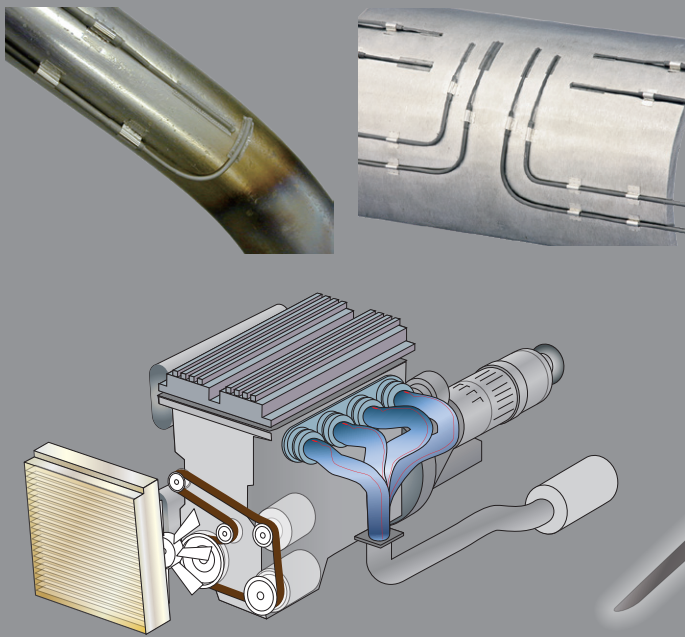


AW Series

Weldable strain gauge



Capable of measuring static and dynamic strain in high temperature range

Can be mounted in narrow or curved areas

Sealed structure made of a special alloy with excellent corrosion resistance

Various measurement applications are available (optional)

Compact base (min. L10 x W3 mm)




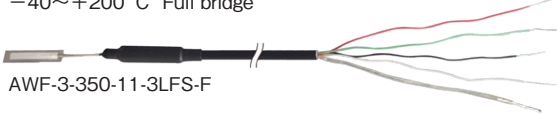



AWM·AWMD·AWH·AWHU·AWC·AWF·AW

These strain gauges have strain sensing elements fully encapsulated in corrosion-resisting metal tubes made of stainless steel or Inconel (except AW-6-350). The strain gauge backings are also made of the same material, and the gauges are installed by spot welding to metal specimens using a dedicated spot welder.

Spot welding

The W-50RC is a charge discharge type spot welder designed to minimize thermal damage to the metal material being measured. Welding energy is not affected by fluctuations in the power supply because of the stabilizing circuit.

Type

<p>AWM -196~+300° C Quarter bridge 3-wire</p>  <p>CE</p> <p>AWM-8-1A Gauge base : Inconel 600 AWM-8-1B Gauge base : SUS304</p>	<p>AW-2/ AW-6 -196~+300° C Quarter bridge 3-wire</p>  <p>CE</p> <p>AW-2-350-11-4FB01LT AW-6-350-11-4FB01LT AWCA-6-350-11-4FB01LT AWRA-6-350-11-4FB01LT</p>
<p>AWMD -196~+800° C for dynamic strain Full bridge</p>  <p>CE</p> <p>AWMD-5 Gauge base : Inconel 600 AWMD-8 Gauge base : Inconel 600</p>	<p>AWF -40~+200° C Full bridge</p>  <p>CE</p> <p>AWF-3-350-11-3LFS-F</p>
<p>AWH -196~+600° C for static strain Full bridge -196~+650° C for dynamic strain</p>  <p>CE</p> <p>AWH-4-7A/AWH-8-7A Gauge base: Inconel 600 AWH-4-7B/AWH-8-7B Gauge base: SUS304</p>	<p>AWC -20~+100° C Quarter bridge 3-wire</p>  <p>CE</p> <p>AWC-8B-11-3LTSB</p>
<p>AWHU -196~+800° C Full bridge</p>  <p>CE</p> <p>AWHU-5 Gauge base: Inconel 600 AWHU-8 Gauge base: Inconel 600</p>	

AW series coding system

①	②	③	④	⑤	⑥	⑦	⑧
AWM	-8	-1	B		-2		-17.0
AWMD	-5	-	A	KM	-2	(6F)	-1.6Hz*
AWMD	-8	-	A		-2		-1.6Hz*
AWH	-8	-7	A		-2		-11.0
AWHU	-5	-9	A	KM	-2	(6F)	-12.7

*: High-pass filter only for AWMD Either one available among 1.6, 7.2 or 16Hz.

①Type	②Gauge length	③Temperature compensation range	④Gauge base ^{*1}	⑤Option		
AWM : static/dynamic 300°C	8 : 8mm	0 : -196°C~ RT 1 : RT ~+300°C	A : Inconel 600 Applicable thermal expansion coefficient of 11ppm/°C or closer B : SUS304 Applicable thermal expansion coefficient of 17ppm/°C or closer	E: Ground earth F: Compression fittings K: Narrow gauge width W=3mm (excluding AWHU) M: Small junction type of sleeve B Φ 2.0mm L=20mm AWHU and AWMD-5 are normally provided with small junction P: NDIS type plug attached ^{*2} R: Bend of gauge backing or pipe Z: Filter-less (AWMD)		
AWMD : dynamic only 800°C	5 : 5mm 8 : 8mm	2 : RT ~+350°C 3 : RT ~+400°C 4 : RT ~+450°C				
AWH : static 600°C dynamic 650°C	4 : 4mm 8 : 8mm	5 : RT ~+500°C 6 : RT ~+550°C 7 : RT ~+600°C 8 : RT ~+650°C 9 : RT ~+800°C 10 : Others				
AWHU : static/dynamic 800°C	5 : 5mm 8 : 8mm	NB1: Dynamic use AWMD is not applicable. NB2: RT Room temperature				
⑥MI cable	⑦Supplied cable length				⑧Temperature compensation materials or High-pass filter	
2 : Φ 1.6mm 2m Core cable of heat-resistive copper	No marks: Φ 4.1mm shielded vinyl cable of 0.5m Except for standard length, required length is given in bracket Example: 4.5m long to (4.5) (6F): Φ 1.6mm shielded fluoroethylene propylene cable (FEP) of 0.5m for AWHU-5/-8, AWMD-5 Except for standard length, required length is given after suffix 6F. Example: 4.5m long to (6F4.5)				Materials available for temperature-compensation 10.9: SUS430 or equivalent 11.0: Mild steel (ferritic) or equivalent 12.7: INCONEL 600 or equivalent 17.0: SUS304 or equivalent High-pass filter for only AWMD 1.6Hz 7.2Hz 16Hz	

*1: Select code A for thermal expansion coefficient of 11ppm/°C or closer, or B for coefficient of 17ppm/°C

*2: For option code P, NDIS plug is attached to the end of cables following Temperature-compensation board or High-pass filter.

AWM/AWMD

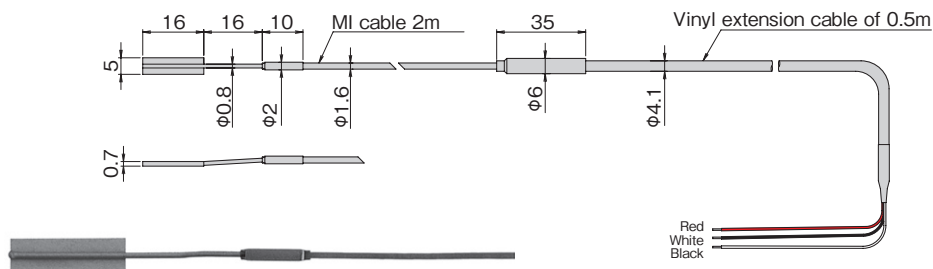
AWM-8

The AWM is usable up to 300° C for both static and dynamic strain measurement. The backing material is available in Inconel 600 or SUS304 which should be selected according to the test specimen material.

Type	Gauge length (mm)	Gauge base		Operating temperature (°C)	Temperature compensation range (°C)	Test specimen	Applicable coefficient of linear thermal expansion ($\times 10^{-6}/^{\circ}\text{C}$)	Resistance in (Ω)
		Dimension (mm)	Materials					
AWM-8-1A-2-11.0	8	L16xW5xT0.7	Inconel 600	For static/dynamic use -196~+300°C	Room-temperature ~ +300°C	Mild steel equivalent	11 $\times 10^{-6}/^{\circ}\text{C}$	120
AWM-8-1B-2-17.0			SUS304			SUS304 equivalent	17 $\times 10^{-6}/^{\circ}\text{C}$	

Leadwire 1.6 mm dia. MI cable 2 m, 4.1 mm dia. shielded vinyl cable 0.5 m (Quarter bridge with 3-wire)
Minimum order quantity is 1 strain gauge.

External dimensions



AWMD-5 / AWMD-8

The AWMD is applicable up to 800° C and it is dedicated to dynamic strain measurement. A high pass filter is a standard accessory. Using the high pass filter, unnecessary direct current component or low frequency component (thermal output, drift etc.) in the measurement signals can be neglected.

Type	Gauge length (mm)	Gauge base		Operating temperature (°C)	Temperature compensation range (°C)	Test specimen	Applicable coefficient of linear thermal expansion ($\times 10^{-6}/^{\circ}\text{C}$)	Resistance in (Ω)
		Dimension (mm)	Materials					
AWMD-5-AKM-2(6F)-1.6Hz*	5	L10xW3xT0.7	Inconel 600	for dynamic use -196~+800°C	N/A	Inconel 600 equivalent	12 $\times 10^{-6}/^{\circ}\text{C}$	60
AWMD-8-A-2-1.6Hz*	8	L16xW5xT0.7	Inconel 600					120

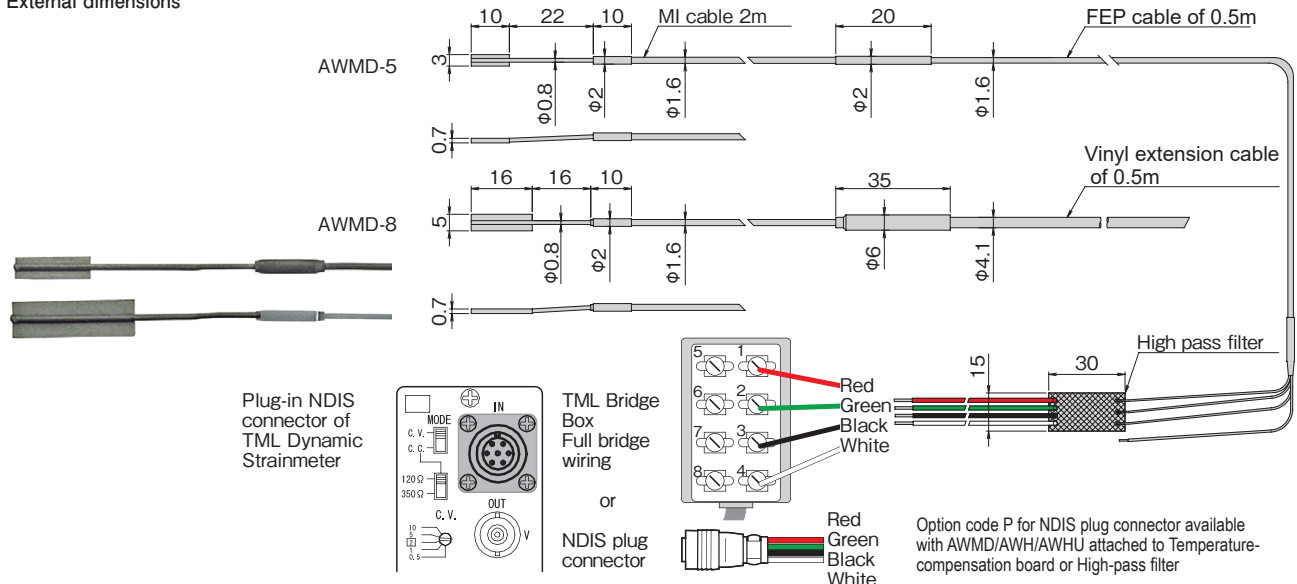
*High-pass filter only for AWMD Either one available among 1.6, 7.2 or 16Hz.

Leadwire AWMD-5 : 1.6 mm dia. MI cable 2 m, 1.6 mm dia. shielded fluorinated resin (FEP) cable 0.5 m (Full bridge)

AWMD-8 : 1.6 mm dia. MI cable 2 m, 4.1 mm dia. shielded vinyl cable 0.5 m (Full bridge)

Minimum order quantity is 1 strain gauge.

External dimensions



AWH/AWHU

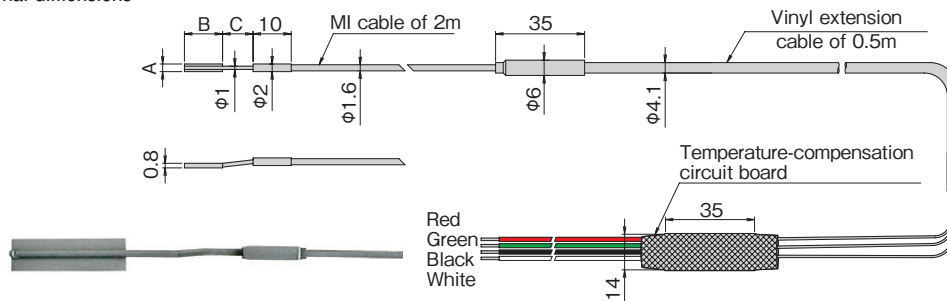
AWH-4 / AWH-8

The backing material of these gauges is available in either of Inconel 600 or stainless steel to be selected according to the material to be measured. The sensing part has half bridge configuration with active element and dummy element, and it is measured in full bridge method using the attached temperature compensation circuit board. This gauge is applicable to static measurement in temperature up to 600°C and applicable to dynamic measurement up to 650°C.

Type	Gauge length (mm)	Gauge base		Operating temperature (°C)	Temperature compensation range (°C)	Test specimen	Applicable coefficient of linear thermal expansion ($\times 10^{-6}/^{\circ}\text{C}$)	Resistance in (Ω)
		Dimension (mm)	Materials					
AWH-4-7A-2-11.0	4	L10xW3xT0.8	Inconel 600	static : -196~+600°C dynamic : -196~+650°C	static : RT~+600°C dynamic : N/A	Mild steel equivalent	$11 \times 10^{-6}/^{\circ}\text{C}$	60
AWH-4-7B-2-17.0			SUS304			SUS304 equivalent	$17 \times 10^{-6}/^{\circ}\text{C}$	
AWH-8-7A-2-11.0	8	L16xW5xT0.8	Inconel 600			Mild steel equivalent	$11 \times 10^{-6}/^{\circ}\text{C}$	
AWH-8-7B-2-17.0			SUS304					

Leadwire 1.6 mm dia. MI cable 2 m, 4.1 mm dia. shielded vinyl cable 0.5 m (Full bridge)
Minimum order quantity is 1 strain gauge.

External dimensions



Type	A	B	C
AWH-4	3	10	8
AWH-8	5	16	16

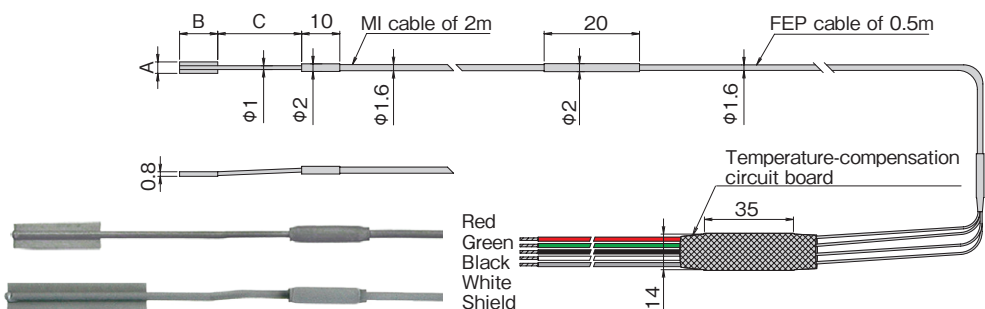
AWHU-5 / AWHU-8

These gauges can be used in temperature up to 800°C for both static and dynamic measurement. However, owing to the construction of the sensing element, measurement is recommended in temperature at 600°C or above. The sensing part has half bridge configuration with active element and dummy element, and it is measured in full bridge method using the attached temperature compensation circuit board. Since these gauges have small backings and thin sleeves and cables as standard specifications, they are applicable to narrow and/or curved areas.

Type	Gauge length (mm)	Gauge base		Operating temperature (°C)	Temperature compensation range (°C)	Test specimen	Applicable coefficient of linear thermal expansion ($\times 10^{-6}/^{\circ}\text{C}$)	Resistance in (Ω)
		Dimension (mm)	Materials					
AWHU-5-9AKM-2(6F)-12.7	5	L10xW3xT0.8	Inconel 600	For static/dynamic use -196~+800°C	Room-temperature ~ +800°C	Inconel 600 equivalent	$11 \times 10^{-6}/^{\circ}\text{C}$	60
AWHU-8-9AKM-2(6F)-12.7	8	L16xW3xT0.8						120

Leadwire 1.6 mm dia. MI cable 2 m, 1.6 mm dia. shielded fluorinated resin (FEP) cable 0.5 m (Full bridge)
Minimum order quantity is 1 strain gauge.

External dimensions



Type	A	B	C
AWHU-5	3	10	22
AWHU-8	3	16	16

Note

Our AWH and AWHU series strain gauges are adjusted to make the thermal output as small as possible in consideration of the material to be measured, the MI cable length and the range of measurement temperature. These strain gauges will be supplied on made-to-order basis except AWH-4-7A-2-11.0 and AWH-8-7A-2-11.0.

* Lead wire lengths other than the standard length are available on request. (Made to order: MI cable length is in increments of 1 meter. Vinyl cable length is in increments of 0.5 meters.)

AW-2-350/AW-6-350/AWCA-6-350/AWRA-6-350

These gauges have corrosion-resisting stainless steel backing with thickness of 0.08mm. They are easily installed by using the dedicated spot welder W-50RC. are suited for strain measurement in high temperature up to 300° C, for measurement of specimen to which adhesion is not applicable or for long term measurement.

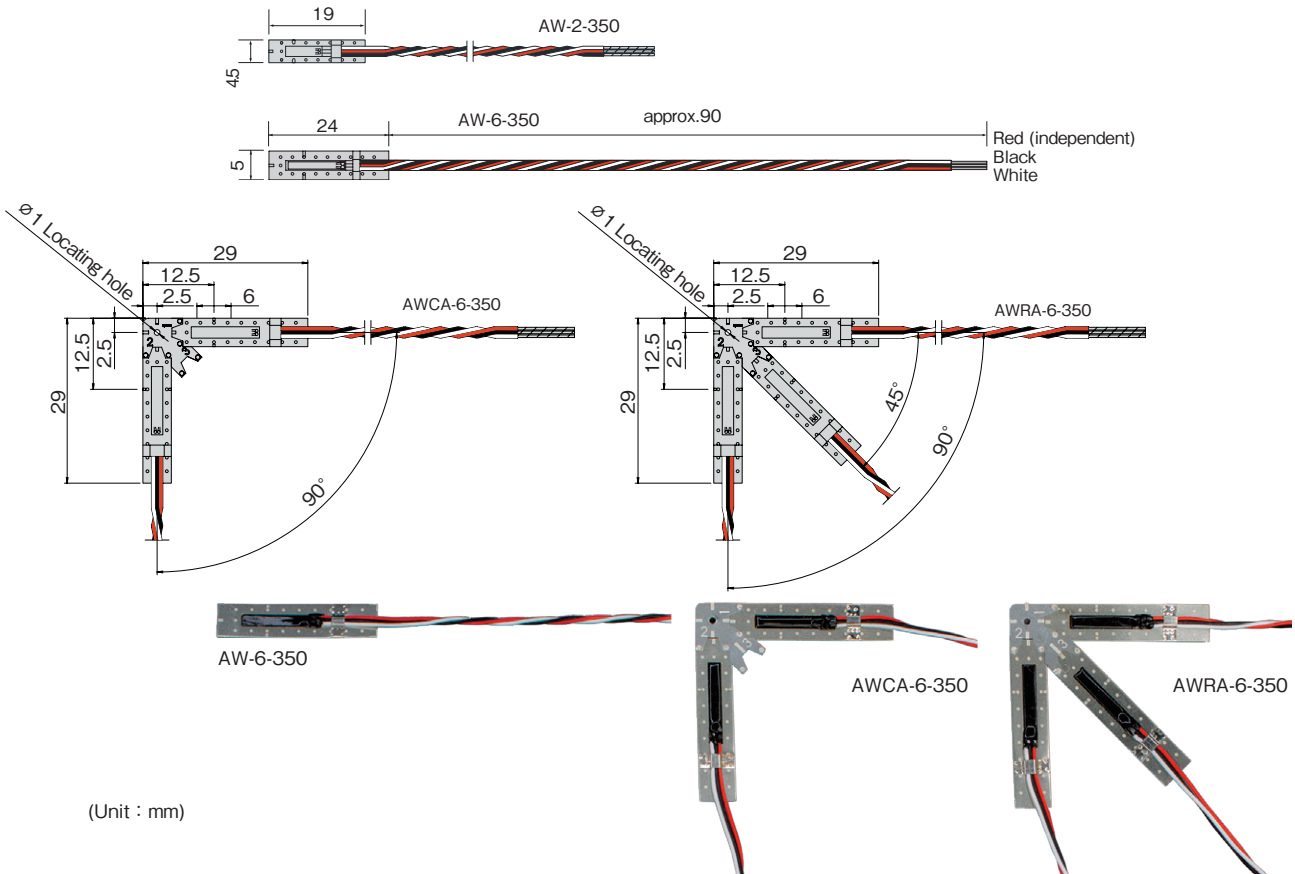
Type	Gauge length (mm)	Gauge base		Operating temperature (°C)	Temperature compensation range (°C)	Test specimen	Applicable coefficient of linear thermal expansion ($\times 10^{-6}/^{\circ}\text{C}$)	Resistance in (Ω)
		Dimension (mm)	Materials					
AW-2-350-11-4FB01LT	2	L19xW4.5	SUS304	-196~+300°C	+10 ~ +100°C	Mild steel	$11 \times 10^{-6}/^{\circ}\text{C}$	350
AW-6-350-11-4FB01LT	6	24x5	SUS304	-196~+300°C	+10 ~ +100°C	Mild steel	$11 \times 10^{-6}/^{\circ}\text{C}$	350
AWCA-6-350-11-4FB01LT	6	29x29	SUS304	-196~+300°C	+10 ~ +100°C	Mild steel	$11 \times 10^{-6}/^{\circ}\text{C}$	350
AWRA-6-350-11-4FB01LT	6	29x29	SUS304	-196~+300°C	+10 ~ +100°C	Mild steel	$11 \times 10^{-6}/^{\circ}\text{C}$	350

Leadwire $\Phi 0.2\text{mm}$ Twisted cross-linked fluorinated resin (PTFE) sheathed leadwire of 0.1m standard (Quarter bridge with 3-wire)

* Lead wire lengths other than the standard length are available on request. (Made to order.)

Minimum order quantity is 5 strain gauges .

External dimensions



Accessories/Options/Installation example (for weldable strain gauges)

W-50RC SPOT WELDER



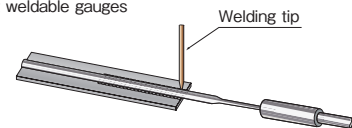
Specifications

Welding energy	Two ranges of 1 to 10 watt second and 5 to 50 watt second (continuously variable) 60 watt second at maximum (AC110V 50Hz)
Output voltage	Approx. 32 V at maximum
Output pulse width	Approx. 5 millisecond
Welding interval	2 welds/second at maximum (at 50 watt second)
Continuous use time	Approx. 15 minutes (at 1 weld/second, 30 watt second, 23°C±5°C)
Welding holder	Holder type III
Welding force	4.9 to 19.6 N
Welding tip	Fixing part Φ3 mm, Tip Φ1 mm
Welding cable length	2m
Environment	0 to 50°C, 85%RH or less (no condensation)
Power supply	
Rated voltage	AC90 to 110V 50/60Hz or AC220V±10% 50/60Hz
Maximum power consumption	550 VA peak (160 millisecond) 210 VA/ 2 times/second
Dimensions	300(W) × 200(H) × 195(D) mm (except projecting parts)
Weight	Approx. 13 kg
Standard accessories	
Operation manual.....	1
AC power cable.....	1
Welding tip.....	3
Abrasive paper(#400).....	5
Hexagonal wrench (width across flats 2.5 mm).....	1
Shoulder belt.....	1

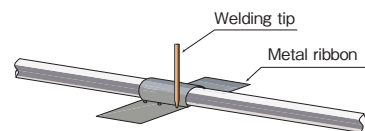
This is a spot welder used for installing weldable strain gauges and fixing leadwires. The welding energy is controlled in two ranges of 1~10 and 5~50 watt second. Its short welding pulse width of approximately 5 millisecond causes very little thermal damage on the material to be welded. The welding energy is not influenced by changes in the power source voltage owing to the adoption of stabilizing circuit. Electrical cables are stored inside the housing for convenience in field applications.

Installation example

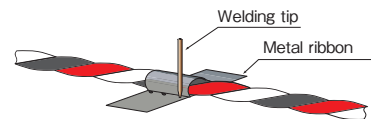
Installing weldable gauges



Fixing the MI cable

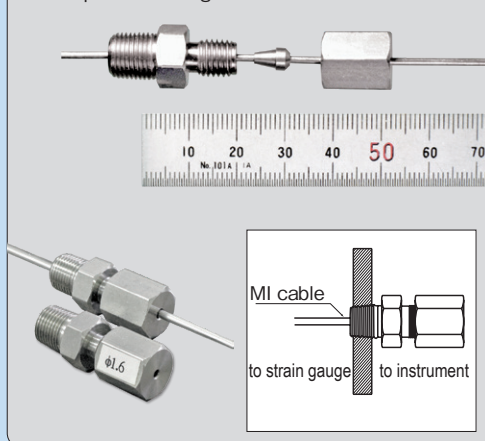


Fixing of fluorocarbon resin coated leadwires



Examples of option

F: Compression fittings



R: Bend of gauge backing or pipe



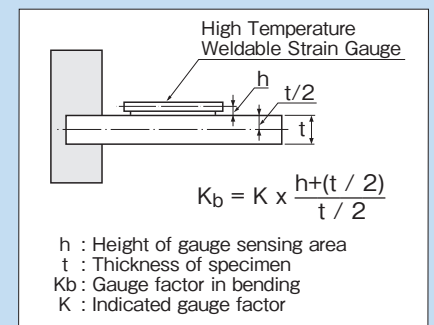
Weldable gauge AWHU and MI cable

Strain gauge tilt compensation

Unlike adhesive-type strain gauges, High Temperature Weldable Strain Gauge have their sensitive parts far from the surface of the test object.

As a result, the sensitivity differs between tension and bending.

Especially in bending tests of thin plates, the sensitivity needs to be compensated as shown in the following equation.



h : Height of gauge sensing area
t : Thickness of specimen
K_b : Gauge factor in bending
K : Indicated gauge factor



Stainless steel ribbon
Designed to fix cables

Size 5mm x 10m x 0.08mm
10mm x 10m x 0.08mm



Welding tips (W-50RDK)

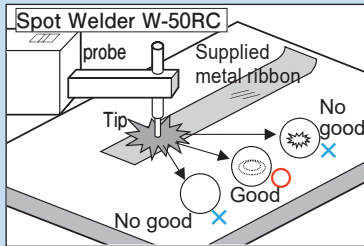
Gauge mounter electrode

Strain gauge installation by resistance welding

Trial Welding (peeling test)

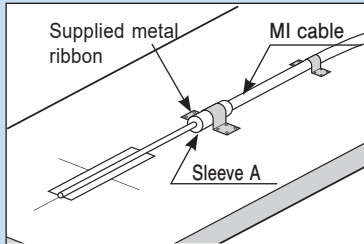
The dedicated spot welder is used for the installation of weldable strain gauges.

In order to securely install the weldable strain gauge on the test object, it is necessary to find the welding conditions suited to the test object



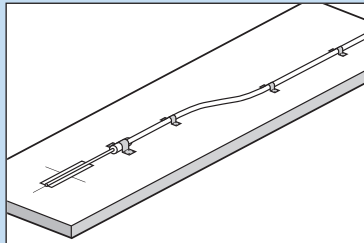
Fixing the sleeve A

Align the center of the strain gauge with the positioning mark, and press down on the gauge so that the gauge is flush against the test object. Fix the sleeve A using the supplied metal ribbon as shown in the figure.



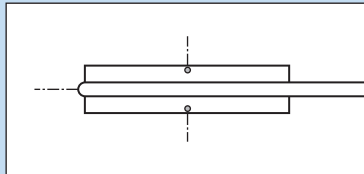
Fixing the cable

Fix the MI cable and the vinyl cable so as to avoid any load applied to the fixed sleeve A. Slightly curve the cable and fix it toward the direction of the cable end so that any excessive load is not applied to the cable. Especially, if the MI cable is fixed along a straight line, the sensing element may be damaged by a kink in the leadwire.



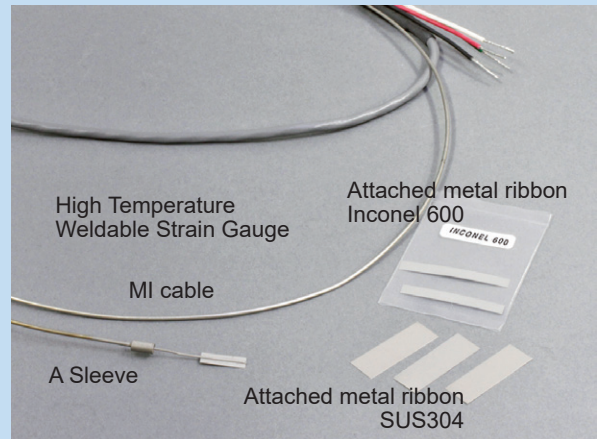
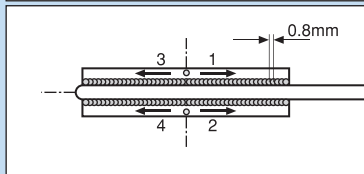
Temporarily fixing the gauge sensing part

Align the gauge sensing part with the positioning mark, and temporarily fix each one point on both sides of the strain gauge as shown in the figure by resistance welding.



Order of resistance welding

Perform resistance welding in the order shown in the figure. The appropriate welding interval is approximately 0.8mm. Refer to the operation manual for the details.



The supplied metal ribbon is exactly the same material and thickness as the gauge base of the welding type strain gauges, and should be used for test welding and cable fixing. AW-6, AWF, AWC, AWH-B, and AWM-B types come with stainless steel ribbons, while AWH-A, AWM-A, AWMD, and AWHU types come with Inconel 600 ribbons.

Attached metal ribbon :

Inconel 600	2 sheets	30 to 50 x 5 x 0.08mm
SUS304	3 sheets	32 x 11 x 0.08mm

▶ Tokyo Measuring Instruments Laboratory Co., Ltd. YouTube Channel

Instructive Explanation of Weldable Gauge Peeling Edition
<https://youtu.be/AGVt-9ReqVE>

Instructive Explanation of Weldable Gauge Preparation Edition
<https://youtu.be/zrjne-zBmMA>

Instructive Explanation of Weldable Gauge
<https://youtu.be/X4fz9Dh1UZo>



Approval Certificate ISO9001
 Design and manufacture of strain gauges, strain measuring equipment and transducers

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