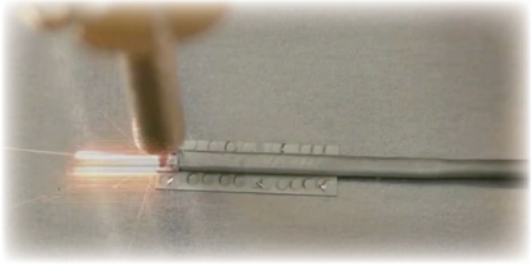


Step 3 Secure the sensing section

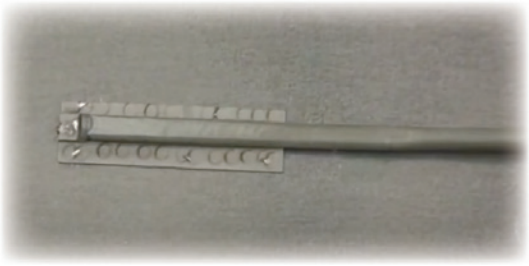
●Spot weld two locations in the center of the flange
●Spot weld at approximately 0.8 mm intervals from the center toward the edges



●Weld the flange tip
(KHCV, KHCR and KHCM-5 models only)



Secured gages



You can view a video showing how to secure the gage. Scan the right for details.

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⚠ Safety Precautions

Be sure to observe the safety precautions given in the instruction manual, in order to ensure correct and safe operation.

- Specifications and designs are subject to change without notice.
- Please contact us if using the detailed products for special applications.
- Detailed company and product names are the trademarks or registered trademarks of their respective owners.
- The warranty details can be found on the "Product Warranty" attached to the product and on the following website.
  www.kyowa-ei.com/eng/company/quality/warranty.html
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