KHCM Encapsulated High-Temperature Strain Gage INSTRUCTION MANUAL

1. Standard accessories

This product comes with the standard accessories listed below. When unpacking, be sure to check that all the accessories are included.

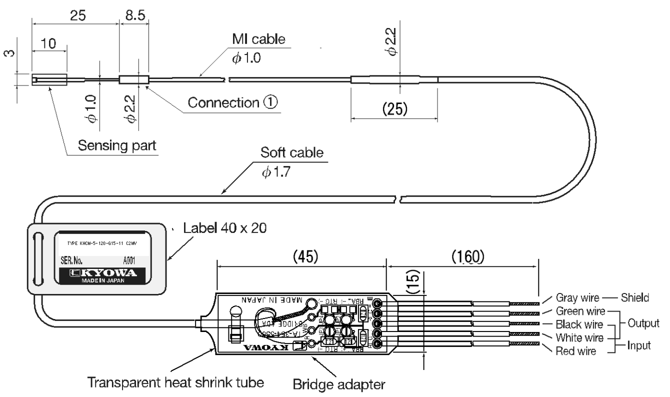
Metal belt (Ni-Cr, L100 x W3 x t0.05 mm)	2
Weld test metal piece (NCF600, L30 x W5 x t0.1 mm)	2
Test data sheet	1
Instruction manual	1

The gage with no bridge adapter attached is provided with following additional accessories.

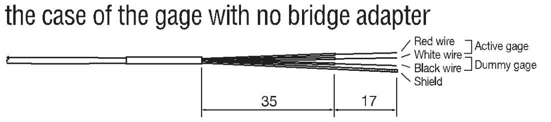
Temperature compensating resistor (R_{TC}: with red tube)	1
Temperature compensating resistor (R_{LC}: with no tube)	1
Balancing resistor (R_{BAL}: with white tube)	1

2. Parts identification and dimensions

KHCM-5

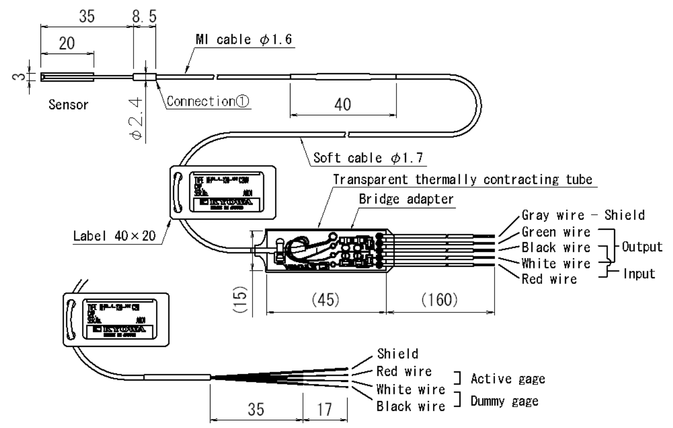


• In the case of the gage with no bridge adapter



(Unit:mm)

KHCM-10



(Unit:mm)

3. Handling precautions

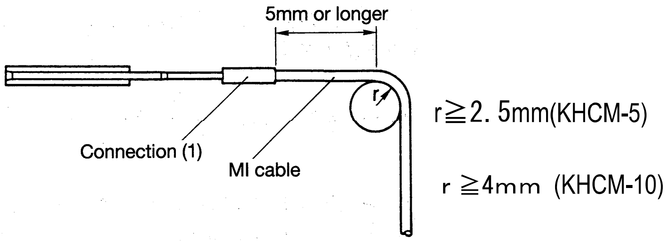
3.1 This gage is installed by spot welding. It is therefore installable to steel materials chiefly . It cannot be installed to aluminum or copper materials.

3.2 Maximum operating temperature is 650℃. Avoid using the gage at a temperature higher than maximum operating temperature.

3.3 Do not cut the MI cable halfway.

3.4 In order to avoid bending and twisting of the sheath tube, fix the MI cable using the accessory metal belt before installing the sensing part.

3.5 When the MI cable has to be bent, be sure that the corner is more than 5mm apart from connection (1), and the radius of curvature is larger than 2.5 mm(KHCM-5), 4 mm(KHCM-10).



3.6 It is recommended to use the KYOWA GW-3C spot welder.

3.7 Use DB-120A with the gage no bridge adapter attached.

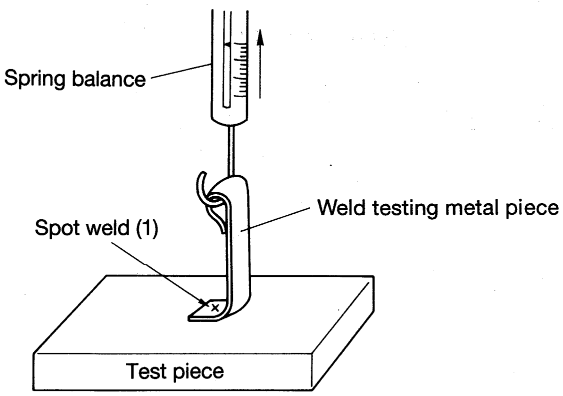
3.8 The cable tip of the product is assembled with the Lead-free solder. Be sure to use the Lead-free solder (Sn96.5%, Ag3%, Cu0.5%) when soldering the cable.

4. Installation

4.1 Spot-welding requirements

Welding energy :	Approx. 10W・s
Electrode pressing force :	Approx. 10N (Ref. 1kgf)
Diameter of electrode tip :	Approx. 0.8 mm
Welding strength :	15N or higher (Ref. 1.5kgf or higher)

Measure welding strength using the accessory weld testing metal piece as illustrated below.



Where no spring balance is available….

Pull the weld testing metal piece with a pair of pliers or the like. If a hole is thus made in the metal piece while the spot weld remain on the test piece, the welding strength satisfies the requirement for strain measurement.

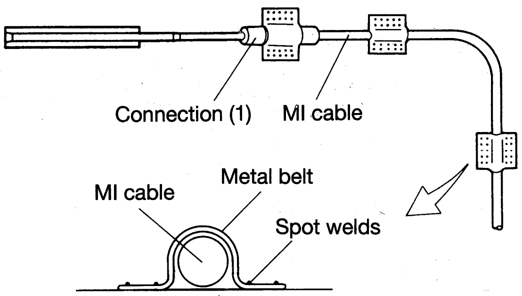
4.2 Prepare the surface of measuring object

Polish the surface of the measuring object using sandpaper (#320 or thereabouts). Remove dust, oil, etc. with a solvent such as acetone. Stained measuring object or electrode tip may cause lots of sparks during spot welding, thereby damaging the gage and electrode.

4.3 Fix the MI cable

a. Set the sensing part in place on the measuring object.

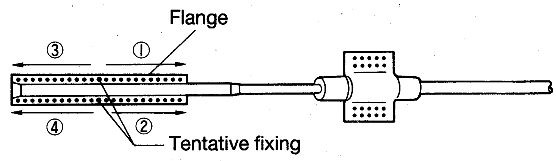
b. Using the accessory metal belt and spot weld, fix the connection (1) and the MI cable. While welding, be sure to use protective glasses to keep burning materials out of the eye.



4.4 Install the sensing part

a. Temporarily fix the sensing part by welding 2 spots at the center of the flange.

b. Spot weld the flange to measuring object in the order of ① to ④ from the center to the end of flange at intervals of 0.7 to 0.8mm.



Note) Welding energy setting conditions of GW-3C spot welder

Welding position	Setting		Welding energy
	COARSE	FINE	
① to ④	LOW	5	12.5 W・s
⑤	HIGH	3	15 W・s

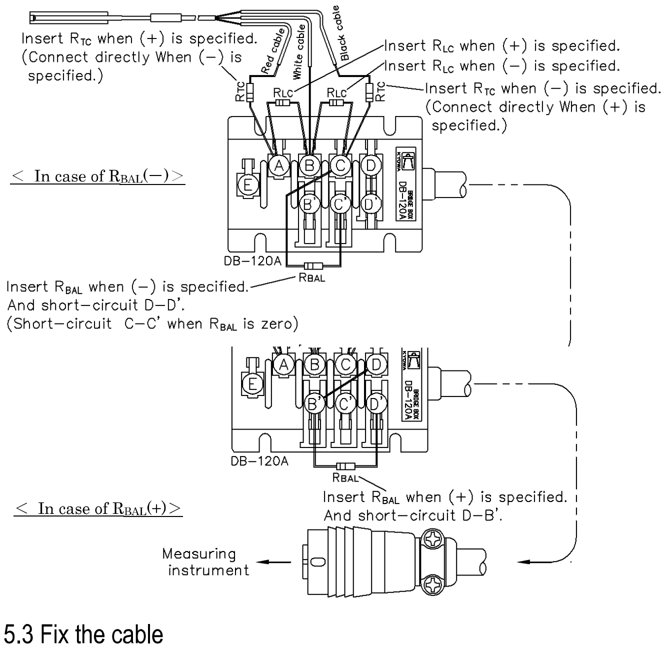
5. Connection with the measuring instrument

5.1 In the case of the gage with bridge adapter attached

For static strain measurement, connect the wires of the bridge adapter to the measuring instrument such as UCAM-60B/65B. For dynamic strain measurement, connect the wires of the bridge adapter to the wires of the optional input cable (U-21 to U-24), color to color, and cover the connection with vinyl tape or the like for insulation. Then, connect the cable plug to measuring instrument such as EDX-100A. For caution's sake, the gray wire should not be connected to the shield wire.

5.2 In the case of the gage with no bridge adapter attached

As shown below, connect the wires of the soft cable to the DB-120A and insert 3 accessory resistors. Then, connect the wires of the adapter to the measuring instrument. Then inserting resistor positions are stated in the test data sheet.



5.3 Fix the cable

Fix the MI cable. Do not move it after fixing. The Zero point may drift, when the MI cable is moved during measurement.

6. Conversion

Using the equation below, obtain the stress-initiated strain from a strain reading on the measuring instrument.

$$\varepsilon_{A(T)} = [\,\varepsilon_{B(T)} - \varepsilon_{C(T)}\,] \times [\,2 / Ks_{(T)}\,] \qquad \ldots\ldots(1)$$

where,

$\varepsilon_{A(T)}$: Stress-initiated strain at temperature T
$\varepsilon_{B(T)}$: Strain reading at temperature T
$\varepsilon_{C(T)}$: Thermally-induced apparent strain at temperature T
$Ks_{(T)}$: Gage factor at temperature T

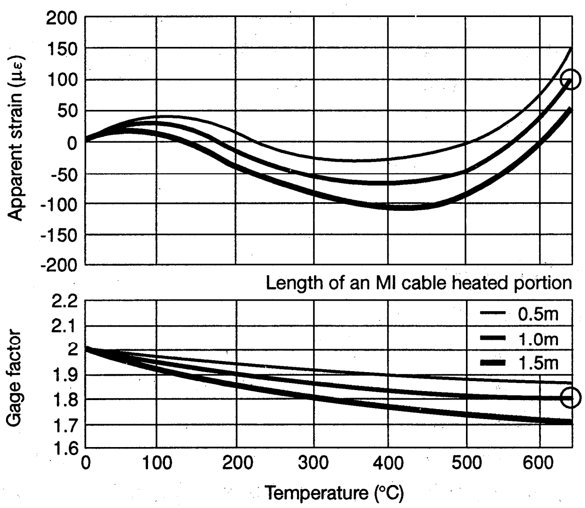
Obtain $\varepsilon_{C(T)}$ and $Ks_{(T)}$ from the test data sheet.

How to obtain Ks and ε_C

(1) Referring to the graph on the test data sheet, find the gage factor Ks and thermally-induced apparent strain ε_C of the overall gage from the sensing part temperature and the length of MI cable heated to the same temperature as the sensing part.
Depending on the location, the temperature of the MI cable changes. Convert the length of MI cable as same temperature as the sensing part.

(2) Overall gage factor can also be obtained using the equations stated on the test data sheet.
Linear expansion coefficient matching the measurement application is calculated as the equation “K” described on the test data sheet. Use the exact linear expansion coefficient when you know it. So, it is needless to use the equation “K”.

Example) In case of KHCM
Sensing part temperature: 650°C
Length of heated MI cable: 1.0 m
Strain reading ε_B at 650°C: 550 με (μm/m)



From the graph, ε_C and Ks at 650°C can be obtained as follows:

$\varepsilon_{C(650)}$: +100με (μm/m)
$Ks_{(650)}$: 1.8

Accordingly, the stress-initiated strain ε_A at 650°C can be obtained using the equation (1) as follows:

$$\varepsilon_A(650) = [\,550 - 100\,] \times [\,2 / 1.8\,] = 500\ \mu\varepsilon\ (\mu m/m)$$

7. Specification

Item \ Model	KHCM-10-120-G15	KHCS-10-120-G12B
Maximum Operating Temperature:	650°C	750°C
Compensated Temperature Range:	25 to 650°C	25 to 750°C
Gage Factor (Sensing Part Only) :	Approx. 2.1 (Normal Temp.)	
	Approx. 1.8 (650℃)	Approx. 1.7 (750℃)
Insulation Resistance:	1000MΩ or More (at Room Temp.)	
	1MΩ or More (650°C)	50kΩ or More (750°C)

Gage Type:	2-element, Temperature Compensation Type
Material of Resistive Element:	Heat Resisting Special Alloy Wire
Gage Resistance:	Approx. 120Ω
Gage Length:	10mm
Applicable Linear Expansion Constant:	11,13,16×10^{-6}/°C ---- 3 kinds
Lead Wire Cable (MI Cable):	3- conductor MI Cable, 1.6mm diameter by 2m long at standard
Lead Wire Cable (Soft Cable):	3- conductor Fluoroplastic Shielded Cable, 1.7mm Diameter by 50cm Long at Standard
Material of Flange and Tube:	NCF600(Equivalent)
Maximum Safe Current:	50mA
Minimum Installable Radius of Curvature:	20mm
Gage Installation Method:	Spotwelding
Compliance:	Directive 2011/65/EU,(EU)2015/863 (10 restricted substances) (RoHS)

Actual Values at High Temp. (for Reference Purpose Only)

Drift: (650°C:KHCM,750°C:KHCS)	±10 με(μm/m)/h or Less
Fatigue Life: (650°C:KHCM,750°C:KHCS)	1×10^6 times or More. (±500 με (μm/m))

The specifications are for reference purpose only.
Actual values may vary depending on operating conditions including temperatures.