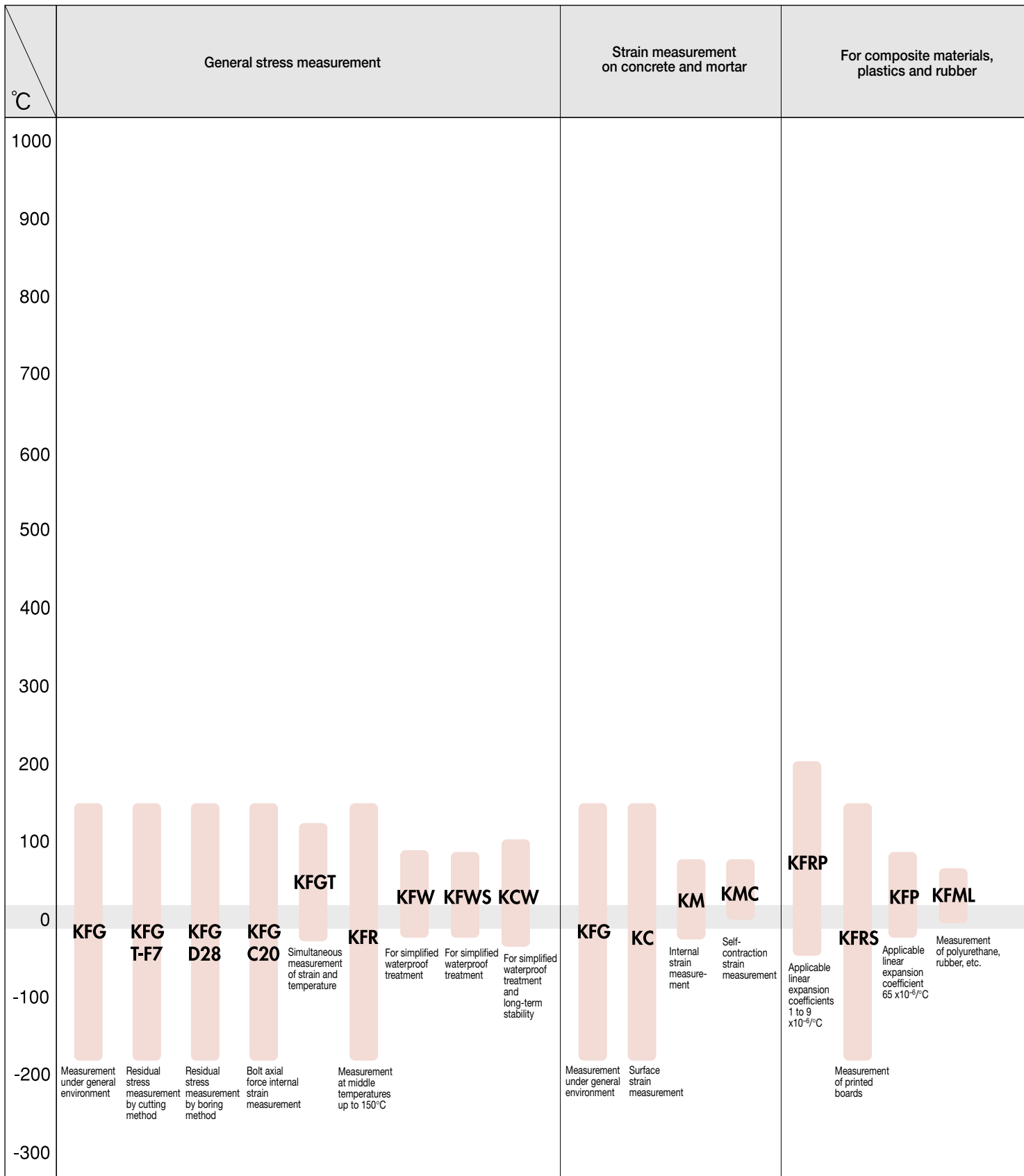


# 1a

## Selecting a strain gage based on operating temperatures and other measuring conditions



Micro-strain measurement (semiconductor gages)	Measurement at high temperatures	Measurement at low temp.	Large strain measurement	For magneto-resistance	Measurement under other conditions	°F
						1832
	Measurement in a temperature range of -196 to 950°C <b>KHCX</b>					1652
	Measurement in a temperature range of room temperature to 800°C <b>KHCD</b>					1472
	Measurement in a temperature range of -196 to 750°C <b>KHCS</b>					1292
	Measurement in a temperature range of -196 to 650°C <b>KHCM</b>					1112
	Measurement in a temperature range of -196 to 550°C <b>KHC</b>					932
	Measurement in a temperature range of -196 to 350°C <b>KFU</b>					752
	Measurement in a temperature range of -50 to 350°C <b>KH</b>					572
	Measurement in a temperature range of -196 to 250°C <b>KFH</b>					392
<b>KSP</b> <b>KSN</b> <b>KSPL</b>			<b>KLM</b> <b>KFEL</b>	<b>KFN</b> <b>KFS</b>	<b>KFF</b> <b>KCH</b> <b>KMP</b> <b>KTB</b> <b>KV</b>	212
Measurement of less than 100µm/m strain under environment of less temperature change		<b>KFL</b>	Elongation measurement up to approx. 20%	Measurement under AC magnetic field	In the case where any gage cannot be bonded inside the structure	32
Impact-initiated strain measurement with no amplifier			Elongation measurement up to approx. 15%	Measurement under high electric field generating inductive noise	Simplified waterproof treatment and ruggedness Internal strain measurement of resin Temperature measurement Measurement of progress and propagation velocity of crack	-148
		Measurement at down to -269°C				-328
						-508

Note: Stated above are operating temperatures.




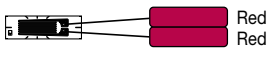

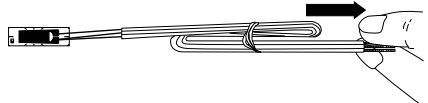
	Name/series designation		Materials		Operating temperature ranges in combination with major adhesives after curing <sup>*1</sup> (°C)	Self-temperature-compensation range (°C)	Applicable linear expansion coefficient (x10 <sup>-6</sup> /°C)	Strain limit at room temp., approx. <sup>*2</sup> (%)	Fatigue life at room temp., approx. <sup>*3</sup> (times)	Page
			Resistive element	Base						
For general stress measurement	General-purpose foil strain gages <b>KFG</b>	For general purpose	CuNi alloy foil	Polyimide	CC-33A: -196 to 120 EP-34B: -55 to 150 PC-6: -196 to 150	10 to 100	5, 11, 16, 23, 27	5.0	1.2 x 10 <sup>7</sup>	P32
		For sensing element of transducers			PC-6: -196 to 150 EP-34B: -55 to 150	10 to 100	11, 16, 23, 27	5.0	1.2 x 10 <sup>7</sup>	P55
		For concrete			CC-35: -30 to 120 PC-12: -196 to 150	10 to 100	11	5.0	1.2 x 10 <sup>7</sup>	P87
		Concentrated stress measurement			CC-33A: -196 to 120 EP-34B: -55 to 150 PC-6: -196 to 150	10 to 100	11, 16, 23, 27	—	—	P51
		Residual stress measurement			CC-33A: -196 to 120 EP-34B: -55 to 150 PC-6: -196 to 150	10 to 100	11, 16, 23, 27	—	—	P66
		Bolt axial tension measurement			EP-18: Room temp. to 50 EP-34B: Room temp. to 50	10 to 100	11	—	—	P70
	Foil strain gages with temperature sensor <b>KFGT</b>		CuNi alloy foil	Polyimide	CC-33A: -10 to 120 EP-34B: -10 to 120 PC-6: -10 to 120	10 to 100	11, 16, 23	3	1 x 10 <sup>6</sup>	P71
	Foil strain gages <b>KFR</b>	Strain measurement at middle temperatures; for transducers	NiCr alloy foil	Polyimide	PC-6: -196 to 150 CC-33A: -196 to 120 EP-34B: -55 to 150	0 to 150	11, 16, 23	2.2	1 x 10 <sup>6</sup>	P72
		Concentrated stress measurement			PC-6: -196 to 150 CC-33A: -196 to 120 EP-34B: -55 to 150	0 to 150	11, 16, 23	—	—	P77
	Waterproof foil strain gages <b>KFW</b>		CuNi alloy foil	Paper base + phenol-epoxy	CC-33A: -10 to 80 EP-18: -10 to 80	10 to 80	11, 16, 23	2.8	3 x 10 <sup>4</sup>	P81
	Small-sized waterproof strain gages <b>KFWS</b>		CuNi alloy foil	Polyimide	CC-33A: -10 to 80 EP-18: -10 to 80	10 to 80	11, 16, 23	5.0	3 x 10 <sup>4</sup>	P85
	Weldable waterproof strain gages <b>KCW</b>		NiCr alloy foil	Stainless steel	(Spot welding) -20 to 100	10 to 90	11	0.5	1 x 10 <sup>6</sup> *A	P86
	Wire strain gages <b>KC</b>		CuNi alloy foil	Paper base + phenol-epoxy	PC-12: -196 to 150 CC-35: -30 to 120	10 to 60	11	1.8	1.5 x 10 <sup>5</sup>	P90
Embeddable strain gages <b>KM</b>		CuNi alloy	Acrylate	(Embedment) -10 to 70	0 to 50	11	0.3	—	P92	
Embeddable strain gages for concrete <b>KMC</b>		CuNi alloy wire	Silicone	(Embedment) Room temp. to 70	—	—	0.3	—	P93	
For composite materials, plastics and rubber	Foil strain gages for composite materials <b>KFRP</b>		NiCr alloy foil	Polyimide	EP-34B: -55 to 200 CC-33A: -196 to 120	0 to 150	1, 3, 6, 9	2.2	1 x 10 <sup>6</sup>	P94
	Strain gages for printed boards <b>KFRS</b>		NiCr alloy foil	Polyimide	CC-33A: -196 to 120 PC-6: -196 to 150	-30 to 120	13	1.6	2 x 10 <sup>6</sup>	P99
	Foil strain gages for plastics <b>KFP</b>		CuNi alloy foil	Paper base + phenol-epoxy	EP-34B: -20 to 80 CC-33A: -20 to 80	10 to 80	65	3.0	1 x 10 <sup>6</sup>	P102
	Foil strain gages for low-elasticity materials <b>KFML</b>		CuNi alloy foil	Phenol-epoxy	EC-30: 0 to 60 CC-33A: 0 to 60	—	—	1.0	—	P105
For infinitesimal strain measurement	Semiconductor strain gages <b>KSP</b>	Micro-strain measurement	P type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120	—	—	0.3	2 x 10 <sup>6</sup> *A	P106
		For sensing element of highly sensitive transducers	P type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120	—	—	0.3	2 x 10 <sup>6</sup> *A	P107
		Micro-strain meas.; 2-element, temperature-compensation type	P type Si N type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120	20 to 70	11	0.3	2 x 10 <sup>6</sup> *A	P107
	Self-temperature-compensation semiconductor strain gages <b>KSN</b>		N type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120 EP-17: -50 to 120(E5)	20 to 70	11, 16	0.3	2 x 10 <sup>6</sup> *A	P108
	High-output semiconductor strain gages <b>KSPH</b>		P type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120	—	—	0.3	2 x 10 <sup>6</sup> *A	P110
	Ultralinear semiconductor strain gages <b>KSPPL</b>		P type Si	Paper base + phenol-epoxy	PC-12: -50 to 150 CC-33A: -50 to 120	—	—	0.3	2 x 10 <sup>6</sup> *A	P111
Notes	<p>*1. Underlined adhesives are those used for strain limit tests at room temperature and for fatigue tests at room temperature.            *2. Typical values with uniaxial gages. Strain limit is the mechanical limit where a difference between the strain reading and mechanical strain initiated by applying tension load exceeds 10%            *3. Typical values with uniaxial gages. Strain level: ±1500 µε; *A: ±1000 µε; *B: ±500 µε, *C: ±100 µε</p>									

	Name/series designation	Materials		Operating temperature ranges in combination with major adhesives after curing <sup>*1</sup> (°C)	Self-temperature-compensation range (°C)	Applicable linear expansion coefficient (x10 <sup>-6</sup> /°C)	Strain limit at room temp., approx. <sup>*2</sup> (%)	Fatigue life at room temp., approx. <sup>*3</sup> (times)	Page
		Resistive element	Base						
For high-temperature applications	Encapsulated strain gages <b>KHCX</b>	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to 950	25 to 950	11, 13	1.0 (950°C)	1 x 10 <sup>6</sup> *C (950°C)	P113
	Encapsulated strain gages <b>KHCD</b>	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) Room temp. to 800	—	—	1.0 (800°C)	1 x 10 <sup>6</sup> *B (800°C)	P114
	Encapsulated strain gages <b>KHCS</b>	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to 750	25 to 750	11, 13, 16	1.0 (750°C)	1 x 10 <sup>6</sup> *B (750°C)	P115
	Encapsulated strain gages <b>KHCM</b>	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to 650	25 to 650	11, 13, 16	1.0 (650°C)	1 x 10 <sup>6</sup> *B (650°C)	P116
	Encapsulated strain gages <b>KHC 20 type</b>	NiCr alloy wire	Heat-resistant metal	(Spot welding) -196 to 550	Room temp. to 500	11, 16	0.8	4 x 10 <sup>5</sup> *A	P117
	Encapsulated strain gages <b>KHC 10 type</b>						0.5	4 x 10 <sup>5</sup> *A	
	Encapsulated strain gages <b>KHC 5 type</b>						0.5	2 x 10 <sup>5</sup> *A	
	High-temperature foil strain gages <b>KFU</b>	NiCr alloy foil	Polyimide	PI-32: -196 to 300	10 to 300	11, 16, 23	1.9	1.5 x 10 <sup>5</sup> *A (300°C)	P121
	High-temperature foil strain gages <b>KH-G4</b>	NiCr alloy foil	Stainless steel	(Spot welding) -50 to 350	10 to 300	11, 16	0.5	1 x 10 <sup>7</sup> *B	P126
High-temperature foil strain gages <b>KFH</b>	NiCr alloy foil	Polyimide	PC-6: -196 to 250 EP-34B: -55 to 200 PI-32: -196 to 250	10 to 250	11, 16, 23	2.1	2 x 10 <sup>5</sup>	P127	
For low temp.	Low-temperature foil strain gages <b>KFL</b>	NiCr alloy foil	Polyimide	PC-6: -269 to 150 CC-33A: -196 to 120 UC-26: -196 to 50	-196 to 50	5, 11, 16, 23	2.2	1 x 10 <sup>6</sup>	P135
For large strain measurement	Ultra-high-elongation wire strain gages <b>KLM</b>	CuNi alloy wire	Epoxy	EC-30: 0 to 60 CC-36: -10 to 80	—	—	20	1 x 10 <sup>6</sup>	P144
	High-elongation foil strain gages <b>KFEL</b>	CuNi alloy foil	Polyimide	CC-36: -10 to 80	—	—	15	1 x 10 <sup>6</sup>	P145
For antimagnetic applications	Noninductive foil strain gages <b>KFN</b>	NiCr alloy foil	Polyimide	PC-6: -196 to 150 CC-33A: -196 to 120	0 to 150	11, 16, 23	1	1 x 10 <sup>4</sup>	P149
	Shielded foil strain gages <b>KFS</b>	CuNi alloy foil (120Ω) NiCr alloy foil (350Ω)	Copper foil	PC-6: -196 to 150 CC-33A: -196 to 120 EP-34B: -55 to 150	10 to 100	11, 16	0.5	1 x 10 <sup>4</sup>	P151
Internal strain	Foil strain gages for bending strain measurement <b>KFF</b>	CuNi alloy foil	Acrylate	CC-33A: -50 to 80 EP-18: -50 to 80 EP-34B: -50 to 80	20 to 60	11, 16, 23	0.2	4 x 10 <sup>6</sup> *B	P152
With protector	Foil strain gages with protector <b>KCH</b>	CuNi alloy foil	Polyimide	Protector: Stud bolt Strain gage EP-34B, CC-33A: -40 to 100	—	11	1	1.2 x 10 <sup>6</sup> *A	P153
Notes	<p>*1. Underlined adhesives are those used for strain limit tests at room temperature and for fatigue tests at room temperature.</p> <p>*2. Typical values with uniaxial gages. Strain limit is the mechanical limit where a difference between the strain reading and mechanical strain initiated by applying tension load exceeds 10%</p> <p>*3. Typical values with uniaxial gages. Strain level: ±1500 με; *A: ±1000 με; *B: ±500 με, *C: ±100 με</p>								

# 2

## Selecting the type and the length of a leadwire cable for the gage selected in 1a and 1b

Virtually all KYOWA strain gages are delivered with a leadwire cable pre-attached to ensure labor saving in gage bonding works by eliminating the need for soldering. Types and lengths of the leadwire cable selectable for each gage are as follows.

Applicable Model of Strain Gage		KFG, KFR, KFRP, KFP, KFL, KFEL		KFG, KFR, KFW, KFWS, KC, KFRP, KFP, KLM, KFEL			
		 2 polyester-coated copper wires		 3 polyester-coated copper wires		 Vinyl-coated flat 2-wire cable	
Type of Leadwire Cable				Uniaxial	Multiaxial	Uniaxial	Multiaxial
		Length of Leadwire Cable	2 cm	N2C2	N2C3		
3	N3C2		N3C3				
4	N4C2		N4C3				
5	N5C2		N5C3				
10	N10C2		N10C3				
15	N15C2		N15C3	L15C2R	L15C2S	L15C3R	L15C3S
30	N30C2		N30C3	L30C2R	L30C2S	L30C3R	L30C3S
50 cm	N50C2		N50C3	L50C2R	L50C2S	L50C3R	L50C3S
1 m	N1M2		N1M3	L1M2R	L1M2S	L1M3R	L1M3S
2				L2M2R	L2M2S	L2M3R	L2M3S
3				L3M2R	L3M2S	L3M3R	L3M3S
4				L4M2R	L4M2S	L4M3R	L4M3S
5				L5M2R	L5M2S	L5M3R	L5M3S
6				L6M2R	L6M2S	L6M3R	L6M3S
8				L8M2R	L8M2S	L8M3R	L8M3S
10				L10M2R	L10M2S	L10M3R	L10M3S
15				L15M2R	L15M2S	L15M3R	L15M3S
20				L20M2R	L20M2S	L20M3R	L20M3S
30 m				L30M2R	L30M2S	L30M3R	L30M3S
Model, etc.	Twisted in the cases of 50cm and 1m long			L-6; L-9 for 6m long or more		L-7; L-10 for 6m long or more	
Coating colors				 Red Red		 (independent wire)	
				 Each vinyl-coated flat cable is bundled with a rubber band. The length can freely be adjusted by pulling it as shown.			

When order, specify the model of the strain gage and the code of the leadwire cable with a space in between.


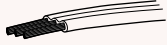
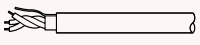



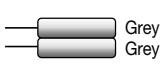




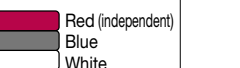
Model of Strain Gage

Code of Leadwire Cable

e.g.

KFG-2-120-C1-11

L1M3R


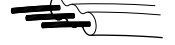








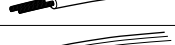

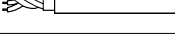
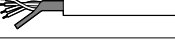
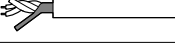

KFG, KFR, KFRP, KFL		KFN, KFS	KFRP, KFH, KFL, KTB	KFU, KFH	
					
Middle-temperature 2-wire cable	Middle-temperature 3-wire cable	Vinyl-coated low-noise 3-wire cable	Fluoroplastic-coated high/low-temperature 3-wire cable	High-temperature 3-wire cable	Glass-coated cable of 3 Ni-clad copper wires
R15C2	R15C3	J15C3	F15C3	H15C3	B15C3
R30C2	R30C3	J30C3	F30C3	H30C3	B30C3
R50C2	R50C3	J50C3	F50C3	H50C3	B50C3
R1M2	R1M3	J1M3	F1M3	H1M3	B1M3
R2M2	R2M3	J2M3	F2M3	H2M3	B2M3
R3M2	R3M3	J3M3	F3M3	H3M3	B3M3
R4M2	R4M3	J4M3	F4M3	H4M3	B4M3
R5M2	R5M3	J5M3	F5M3	H5M3	B5M3
R6M2	R6M3	J6M3	F6M3	H6M3	B6M3
R8M2	R8M3	J8M3	F8M3	H8M3	B8M3
R10M2	R10M3	J10M3	F10M3	H10M3	B10M3
R15M2	R15M3	J15M3	F15M3	H15M3	B15M3
R20M2	R20M3	J20M3	F20M3	H20M3	B20M3
R30M2	R30M3	J30M3	F30M3	H30M3	B30M3
L-11	L-12	L-13	L-3	L-17	
					

For KCW, KM, KH and KFRS, refer to Pages 86, 92, 126 and 99, respectively.

To select the leadwire cable separately, see Page 26.

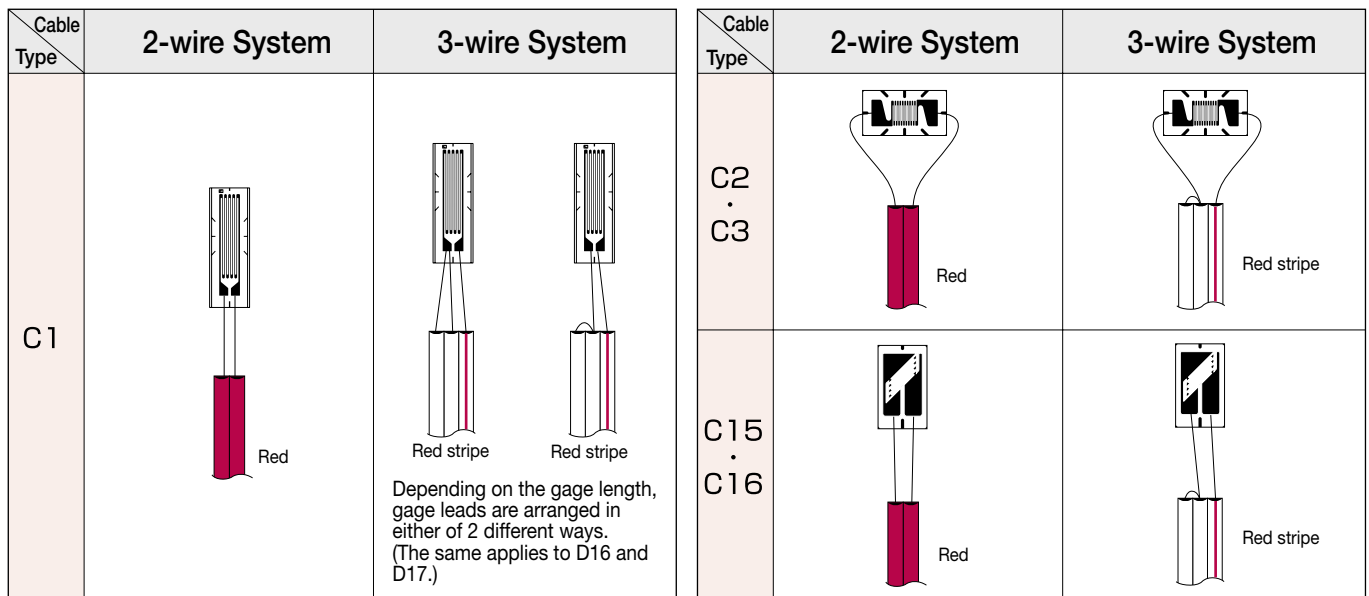
# Selecting a leadwire cable based on operating temperature range and connection examples

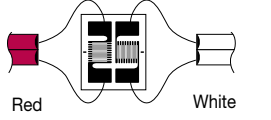
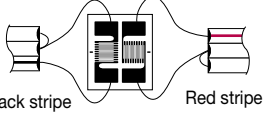
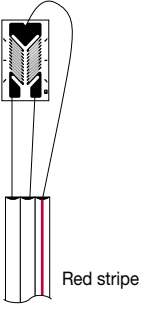
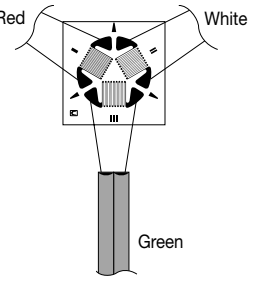
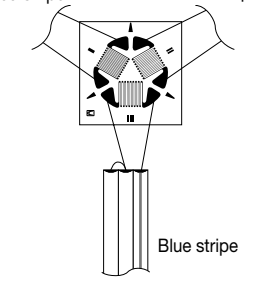
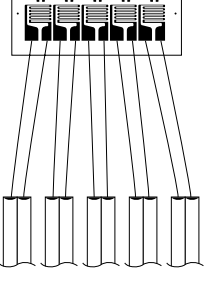
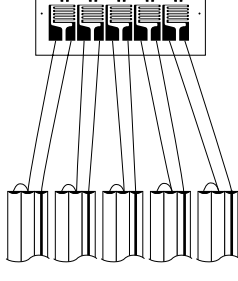
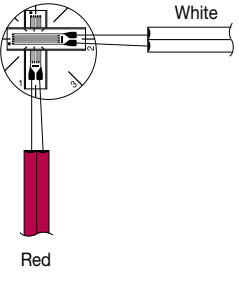
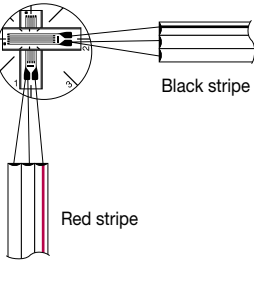
## L-type Leadwire Cables

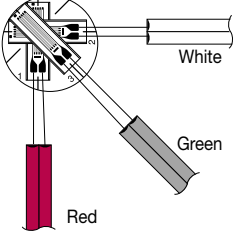
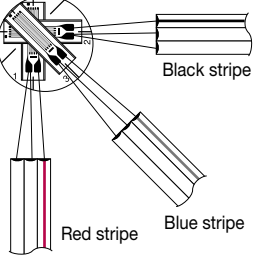
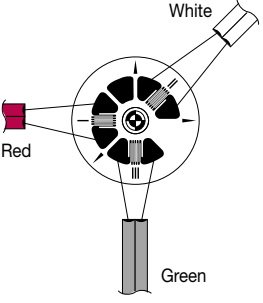
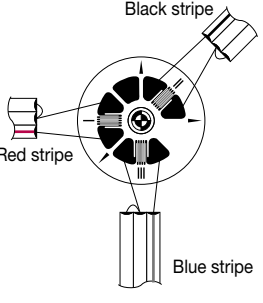
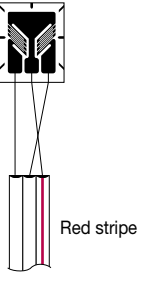
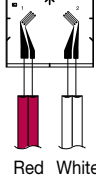
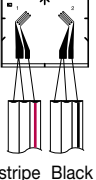
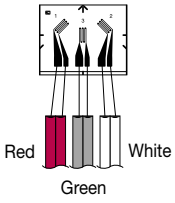
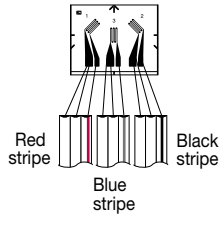
Operating Temperature Range	Model	Type	Conductor Material	Nominal Cross Section of Conductor (mm <sup>2</sup> )	Number of Strands/Wire Diam. (mm)	Reciprocating Resistance per meter (Ω)	Coated Wire Diameter (mm)	Unit Length
Room temp. to 350	L-1	 High-temperature leadwire	CuNi alloy wires	0.07	1/0.30	14.20	0.50	50m
-10 to 80	L-2	 Vinyl-coated flat 3-wire cable	Copper wires	0.30	12/0.18	0.12	2.30	100m
-269 to 250	L-3	 Fluoroplastic-coated high/low-temp. 3-wire cable	Silver-plated copper wires	0.14	7/0.16	0.28	0.98	50m
Room temp. to 350	L-4	 High-temperature leadwire	Nickel-clad copper wires	0.20	1/0.50	0.18	0.70	30m
-10 to 80	L-5	 Vinyl-coated flat 2-wire cable	Copper wires	0.50	20/0.18	0.07	2.50	100m
-10 to 80	L-6 <sup>*1</sup>	 Vinyl-coated flat 2-wire cable	Copper wires	0.08	7/0.12	0.44	1.00	100m
-10 to 80	L-7 <sup>*2</sup>	 Vinyl-coated flat 3-wire cable	Copper wires	0.08	7/0.12	0.44	1.00	100m
-10 to 80	L-9 <sup>*1</sup>	 Vinyl-coated flat 2-wire cable	Copper wires	0.11	10/0.12	0.32	1.00	100m
-10 to 80	L-10 <sup>*2</sup>	 Vinyl-coated flat 3-wire cable	Copper wires	0.11	10/0.12	0.32	1.00	100m
-100 to 150	L-11	 Middle-temperature 2-wire cable	Silver-plated copper wires	0.08	7/0.12	0.50	0.86	100m
-100 to 150	L-12	 Middle-temperature 3-wire cable	Silver-plated copper wires	0.08	7/0.12	0.50	0.86	100m
-10 to 80	L-13	 Vinyl-coated normal-temp. low-noise 3-wire cable	Tin-plated copper wires	0.09	7/0.13	0.46	3.50	100m
-50 to 90	L-14	 Chloroprene-coated normal-temp. low-noise 4-wire cable	Tin-plated copper wires	0.08	7/0.12	0.48	4.00	100m
-269 to 250	L-15	 Fluoroplastic-coated high/low-temp. low-noise 3-wire cable	Silver-plated copper wires	0.08	7/0.12	0.48	2.50	10m
-269 to 250	L-16	 Fluoroplastic-coated high/low-temp. low-noise 4-wire cable	Silver-plated copper wires	0.08	7/0.12	0.48	3.30	10m
-269 to 350	L-17	 High/low-temperature 3-wire cable	Nickel-plated copper wires	0.07	1/0.30	0.50	0.38	30m

\*1. These models have a suffix R, W, G, Y or B indicating the coating color; red, white, green, yellow or black. e.g. L-6B: Black vinyl coated.

\*2. These models have a suffix WR, WL or WY indicating the stripe color; red, blue or yellow on white vinyl coating. e.g. L-7WR: Red stripe on white coating.



Cable Type	2-wire System	3-wire System
D1	 Red White	 Black stripe Red stripe
D2		 Red stripe
D4	 Red White Green	 Red stripe Black stripe Blue stripe
D9 D19 D39		
D16	 Red White	 Black stripe Red stripe

Cable Type	2-wire System	3-wire System
D17	 Red Green	 Black stripe Blue stripe
D28	 Red White Green	 Red stripe Black stripe Blue stripe
D31		 Red stripe
D29	 Red White	 Red stripe Black stripe
D30	 Red Green White	 Red stripe Blue stripe Black stripe



# 3

## Selecting adhesive and bonding tools

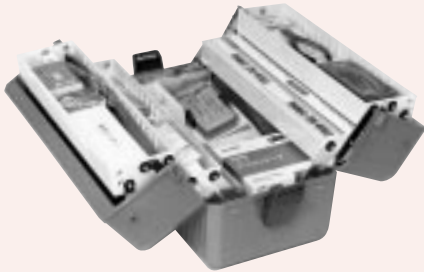


To obtain good measurement results, the strain gage must be bonded completely to the measuring object. Thus, it is important to select a suitable adhesive for the materials of the measuring object and gage base and for measuring conditions.

Applicable Gages	Model	Features	Curing Requirements 100kPa = Approx. 1kgf/cm <sup>2</sup>	Operating Temperature Range (°C)	Ingredient	Content (g)
KFG KFGT KFR KFW KFWS KFRP KFRS KFP KFML KSP KSN (excl. E5) KSPH KSPL KFL KFN KFS KFF KCH KV KTB	CC-33A	High-speed cold setting, enabling measurement 1 hour after bonding with finger pressure. Suitable for strain measurement of metal, plastics and composite materials under normal room temperature.	Apply finger pressure (100 to 300kPa) for 15 to 60 seconds. Then, leave the gage as it is for 1 hour or more at normal temperatures. The finger pressure application time depends on temperature and humidity conditions. Lower the temperature and humidity, the longer the finger pressure application time required.	-196 to 120	Cyanoacrylate, 1 liquid	2g x1 or 2g x5
KFG KFGT KFR KC KFRP KFP	CC-35	High-speed cold setting. Suitable for porous materials such as lumber, concrete and composite materials.	Apply finger pressure (100 to 300kPa) for 30 to 60 seconds. Then, leave the gage as it is for 1 hour or more at normal temperatures. The finger pressure application time depends on temperature and humidity conditions. Lower the temperature, the longer the finger pressure application time required.	-30 to 120	Cyanoacrylate, 1 liquid	2g x1 or 2g x5
KLM KFEL	CC-36	For high-elongation strain gages. Instantaneous bonding at room temperature and less aging change.		-10 to 80	Cyanoacrylate, 1 liquid	2g x1 or 2g x5
KFG KC KSP KSN (excl. E5) KSPH KSPL	PC-12	Cold setting. Suitable for strain measurement at middle to high temperatures. <small>Product under export regulations</small>	Apply pressure (30 to 50kPa) for 2 hours at normal temperatures.	-196 to 250	Polyester, 2 liquids	30 or 100
KFG KFGT KFR KFRP KFP KFH KFF KTB	EP-34B	Cold or hot setting. Suitable for strain measurement at middle to high temperatures and for bonding gages to transducers used at room temperature.	Apply pressure (30 to 50kPa) for 24 hours at 25°C or for 2 hours at 80°C. Pressing is possible with tape.	-55 to 200	Epoxy, 2 liquids	30 (main agent 5.6g x4 & curing agent 2.1g x4)
KFG KFR KFH KFL KFN KFS	PC-6	Hot setting. Suitable for strain measurement at middle to high temperatures and for bonding gages to transducers.	Apply pressure (150 to 300kPa) for 1 hour at 80°C, for 2 hours at 130°C and for 2 hours at 150°C.	-269 to 250	Phenol, 1 liquid	100
KFG (C20) KFW KFWS KFF	EP-18	Cold or hot setting. Low viscosity makes it suitable for bonding bolt tightening force gages.	Apply pressure (50 to 100kPa) for 24 hours at normal temperatures or for 2 hours at 80°C.	-50 to 100	Epoxy, 2 liquids	30
KSN-2-E5	EP-17	Hot setting. Dedicated to KSN-2-E5. (Less cure shrinkage strain)	With the gage put on the adhesive, heat it for 2 hours at 130°C and for additional 2 hours at 150°C.	-50 to 170	Epoxy, 1 liquid & 1 powder	30
KFG KFR	PC-28	Hot setting. Suitable for aluminum alloy and for bonding gages to transducers.	Apply pressure (150 to 300kPa) for 1 hour at 100°C and for 2 hours at 160°C.	-20 to 80	Phenol, 1 liquid	60 (30g x2)
KFU KFH	PI-32	Hot setting. Suitable for strain measurement at high temperatures. <small>Product under export regulations</small>	Apply pressure (200 to 500kPa) for 1 hour at 100°C and for 2 hours at 200°C. Then, with the pressure removed, heat it for 2 hours at operating temperatures. Or apply pressure (200 to 500kPa) for 1 hour at 100°C and for 5 hours at 160°C and with the pressure removed, heat it for 2 hours at operating temperatures.	-269 to 350	Polyimide, 1 liquid	20
KFL	UC-26	Cold setting. Dedicated to KFL gages. (Mainly for concrete and lumber)	Apply pressure (30 to 50kPa) for 24 hours at normal temperatures.	-196 to 50	Polyurethane, 2 liquids	40
KFML KLM	EC-30	Cold setting. Mainly for ultrahigh-elongation gages.	Apply pressure (30 to 50kPa) for 24 hours at normal temperatures.	0 to 60	Epoxy, 2 liquids	30
<small>Product under export regulations</small>	S-7	Cure accelerator for CC-33A (shortens the curing time in cold environments)				30mL
on strategic commodities as provided for in the Foreign Exchange Law and the Foreign Trade Control Law. The necessary legal procedures should therefore be taken, including acquisition of an export license from the Government of Japan, if they are to be taken abroad.	S-9	Surface treatment agent for instantaneous adhesives (improves adhesion to polyethylene, etc.) <small>Product under export regulations</small>				100mL

Note: The stated operating temperature ranges are of adhesives. Practical ranges depend on combination with strain gages. When using, read the attached Instruction Manual carefully.

## ■ Gage Bonding Tool Kit



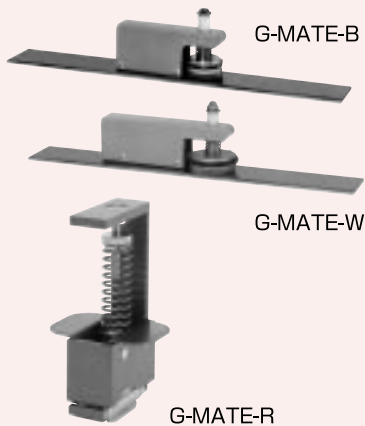
### ● GTK-77 Tool Kit

This kit includes all tools, gage terminals, solder and other expendables required for gage bonding work.

#### Contents

Tool box, screwdriver set, tweezers, nippers, radio pliers, tape measure (2m), stainless steel scale, protractor, sandpaper (#100), sandpaper (#320), soldering iron tip cleaner, knife, cutter, scribe, soldering iron (40W), compasses, roller, picker, marking pencil, mending tape, pencils (4H, 6H), scissors, cotton swabs, clean paper, high-temperature solder, flux for high-temperature solder, heat-resistant glass tube, gage terminals (T-P1, T-P4, T-P5, T-P6, T-P7, T-P8, T-P9, T-P10, T-F2, T-F3, T-F7, T-F8, T-F10, T-F13, T-F17, T-H11, T-R9), hair dryer (400W), AC plug, insulation vinyl tape, table tap (2.5m), soldering iron (ANTEX), silicon rubber (2m), fluoroplastic sheet (0.1mm)

## ■ Gage Pressers



### ● Gage Pressers G-MATE

The G-MATE can apply pressure to a bonded strain gage continuously until the adhesive is cured. It consists of a frame equipped with a strong ferrite magnet to firmly fix the object under testing and a presser disk equipped with silicon sponge rubber and coil spring to apply constant pressure to the strain gage.

Name	Model	Application
Gage Mate	G-MATE-B	For normal temp. (up to approx. 80°C)
High-temperature Gage Mate	G-MATE-H	For high temp. (up to approx. 180°C)
Waterproof Gage Mate	G-MATE-W	For KFW and KFWS
Reinforcing Steel Bar Gage Mate	G-MATE-R	For reinforcing steel bar

Sales unit: 6 pieces per pack

### ● Gage Picker G-PICKER



Utilizing the adhesion of cellophane tape, the G-PICKER enables the user to freely pick up the strain gage by lightly applying the tip of the G-PICKER to the gage terminal, etc. Thus, it improves the efficiency of gage bonding work.

## ■ Compact Spot Welder



### ● GW-3C Compact Spot Welder

Developed to mount encapsulated strain gages such as the KHGX, KHCS and KHCD and to fix high-temperature leadwires and thermocouples, the GW-3C is an easy-to-use welder providing an increased welding capability and allowing continuously variable settings of welding energy. (Patent pending)

#### Specifications

##### Welding Energy:

LOW: 0 to 25Ws, continuously variable

HIGH: 0 to 50Ws, continuously variable

##### Welding Speed:

1Ws: 150 times/min., 5Ws: 120 times/min., 10Ws: 80 times/min., 20Ws: 60 times/min., 50Ws: 30 times/min.

Power Requirements: 90 to 110 VAC, 50/60Hz: 500VA max.

##### Dimensions and Mass:

183(W) x 153(H) x 313(D) mm (excluding protrusions), approx. 8.2kg (mainframe)

##### Accessories:

Square welding head, grounding clip (with 0.3m long cable), 2 electrodes (GW-02), metal file, fuse (5A), hexagonal wrench, instruction manual




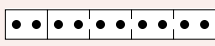

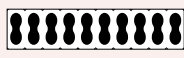

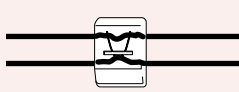

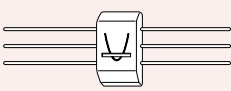
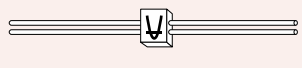
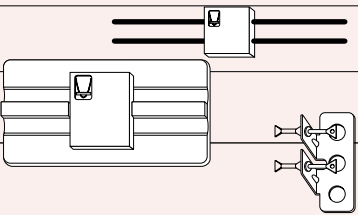
Option: Aluminum trunk (GW-01)

# 4

## Gage terminals and other accessories

A gage terminal is applied to the connection between a strain gage and leadwire to protect the gage leads. It prevents the strain gage from receiving force and the gage leads from breaking or peeling off if the leadwire is pulled to some extent.

### Gage Terminals

	Model	Dimensions (mm) (W x L x t)	Base Material	Conductor Material	Q'ty per Pack	Operating Temperature Range (°C)	Recom- mended Adhesive	Remarks
Foil type		T-F2 5-pole 13 x 55 x 0.1 1-pole 13 x 11 x 0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-18	
		T-F3 5-pole 13 x 65 x 0.1 1-pole 13 x 13 x 0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-18	For 3-wire system
		T-F13 5-pole 13 x 65 x 0.15 1-pole 13 x 13 x 0.15	Glass epoxy + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-F7 5-pole 6 x 25 x 0.1 1-pole 6 x 5 x 0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-18	Compact
		T-F17 5-pole 6 x 25 x 0.15 1-pole 6 x 5 x 0.15	Glass epoxy + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-F8 5-pole 4 x 30 x 0.1 1-pole 4 x 6 x 0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-18	
		T-F10 15 x 50 x 0.1	Glass epoxy	Copper foil	10 sheets	-196 to 120	CC-33A EP-18	Mainly for 5-element gages
		T-F23 5-pole 14 x 55 x 0.1 1-pole 14 x 11 x 0.1	Polyimide	Copper foil	20 sheets (5 poles/ sheet)	-196 to 200, -196 to 120 with CC-33A	CC-33A EP-34B	For high temperature: compact
		T-F24 5-pole 9 x 40 x 0.1 1-pole 9 x 8 x 0.1						
		T-F25 5-pole 6 x 25 x 0.1 1-pole 6 x 5 x 0.1						
	T-F26 5-pole 14 x 55 x 0.1 1-pole 14 x 11 x 0.1	Polyimide	Copper foil	20 sheets (5 poles/ sheet)	-196 to 350	PI-32	For high temperature	
	T-F27 5-pole 9 x 40 x 0.1 1-pole 9 x 8 x 0.1							
	T-F28 5-pole 6 x 25 x 0.1 1-pole 6 x 5 x 0.1							
Mold type		T-P1 14 x 10 x 4	Styrene	Tin-plated copper wire	20 pieces	-30 to 80	CC-33A	
		T-P4 14 x 10 x 4.5	Styrene + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P5 6 x 6 x 2	ABS	Tin-plated copper wire	20 pieces	-30 to 120	CC-33A	Compact
		T-P6 6 x 6 x 2.5	ABS + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P7 15 x 10 x 4	ABS	Tin-plated copper wire	20 pieces	-30 to 80	CC-33A	For 3-wire system
		T-P8 15 x 10 x 4.5	ABS + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P9 6 x 5 x 4	Heat-resistant styrene	Tin-plated copper wire	40 pieces	-30 to 90	CC-33A	Compact
		T-P10 6 x 5 x 6	Heat-resistant styrene + rubber					Rubber on the rear
		T-R9 10 x 10 x 5	Neoprene rubber	Tin-plated copper wire	20 pieces	-30 to 80	CC-33A	For large strain
		T-R10 15 x 30 x 6	Neoprene rubber	Tin-plated copper wire	20 pieces	-10 to 80	CC-33A	With lead contact preventing plate
T-H11 7 x 20 x 8		Stainless steel + silicic acid glass	Kobar	10 pieces	Room temperature to 300	Welding	For high- temperature gage	

## ■ Coating Agents



### ● Coating Agents

Coating agents are applied to gages and gage terminals to prevent gages from adsorbing moisture in outdoor or long-term measurement.

◎ : Excellent  
○ : Somewhat excellent  
△ : Somewhat inferior  
× : Inferior

Model	C-1B	C-4	C-5	AK-22	VMTAP	ARALDITE-T,-C	HAMATITE-Y	KE-4898W
Type	Hot-melt type	Hot-melt type	Rubber solvent type	Special clay	Press-fitting rubber type	2-liquid type (1:1)	Rubber solvent type	Silicon solvent type
Operating Temp. Range	-30 to 40°C	-50 to 60°C	-269 to 60°C	-196 to 170°C	-30 to 80°C	-50 to 100°C	-20 to 70°C	-50 to 200°C
Curing Requirements	Heat-melted & cured at room temp.	Heat-melted & cured at room temp.	Melted & dried at room temp. 12 hrs.	Press-fitted	Press-fitted	24 hours at room temp.	Melted & dried at room temp. 12 hrs.	Melted & dried at room temp. 12 hrs.
Moisture/Water-proofness	◎	◎	◎	◎	○	△	○	△
Mechanical Protection	△	△	△	△	△	◎	△	△
Oil Resistance	△	△	△	△	△	○	△	△
Alcohol Resistance	○	○	○	○	○	○	○	○
Toluene Resistance	×	×	×	×	×	○	×	×
Alkalescent Resistance	○	○	○	○	○	○	△	△
Weak-acid Resistance	○	○	○	○	○	○	△	△
Content	500g	500g	100g	500g	38mm x 6m	T: 170g C: 1.8kg	1.5kg	100g
Material	Paraffin wax	Microcrystalline wax	Butyl rubber	Butyl rubber + inorganic additive	Butyl rubber	Epoxy	Chloroprene rubber	Silicon
Color	White	White	Light yellow	Dark green	Black	Main agent: Light milk white Curing agent: Light yellow	Black	Milk white
Features	Can be applied with a brush after melting through heating. Suitable for underlayer of multilayer coating.	Excellent cohesiveness makes it suitable for application to wall surface.	Minimal restriction in ultra-low temperature applications.	The clay-like shape ensures easy coating work. Operating temp. range is wide.	The tape shape facilitates coating work.	Highly effective mechanical protection makes it suitable for upper layer of multilayer coating.	Suitable for final finish of multilayer coating.	Highly heat-resistant coating agent.

When using, read the attached Instruction Manual carefully.

## ■ Accessories for High-temperature Gages

### ● HTG Series Accessories for High-temperature Gages



Description	Model	Specifications	Q'ty
High-temperature solder	HTG-S	Fusion temperature: 304 to 365°C Maximum operating temperature: 350°C	40cm long bar x 2
Flux for high-temperature solder	HTG-S-F	Ingredients: Inorganic acid + alcohol	20mL
Heat-resistant glass tube	HTG-G-TUBE	Inner diameter: 1.5mm Length: 1m	10 pieces
Heat-resistant Teflon tape	HTG-T-TAPE	Heat resistance: 200°C Width: 12.7mm	32.9m long
Heat-resistant glass tape	HTG-G-TAPE	Heat resistance: 350°C Width: 25mm	33m long

Note: The maximum operating temperature of 350°C for the high-temperature solder and the heat resistance of 350°C for the heat-resistant glass tape apply to a short-term operation.