




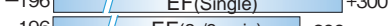



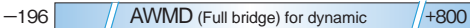


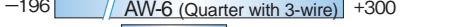




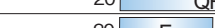









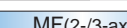








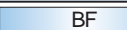



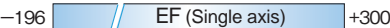




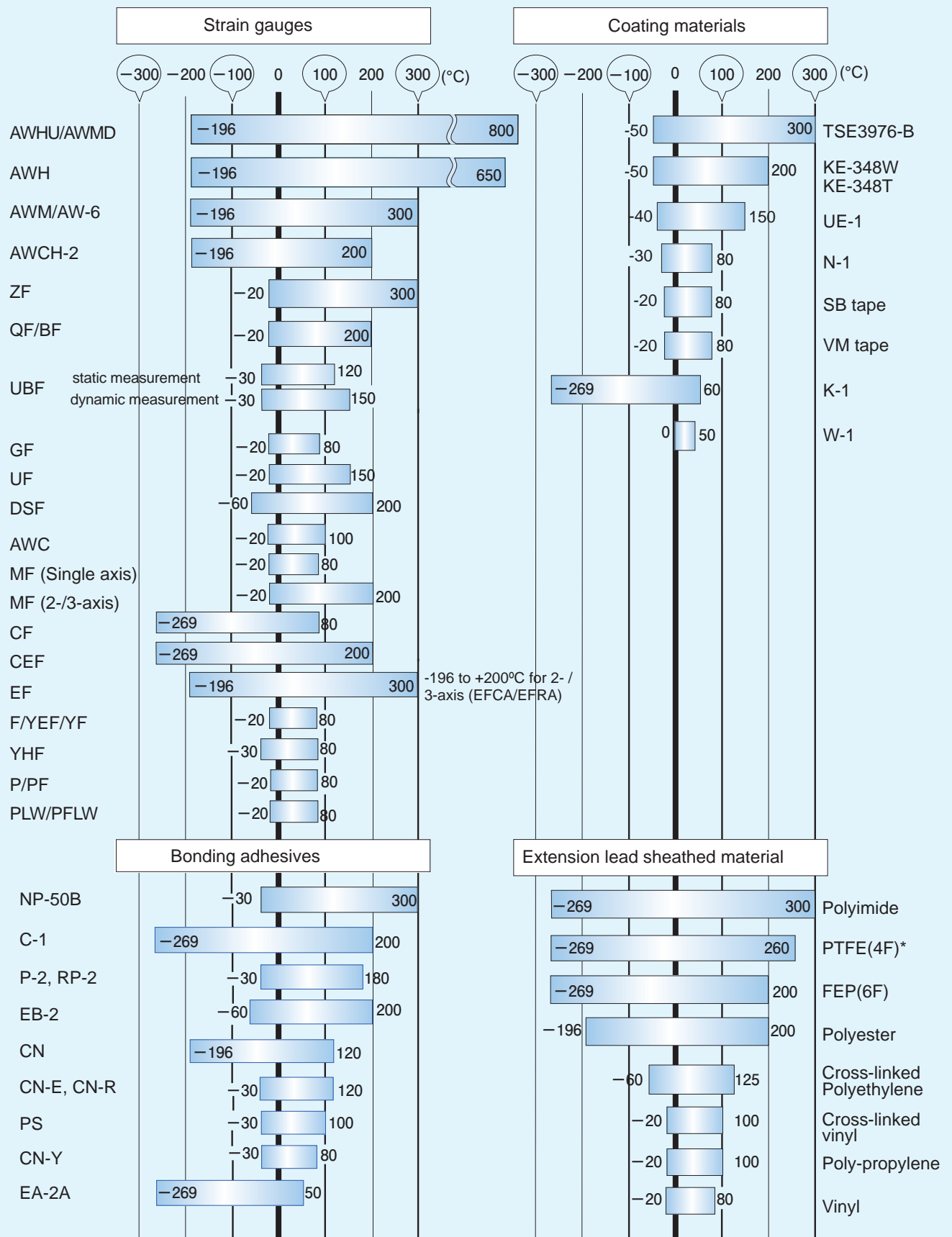
## TML STRAIN GAUGES SELECTION

## Measuring purpose

Material - Purpose	Gauges series & Operating temperature (°C)	Bonding adhesive	Coating materials	Code of extension wire recommended
Metal				
General use    Normal Under water General use Mid-high temperature High temperature High temperature Miniature, High Miniature, High Wide range temp. Cryogenic temp.	-20  +80	CN/P-2/EB-2	W-1/N-1/SB tape	-LE, -L, -LT
	0  +80	CN/P-2	W-1/N-1/SB tape	-L, -LT
	-20  +150	CN/P-2/EB-2	W-1/N-1/SB tape	-LE, -L, -LT, -6FA-LT
	-20  +200	CN/C-1/NP-50B	KE-348	-6FA-LT
	-20  +300	CN/C-1/NP-50B	Consult TML	-4FA-LT
	-196  +300	CN / EB-2 / C-1	KE-348	-6FA-LT, -4FA-LT
	-196  +200	NP-50B		
	-269  +200	EA-2A/CN/C-1	K-1	-6FA-LT
-269  +80				
Spot welding	-196  +300	Spot welding (Welder W-50RB)	Consult TML	MI cable
	-196  +800			
	-196  for static +600 for dynamic +650			
	-196  +800			
	-196  +300			
	-20  +100			
-196  +200			-LT(4FA-LT)	
			-LQ, -LT	
			-LQ	
Long-term	-20  +80	C-1/NP-50B/EB-2	W-1	Vinyl/Cross-linked vinyl/PTFE(4F)
	-196  +80	Spot welding	SB tape	
Stress concentration	-20  +80	CN/P-2/EB-2	W-1/SB tape	-L, -LT
	-20  +200	CN/C-1/NP-50B	KE-348	-6FA-LT
Residual stress	-20  +80	CN/P-2/EB-2	W-1/SB tape	-L, -LT
Torque	-20  +80	CN/P-2/EB-2	W-1/SB tape	-L, -LT
	-20  +200	CN/C-1/NP-50B	KE-348	-6FA-LT
Shear strain	-20  +80	CN/P-2/EB-2	W-1/SB tape	-L, -LT
	-20  +200	CN/C-1/NP-50B	KE-348	-6FA-LT
One-side gauge	-10  +70	CN/P-2	—	-L, -LT
Bolt axial strain	-10  +80	A-2/CN	—	-L, -LT
Large strain	-20  +80	CN/CN-Y	SB tape	-L, -LT
	-30  +80			
Metal or Concrete				
Magnetic field use	-20  +80 MF(Single axis)	CN/CN-E/RP-2	W-1/SB tape	-L, -LS
	-20  +200 MF(2-/3-axis)	CN/NP-50B EB-2/C-1	KE-348	-6FD-LTS
Concrete or Mortar				
Surface strain	-20  +80	CN-E/RP-2/PS	W-1/SB tape	-L, -LT
	-20  +80 FLM/WFLM	PS		-LT
Internal strain	-20  +60 PM/PMF	Embedment	—	-LT
Asphalt				
Internal strain	-20  +60 PMFLS	Embedment	—	Special
Plastics				
	-20  +80	CN	W-1/N-1/SB tape	-L, -LT
Composite				
General purpose	-20  +200	CN/NP-50B/EB-2	W-1/SB tape	-L, -LT, -6FA-LT
	-30  for static +120 for dynamic +150	CN/EB-2		
Fatigue test	-60  +200	CN/C-1/EB-2	—	-L, -LT, -6FA-LT
Printed circuit board				
General purpose	-196  +300	CN/NP-50B/EB-2	—	-L, -LT, -6FA-LT, -4FA-LT
	-196  +200			
Wood long-term/Gypsum				
General purpose	-20  +80 PFLW/PLW/LF	PS/CN-E	W-1/N-1/SB tape	-L, -LT
General use				
Temperaute	-20  +200	CN/C-1/NP-50B	W-1/SB tape	-L, -LT, -6FA-LT

## TML STRAIN GAUGES SELECTION

## Operating temperature (°C)



N.B.: PTFE(4F)  
Short term use of 300°C  
available

## TML STRAIN GAUGES SELECTION

## GENERAL USE

## ¶ F series Foil strain gauges

P.39



These gauges employ Cu-Ni alloy foils for the grid and epoxy resin for the backing. The epoxy resin backing exhibits excellent electrical insulation performance, and is color-coded to identify the objective material for self-temperature-compensation. Various types of strain gauges such as for residual stress measurement and are available in addition to general use gauges.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN/P-2/EB-2	Epoxy	Cu-Ni	5%(50,000)

General use	P.39
Residual Stress measurement	P.40
Shearing strain measurement	P.40
Torque measurement	P.40
Glass/Ceramic materials	P.41
Stress concentration measurement	P.41,42



## ¶ UF series strain gauges P.45

These strain gauges utilize Cu-Ni alloy foils for the grid and polyimide-amide resin for the backing. It enables the strain gauges to be used in 150°C at the maximum. The backing features excellent flexibility, thus allowing easy adhesion even on a curved surface and providing excellent stability in thermal characteristics of the strain gauges. The backing is color-coded to identify the objective material for self-temperature-compensation in the same manner as the F series.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-20~+150°C	+10~+100°C	CN/P-2/EB-2	Polyimide amide	Cu-Ni	5%(50,000)

## WATERPROOF CONSTRUCTION

## WF series strain gauges

P.43



These gauges eliminate the need for a moisture-proofing coating, which is sometimes troublesome in a field test. These have an integral vinyl leadwire, and whole area of the strain gauge and the leadwire junction are coated with epoxy resin. The coating is transparent and flexible, so the positioning and bonding works are very easy. By merely bonding the gauge with CN or P-2 adhesive, outdoor or underwater measurement for a short-term becomes possible. These gauges are also effective in eliminating the primary coating in case of applying a multi-layer coating.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
0~+80°C	+10~+80°C	CN/P-2	Epoxy	Cu-Ni	3%(30,000)

## TEMPERATURE-INTEGRATED

## FLA-T and QFLA-T series Strain Gauge P.44



These are strain gauges having a thermocouple integrated with the pre-attached leadwire. One core of the three-core parallel leadwire is made of Cu-Ni wire while other two cores are made of ordinary copper wire. A type T thermocouple is composed of the Cu-Ni wire and the copper wire. Simultaneous measurement of strain with quarter bridge 3-wire method and temperature with type T thermocouple is possible by using TML data loggers. The QFLA-T uses FEP sheathed leadwire to withstand high temperature up to 200°C.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
F : -20 ~ +80°C	+10 ~ +80°C	CN/P-2	Epoxy	Cu-Ni	5%(50,000)
QF : -20 ~ +200°C		NP-50B	Polyimide	Cu-Ni	3%(30,000)

## HIGH TEMPERATURE USE

P.47



## ¶ QF series strain gauges

These are foil strain gauges having a polyimide resin backing, which exhibits excellent performance in high temperature up to 200°C. Stress concentration measurement gauges and shear stress measurement gauges are also available in this series.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-20~+200°C	+10~+100°C	CN/NP-50B/C-1	Polyimide	Cu-Ni	3%(30,000)

## HIGH TEMPERATURE USE

## ¶ ZF series strain gauges

P.49



These strain gauges are designed for measurement in high temperature up to 300°C. They utilize specially designed Ni-Cr alloy foil for the grid and polyimide resin for the gauge backing. Owing to the construction, these strain gauges are successfully used for measurement in high temperature.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-20~+300°C	+10~+100°C	CN/NP-50B/C-1	Polyimide	Ni-Cr	1%(10,000)

## ¶ EF Series strain gauges

P.50



Polyimide backing strain gauges for high temperature use. The gauges have a miniature grid pattern required as strain gauges to measure the mechanical properties of printed circuit boards and mounting parts which are getting smaller.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal*	Compensation*		Backing	Grid	
Single element (EFLA)					
-196~+300°C	+10~+150°C	CN/EB-2 NP-50B/C-1	Polyimide	Ni-Cr	1%(10,000)
2-/3-element (EFCA/EFRA)					
-196~+200°C	0~+150°C	CN/EB-2 NP-50B/C-1	Polyimide	Ni-Cr	1%(10,000)

## HIGH &amp; LOW TEMPERATURE USE

## CEF series strain gauges

P.50



These are strain gauges utilizing polyimide resin for the gauge backing and special alloy foil for the grid. These feature a wide range of operating temperature from cryogenic temperature to +200°C. This series is available only in single axis configuration with gauge length of 1,3 and 6mm.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-269~+200°C	-196~+80°C	CN/EA-2A C-1	Polyimide	Special	1%(10,000)

## CRYOGENIC TEMPERATURE USE

## CF series strain gauge

P.51



These are foil strain gauges with epoxy backing designed for measurement under cryogenic conditions. These are available in single element, rectangular 2-element and rectangular 3-element configurations with 350Ω resistance. The specially selected and heat treated grid of these gauges shows very small zero shift under cryogenic temperature compared to conventional strain gauges.

Operating temperature		Bonding adhesive	Materials		Strain limit (μΕ)
Normal	Compensation		Backing	Grid	
-269~+80°C	-196~+80°C	CN/EA-2A C-1	Epoxy	Special	1%(10,000)

## WELDABLE TYPE

## AW series strain gauges

P.53



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. The maximum operating temperature is 800°C for the AWHU. These gauges are suited to measurement in high temperature, harsh environments such as underwater or gas-filled atmosphere, or for long term. The AWC-2B and AWCH-2 adopt 1-gauge 4-wire strain measurement method.

AWM-8	Quarter bridge with 3-wire system	: -196 ~ +300°C
AWMD-5, AWMD-8	Full bridge for dynamic measurement	: -196 ~ +800°C
AWH-4, AWH-8	Full bridge for static measurement	: -196 ~ +600°C
	Full bridge for dynamic measurement	: -196 ~ +650°C
AWHU-5, AWHU-8	Full bridge for static & dynamic	: -196 ~ +800°C
AW-6-350-11-01LT	Quarter bridge with 3-wire system	: -196 ~ +300°C
AWC-2B-11-3LT	1-Gauge 4-Wire	: -20 ~ +100°C
AWC-8B-11-3LT	Quarter bridge with 3-wire system	: -20 ~ +100°C
AWCH-2-11-05LQ	1-Gauge 4-Wire	: -196 ~ +200°C

## TML STRAIN GAUGES SELECTION

## CONCRETE MATERIAL USE

## P series Polyester wire strain gauges

P.59



These are wire strain gauges utilizing a transparent plastic backing impregnated with polyester resin. The gauge length is available in 3 steps of 60, 90 and 120mm, so it is suited to the measurement of concrete strain. Since the backing is transparent, the bonding position can easily be checked in the installation works.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN-E/RP-2	Polyester	Cu-Ni wire	2%(20,000)

## PF series Polyester foil strain gauges

P.59



These are foil strain gauges utilizing a polyester resin backing which is the same as the P series. The gauge length is available in 3 steps of 10, 20 and 30mm, so it is suited mainly to strain measurement on concrete or mortar. The backing is transparent and the installation is easy.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN/RP-2	Polyester	Cu-Ni	2%(20,000)

## FLM/WFLM series Metal backing strain gauges

P.60



These strain gauges have thin stainless steel backings which prevent the penetration of moisture from the reverse sides. These constructions are aimed for successful strain measurement on concrete surface. The WFLM gauges have moisture proofing over-coating and integral leadwire in addition to the stainless steel backing. These are intended for long term measurement or measurement on underwater-curing concrete.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	PS	SUS 304	Ni-Cr	0.5%(5,000)

## PM series Mold strain gauge Embedment type

P.60



These gauges are designed exclusively for the measurement of internal strain of concrete or mortar under loading test. These are embedded into the measurement position when the concrete or mortar is placed. These gauges have a construction of the sensing element sealed into the backing made of acrylic resin for waterproofing.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+60°C	Not applicable	Embedment	Special pla	Cu-Ni	N/A

## PMF series Mold strain gauge Embedment type

P.62



These gauges are designed for the measurement of internal strain of concrete or mortar under loading test. These can also be used for short-term measurement of the behavior of concrete. These are embedded into the measurement position when the concrete or mortar is placed. These employ super engineering plastics as the backing for sealing the sensing element, which provides excellent waterproofing. A temperature-integrated type PMFL-T is available for measurement of both strain and temperature using our data loggers.

\*For long-term measurement of concrete structures, the use of Strain Transducer KM is recommended.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+60°C	Not applicable	Embedment	Super engineering plastic	Cu-Ni	N/A

## CONCRETE MATERIAL CIVIL ENGINEERING USE

## KM Strain Transducer

P.63



The KM series are embedment type transducers designed for measurement of internal strain of materials such as concrete and synthetic resin not only in their hardened state but also in curing process. The apparent elastic modulus is as low as approx. 40N/mm<sup>2</sup>, and they are ideally suited to strain measurement during the very early stage of curing (except KM-A and KM-AT). They are totally impervious to moisture absorption producing excellent stability for long-term strain measurement. The KM-100B and KM-100BT are also applicable to measurement of surface strain of steel or concrete structures by using optional collars for surface installation.

## ASHPHALT USE, EMBEDMENT TYPE

## PMFLS series Asphalt Mold strain gauges

P.62



The gauges are embedded in asphalt and used for strain measurement in loading test such as rolling compaction. The material of the backing is super engineering plastics featuring high temperature resistivity and waterproofing performance. The gauges withstand a high temperature up to 200°C during placement of asphalt, while the operating temperature range is -20 to +60°C.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+60°C	Not applicable	Embedment	Special plastic	Cu-Ni	N/A

## ASPHALT PAVEMENT CIVIL ENGINEERING USE

P.64



## KM-HAS Strain Transducer

This transducer is embedded into asphalt for measurement of the internal strain. It has flanges with reinforcing bars on its both ends for good fixation to asphalt pavement materials. The operational temperature range of the transducer is -20 to +180°C, and it has a fully waterproof construction.

## COMPOSITE MATERIAL USE

## UBF series Composite strain gauges

P.65



These are strain gauges developed for measurement on composite materials. These have a specially designed grid pattern to reduce the stiffening effect of the strain gauge. In addition, owing to the development of gauge backing with better compliance, the number of repetition in thermal cycling test and the creep characteristics have been significantly improved compared to conventional strain gauges.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-30~+150°C	Not applicable	CN/EB-2	Polyimide-amide	Cu-Ni	3%(30,000)

## BF series Composite strain gauges

P.65



These are foil strain gauges designed for measurement on composite materials. These have a specially designed grid pattern to enable small stiffening effect and excellent performance in strain measurement up to 200°C. This series is available with self-temperature-compensation for a material having coefficient of thermal expansion of 3.5 or 8×10<sup>-6</sup>/°C. This series is recommended for use on ceramic, carbon and composite materials.

Operating temperature		Bonding adhesive	Materials		Strain limit (μ $\epsilon$ )
Normal	Compensation		Backing	Grid	
-20~+200°C	+10~+80°C	CN/NP-50B EB-2	Polyimide	Cu-Ni	3%(30,000)



## TML STRAIN GAUGES SELECTION

## LOW ELASTIC MATERIAL USE

## ¶ GF series strain gauges for plastics

P.66



These gauges are suited for the measurement on materials such as plastics, which have low elastic modulus compared to metal. These specially designed grid reduce the stiffening effect of the strain gauges to the specimen material, and also reduce the effect of Joule heat in the strain gauges. This series is available with self-temperature-compensation for the material having coefficient of thermal expansion of 50 or 70×10<sup>-6</sup>/°C.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN	Epoxy	Cu-Ni	3%(30,000)

## ¶ LF series strain gauges for wood gypsum

P.67



These are foil strain gauges for the measurement on materials having low elastic modulus such as wood or gypsum. These specially designed grid reduce the stiffening effect of the strain gauges to the specimen material. They have a backing made of epoxy resin, which is compliant to the strain on the specimen. These gauges are temperature-compensated for the material having coefficient of thermal expansion of 11×10<sup>-6</sup>/°C

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN-E	Epoxy	Cu-Ni	3%(30,000)

## WOOD MATERIAL USE FOR LONG TERM OF PERIOD

## ¶ PFLW and PLW series strain gauges

P.67



These gauges are specially designed for long term measurement on wood. It has a metal foil lined on the back of the PFL or PL strain gauge. The metal foil is effective to protect the strain gauge from the influence of moisture in the wood.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	PS	Polyester	Cu-Ni	2%(20,000)

## MAGNETIC FIELD USE

## ¶ MF series strain gauges

P.68



These gauges are designed for strain measurement in the magnetic field. The gauges have a sensing element material which exhibits low magnetoresistance. In addition, the sensing element consists of two identical grids with one grid folded back on another. This construction makes the strain gauges less sensitive to the influence of the alternating field. These gauges have a twisted leadwire pre-attached which is also effective to avoid the influence of the alternating field. The 2-element and 3-element gauges of this series are usable in high temperature up to 200°C.

Single element with twisted Vinyl leadwire of 1m

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	+10~+80°C	CN/CN-E/RP-2	Epoxy	Ni-Cr	1%(10,000)

2-/3-axis element Rosette, stacked  
with 3-wire twisted Fluorinated (FEP) resin leadwire of 1m

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+200°C	+10~+100°C	CN/CN-E/RP-2 NP-50B	Polyimide	Ni-Cr	1%(10,000)

## POST-YIELD (Large strain) MEASUREMENT

## ¶ YEF series Post-yeild strain gauges

P.69



These gauges are applicable to the measurement of large strain up to 10~15%. Also they withstand the repeated strain in elastic range (at strain level ±1500×10<sup>-6</sup> strain) like as ordinary strain gauges. However, these are not applicable to the measurement of repeated strain in a large range.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	N/A	CN/CN-Y	Special plastics	Cu-Ni	YEF: 10~15%

## ¶ YF series Post-yeild strain gauges

P.69

These gauges are applicable to the measurement of large strain up to 15 to 20%. The gauges are not applicable to the measurement of repeated strain in elastic range as well as in large range.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-20~+80°C	N/A	CN/CN-Y	Special plastics	Cu-Ni	YF :15~20%

## ¶ YHF series Post-yeild strain gauges

P.69

These gauges are developed for the measurement of very large strain up to 30~40%. These are not applicable to the measurement of repeated strain in elastic range as well as in large range.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-30~+80°C	N/A	CN/CN-Y	Special plastics	Special	YHF: 30~40%

## HIGH ENDURANCE STRAIN GAUGE

## ¶ DSF series strain gauge

P.71



These gauges are designed for fatigue test in high stress level. The gauges satisfy the fatigue life over 10 million times at a strain level of ±3000μϵ. These are available for use in cyclic loading test of composite materials.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-60~+200°C	N/A	CN/EB-2/C-1	Polyimide	Special	N/A

## ONE-SIDE STRAIN MEASUREMENT

## ¶ DD series One-side strain gauges

P.71



These gauges are intended for measuring the bending and tensile strains separately by simply bonding the gauges on one side of a plate or beam. These work on the assumption that the strain distribution in the section of the specimen is linear along the height of the section when the section is subjected to both tensile and bending stress. These gauges are effectively used for the measurement of a box construction in structures such as bridges or pressure vessels, where the reverse side of the measurement object is not accessible for strain gauge installation.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-10~+70°C	N/A	CN, P-2	Acrylic	Cu-Ni	0.15%(1,500)

## CRACK DETECTION GAUGE

## ¶ FAC series Crack detection gauges

P.72



These gauges are designed to measure the propagation speed of fatigue crack in a metal specimen. The gauges are bonded with an adhesive on the position where the crack is initiated or the crack initiation is expected. The grids of the gauges, which are aligned with interval of 0.1mm or 0.5mm, are disconnected one by one with the propagation of the crack. The gauges are used together with the crack gauge adaptor CGA-120B, and the disconnection of one grid is measured as the change of approx. 45 or 40× 10<sup>-6</sup> strain by a strainmeter.

Operating temperature		Bonding adhesive	Materials		Strain limit (μϵ)
Normal	Compensation		Backing	Grid	
-30~+80°C	N/A	CN, RP-2	Epoxy	Cu-Ni	N/A

**STRESS GAUGE****¶ SF series Stress gauges**

P.72



These gauges are intended to measure the stress in an optional direction of the specimen in plane stress field. The gauges are sensitive not only in their axial direction but also in their transverse direction, and the sensitivity ratio of the transverse direction to the axial directions is equal to the Poisson's ratio of the specimen material. In addition, the gauges are not sensitive to the shearing strain. Accordingly, the output of the gauges is proportional to the stress in the axial direction. The gauges are available in three types depending on the Poisson's ratio of the specimen material.

Operating temperature		Bonding adhesive	Materials		Strain limit (με)
Normal	Compensation		Backing	Grid	
-20~+200°C	+10~+100°C	CN/NP-50B C-1	Polyimide	Cu-Ni	N/A

**BOLT AXIAL STRAIN MEASUREMENT EMBEDMENT TYPE****¶ BTM series Bolt strain gauges**

P.75



These gauges are used for measurement of tensile strain of bolt. These are simply inserted into a pre-drilled hole in the bolt head together with A-2 bonding adhesive and cured. The gauge series is recommendable if an ordinary strain gauge cannot be mounted on the bolt surface. Accurate tensile force measurement is possible by calibrating the bolt after installing the bolt gauges.

Operating temperature		Bonding adhesive	Materials		Strain limit (με)
Normal	Compensation		Backing	Grid	
-10~+80°C	N/A	A-2	Special plastics	Cu-Ni	0.5%(5,000)

**¶ BTMC series Bolt strain gauges**

P.75

The BTMC series is also available for measurement of tensile strain of bolt, while it is designed with round shape sensing element to be easily bonded by fast-room-temperature curing CN adhesive. Accurate tensile force measurement is possible by calibrating the bolt after installing the bolt gauges.

Operating temperature		Bonding adhesive	Materials		Strain limit (με)
Normal	Compensation		Backing	Grid	
-10~+80°C	N/A	CN	Special plastics	Cu-Ni	0.5%(5,000)

**TRANSDUCER-SPECIFIC STRAIN GAUGES**

P.73

TML strain gauges are used not only for the purpose of knowing strain/stress but also as sensors for strain gauge type transducers. A strain gauge type transducer converts physical quantity such as load, pressure or displacement into mechanical strain on the strain generating body (elastic body), and the mechanical strain is converted into electrical output using strain gauges mounted on the elastic body. We offer various types of transducer-specific strain gauges featuring highly reliable and stable performance.

**TEMPERATURE GAUGE****¶ TF series Temperature gauge**

P.77



These gauges are bonded on the specimen surface like as ordinary strain gauges, and measure the surface temperature. By combining with the dedicated temperature gauge adaptor (TGA-1A or TGA-1B), actual temperature can be measured easily using a strainmeter.

Operating temperature		Bonding adhesive	Materials		Strain limit (με)
Normal	Compensation		Backing	Grid	
-20~+200°C	N/A	CN/NP-50B C-1	Polyimide	Ni alloy	N/A

**FRICITION TYPE STRAIN TRANSDUCER/CHECKER****¶ FGAH-1A Axial Strain Transducer**

P.84



This is a transducer to measure the axial strain of the steering tie-rod of a car or the tension rod of a structure. Since frictional strain gauges are used in this transducer, installation is completed and it gets ready for measurement by merely pinching the tie-rod with the transducer, without detaching the tie-rod. In addition, there is no need of technical skill and complicated works for attaching strain gauges on the tie-rod.

**¶ FGDH Frictional Torque Transducer (Digital telemetry)**

P.85



This is a transducer to measure torque on the drive shaft of a car. Frictional strain gauges are used as sensing elements, and the installation is completed by merely pinching the shaft with the transducer. There is no need of detaching the shaft nor bonding and wiring strain gauges for the installation. In addition, since a telemetry transmitter with battery is built in the transducer, measured data are transferred to an exclusive receiver by wireless and output as analog signals. The transducer is applicable to shafts having diameter of 20mm to 30mm using spacers together, which are available as optional items. For wireless transmission, the FGDH-2A uses 315MHz band extremely low power radio wave while the FGDH-3A uses 2.4GHz band advanced low power radio communication system.

**¶ FGMH series Strain Checker**

P.87



An ordinary strain gauge picks up the strain generated in the specimen through the adhesive layer. The Strain checker FGMH picks up the strain through the frictional force working on the contact surface of the frictional strain gauge by pressing the gauge against the structure with magnetic force. The checker can be easily fixed on the position of interest and immediately get ready for strain measurement. The FGMH-1B is a standard type of small and lightweight construction. The FGMH-2A features measurement in a narrow place such as near a welding point. These are for single axis measurement. The FGMH-3A is a 3-element type of 0°/45°/90° rectangular rosette configuration.