

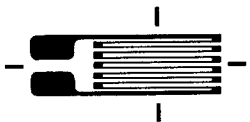
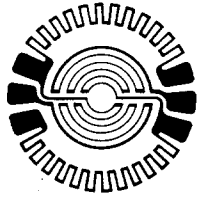

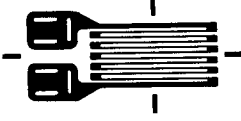

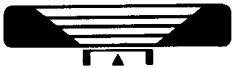

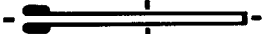


RS 632-124 N11-MA2-120-11 2mm
 RS 632-145 N11-MA2-120-23 2mm
 RS 632-168 N11-MA5-120-11 5mm
 RS 632-180 N11-MA5-120-23 5mm

RS 308-102 N11-FA8-120-11 8mm
 RS 308-118 N11-FA8-120-23 8mm

FOIL STRAIN GAUGES AND ACCESSORIES

(TERMINALS/CEMENT)

CODES FOR BASIC PATTERNS

N		Q	
R		Y	
T		C	
U		X	
Z		P	

CODES

FOR BASIC PATTERN COMBINATIONS

11	21	31		51
—	L	∟		
	22	32		
	+	*		
	23			
	24	34	44	
	T	△	◎	
		35		
		∟		

Y: Yielding type.

For measurement of large strains ranging to plastic sphere. Designed not to cause stress concentration at the point where leads are soldered.

C: For crack analysis.

Gauge grids are arranged in parallel. Gauge resistance increases in the form of stairs when a crack takes place somewhere within the grids.

X: For crack propagation detection.

With the lengthy grid of this gauge, cracks propagating extensively can be sensed.

P: For application to internal surface of pipes or threaded holes where gauges are difficult to install.

The test object is perforated for installation of this gauge inside. Note however that application is considerably critical as the gauge is likely to be damaged when installed or its performance is affected by air bubbles introduced during installation.

* W: Waterproof Moulded Type Strain Gauge

Vinyl cable (2 parallel wires of 1 mm. in external dia., resp.) is being connected with strain gauge and the gauge is moulded with special Epoxy resins. No special protection for waterproofing is necessary after its having been installed on the test object. This feature can be applied to all versions in Nxx-FA Series, except N34, N35 and N51.

FEATURES :

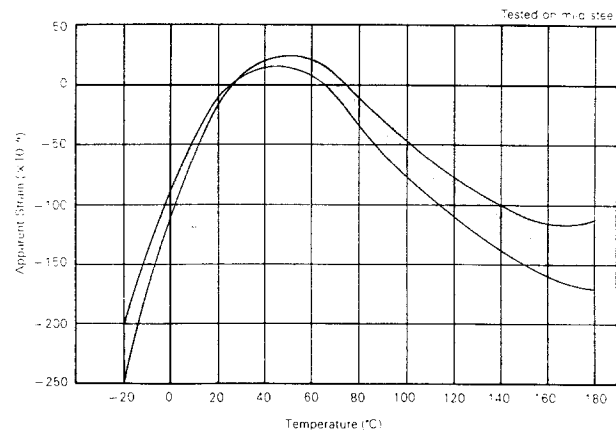
- * Almost no effect on test object.
- * Distant and multi-points measurements are possible.
- * Applicable to both static and dynamic strains.
- * Both surfaces being completely laminated, the gauge grids are entirely protected.
- * The gauges, being fitted with leads, are easy to handle.

STANDARD SPECIFICATIONS :

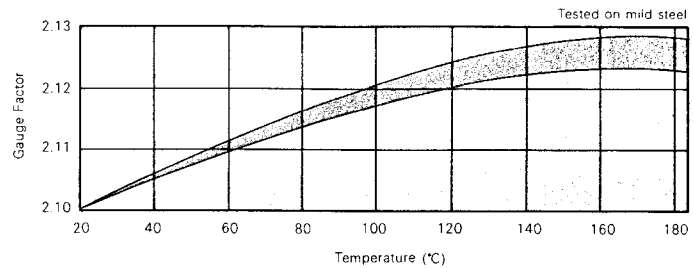
Gauge Length	0.3 mm. min. to 60 mm. max.
Measurable Strain	2 to 4% maximum. Up to 10% with foil yielding strain gauges.
Temperature Range	FA (Polyester Backing) -30°C to +80°C MA (Polyimide Backing) -30°C to +180°C
Thermal Output (See Fig. 1)	FA: Within $\pm 2\mu\epsilon/^\circ\text{C}$ (At room temperature up to +80°C) MA: Within $\pm 2\mu\epsilon/^\circ\text{C}$ (At room temperature up to +160°C) Within $\pm 5\mu\epsilon/^\circ\text{C}$ (At +160°C up to +180°C)
Gauge Factor Change with Temperature (See Fig. 2)	Within $\pm 0.015\%/^\circ\text{C}$
Gauge Resistance Tolerance	Within $\pm 0.5\%$ of the nominal resistance.
Gauge Factor	2.00 (Nominal)
Gauge Factor Tolerance	Within $\pm 1\%$ of the value indicated on individual gauge packet for gauge lengths of 5 mm. to 60 mm. Within $\pm 2\%$ of the value indicated on individual gauge packet for gauge lengths of 0.3 mm. to 3 mm.
Fatigue Life	More than 10^5 reversals at 1000×10^{-6} strain.

GENERAL PERFORMANCES OF TYPE N11-MA-5-120-11 STRAIN GAUGE

Thermal Output Characteristics (Fig.1)



Gauge Factor variation with temperature (Fig. 2)



CONFIGURATIONS :

N11-FA-5-350-16-L03


- Optional Specifications
03: Length of Leads
L Resin Clad Copper Wire (Up to 0.3m)
W Waterproof Moulded Type* (See page 1)
P Optional Pattern Type
(Subject to special quotations)
- Linear Expansion Factor of Material against which Strain Gauge is self-temperature compensated and its base colour classification

Base Colour	Materials against which strain gauge is self-temperature compensated	Linear expansion factor of materials	Codes
Red	Mild steel	$10.8 \times 10^{-6}/^\circ\text{C}$	11
Orange	Stainless steel	$16.2 \times 10^{-6}/^\circ\text{C}$	16
Blue	Aluminium alloy	$23.4 \times 10^{-6}/^\circ\text{C}$	23

Remarks : Base colour classifications are made in FA Series only.
Code of "11" for mild steel can be deleted.

- Gauge Resistance
Expressing strain gauge nominal resistance in the unit of Ω . Can be deleted when nominal resistance is 120 Ω .
- Gauge Length
Expressing grid effective length in figures in the unit of mm.
- Foil Material
A: Cu-Ni Alloy
- Base Material
F: Polyester, M: Polyimide
- Basic Pattern and its Combinations

PATTERNS AND SPECIFICATIONS :

Strain Gauge Pattern	Type	Nominal Resistance (Ω)	Dimensions(mm)				Approx. Gauge Factor	Material against which strain gauge is self temperature compensated			Compatible Cement				Number of Gauges per Packer
			Grid		Base			Mid Steel (11)	Stainless Steel (18)	Aluminum Alloy (23)	F1	F3	18M	E110	
			Length	Width	Length	Width									
	N11-FA-03-120-(11,16,23)	120	0.3	1.8	3.5	2.5	1.9	●	●	●	●	●	●	●	10
	N11-FA- 1-120-(11,16,23)	120	1.0	1.5	4.0	2.5	2.0	●	●	●	●	●	●	●	
	N11-FA- 2- 60-(11)	60	2.0	1.6	6.0	2.5	2.0	●	●	●	●	●	●	●	
	N11-FA- 2-120-(11,16,23)	120	2.0	1.6	6.0	2.5	2.0	●	●	●	●	●	●	●	
	N11-FA- 2-350-(11,16,23)	350	2.0	2.2	7.0	3.5	2.0	●	●	●	●	●	●	●	
	N11-FA- 5- 60-(11)	60	5.0	1.8	9.5	3.5	2.1	●	●	●	●	●	●	●	
	N11-FA- 5-120-(11,16,23)	120	5.0	1.8	9.5	3.5	2.1	●	●	●	●	●	●	●	
	N11-FA- 5-350-(11,16,23)	350	5.0	2.6	11.0	4.0	2.1	●	●	●	●	●	●	●	
	N11-FA- 8-120-(11,16,23)	120	8.0	2.0	13.0	4.0	2.1	●	●	●	●	●	●	●	
	N11-FA- 8-350-(11,16,23)	350	8.0	4.0	14.0	6.0	2.1	●	●	●	●	●	●	●	
	N11-FA-10-120-(11,16,23)	120	10.0	2.2	15.0	5.0	2.1	●	●	●	●	●	●	●	
	N11-FA-10-350-(11,16,23)	350	10.0	4.5	18.0	6.5	2.1	●	●	●	●	●	●	●	
	N11-FA-10-600-(11)	600	10.0	3.0	16.0	5.0	2.1	●	●	●	●	●	●	●	
	N11-FA-10-1000-(11)	1000	10.0	4.5	15.0	6.0	2.0	●	●	●	●	●	●	●	
	N11-FA-30-120-(11)	120	30.0	1.2	40.0	4.5	2.1	●	●	●	●	●	●	●	
	N11-FA-60-120-(11)	120	60.0	2.2	65.0	5.5	2.1	●	●	●	●	●	●	●	
	N11-MA-03-120-(11,16,23)	120	0.3	1.8	3.5	2.5	1.9	●	●	●	●	●	●	●	
	N11-MA- 1-120-(11,16,23)	120	1.0	1.5	4.0	2.5	2.0	●	●	●	●	●	●	●	
	N11-MA- 2-120-(11,16,23)	120	2.0	1.6	6.0	2.5	2.0	●	●	●	●	●	●	●	
	N11-MA- 2-350-(11)	350	2.0	2.2	7.0	3.5	2.0	●	●	●	●	●	●	●	
	N11-MA- 5-120-(11,16,23)	120	5.0	1.8	9.5	3.5	2.1	●	●	●	●	●	●	●	
	N11-MA- 5-350-(11)	350	5.0	2.6	11.0	4.0	2.1	●	●	●	●	●	●	●	
	N11-MA- 8-120-(11,16,23)	120	8.0	2.0	13.0	4.0	2.1	●	●	●	●	●	●	●	
	N11-MA- 8-350-(11)	350	8.0	4.0	14.0	6.0	2.1	●	●	●	●	●	●	●	
N11-MA-10-120-(11,16,23)	120	10.0	2.2	15.0	5.0	2.1	●	●	●	●	●	●	●		
N11-MA-10-350-(11)	350	10.0	4.5	18.0	6.5	2.1	●	●	●	●	●	●	●		
N11-MA-10-600-(11)	600	10.0	3.0	16.0	5.0	2.1	●	●	●	●	●	●	●		
N11-MA-10-1000-(11)	1000	10.0	4.5	15.0	6.0	2.0	●	●	●	●	●	●	●		

INSTRUCTIONS

In order to obtain the best possible results from a strain gauge installation it is important that care and attention is given to the preparation of the gauge, the surface of the specimen, and bonding techniques.

Whilst circumstances may call for variations in technique for particular installations, the following instructions based on extensive experience, should ensure the complete success of the bonding of Showa foil strain gauges. In applications where it is considered there may be special problems, we will be pleased to give any advice and assistance we can.

1. Specimen Surface Preparation.

An area larger than the installation should be cleared of all paint, rust etc., and finally smoothed with a fine grade emery paper or fine sand blasting to provide a sound bonding surface. The area should now be degreased with a solvent such as trichlorethylene and finally neutralised with a weak detergent solution. One should use tissue for this operation, wetting the surface and wiping off with clean tissues until the final tissue used is stain free. Care must be taken not to wipe grease from a surrounding area onto the prepared area or to touch the surface with the fingers.

This final cleaning should take place immediately prior to installing the strain gauges.

2. Strain Gauge Preparation.

Normally the gauge is ready for applying as soon as it is removed from the packet but, experience shows that some engineers prefer to roughen the back of the gauge before applying it. Extreme care should be taken and the area under the tags should be avoided. One method is to sprinkle pumice powder onto a piece of blotting paper and with one finger tip lightly rub the back of the gauge over the powder. Remove all products of the abrasion and wipe back of gauge with a tissue.

Note: It is advisable not to mix the adhesive until all the gauges to be installed have been prepared to this stage.

3. Strain Gauge Installation.

By sticking a short length of sellotape lengthways along the upper face of the gauge it may be picked up from a flat clean surface. Holding both ends of the tape, orientate the gauge in the desired location and stick the end of the tape furthest from the tags, to the specimen. Bend the other end of the tape back on itself thereby exposing the

back of the gauge.

Adhesives.

Three basic types of adhesives are recommended: (1) Epoxy resin, (2) Phenol-Epoxy resin and (3) pressure sensitive (Cyanoacrylate series) adhesive.

The single component pressure sensitive adhesive is recommended where fast bond and thin glue are optimum requirements as this adhesive reacts immediately upon water contained in the atmospheric air.

For an installation where long term stability under adverse atmospheric conditions is the main requirement one should use Epoxy or Phenol-Epoxy system. F3 cement is simple to use and may be cured at ambient room temperature, whilst F1 cement has excellent heat resistance quality. E110 is most suitable for use with MA Series (Polyimide backing) gauges for high temperature application.

i) Epoxy Adhesives F1 and F3.

Coat the exposed back of the gauge with adhesive and gently push the gauge down into position, at the same time wiping excessive adhesive to the two outside edges of the gauge. Stick the whole length of the sellotape to hold the gauge in position, cover the area with the piece of polyethylene provided and apply a light weight or clamp as required. Care should be taken that there is an even layer of adhesive and no air bubbles are left under the grid. The installation is now ready for curing. After curing remove the tape as per para. 4.

F1	10 parts resin :	2 parts hardener	2 hrs. at 100°C
F3	10 parts resin :	6 parts hardener	24 hrs. at room temp.

Of this two pack adhesive, the base material (A) is inert, and this should be harmless when in contact with human tissue.

The hardener (B) is slightly toxic and can possibly be harmful if allowed in contact with human tissue.

Warning:

- Do not allow the mixed or unmixed materials to contact skin. Protective gloves should be worn. Should skin be inadvertently contaminated it must be washed off immediately and thoroughly, with soap or detergent and water.***
- If heat is applied to accelerate the cure time of the adhesive then adequate ventilation is necessary to avoid inhalation of resulting fumes.***

ii) Phenol-Epoxy Adhesive E110.

The cement is spread by brush or by spatula on both the specimen surface and strain gauges and these must then be left in this condition and dried in a clean atmosphere for 1 to 3 hours in order to allow evaporation of solvents from the cement. If cement is applied by spraygun, the cement should be diluted before it is applied, by methyl-ethyl-ketone until its solidity rate

reaches to 20%. After drying, both the strain gauges and the specimen surface are contacted face to face and clamped and heated in an oven for 30 minutes at 140°C to complete bonding.

iii) Pressure Sensitive Adhesive 18M.

Follow strain gauge installation instructions as above sticking one end of the tape down to the specimen completely up to the gauge. Drop a fillit of adhesive in the 'hinge' formed by the gauge and the specimen. Starting at the fixed end with one finger push the gauge down at the same time pushing the adhesive along the gauge in a single wiping motion until the whole gauge is stuck down. Apply pressure with the finger over the whole length of the gauge for one minute. Extra attention may need to be given to the tag and lead wire area.

4. Removing the tape.

Remove the tape by slowly and very carefully pulling it back over itself starting at the end furthest from the tags. Do not pull upwards.

5. Wiring.

Showa strain gauges are fitted with short leads and it is standard practice to wire these to small stick-on or self adhesive terminals placed adjacent to the gauges. These serve as a bridge-completion point and a change-over point to the heavier wire required for the run to measuring or recording instruments.

The lead out wires from the gauges are fragile, and should be handled with care. Preparatory tinning of the ends of the leadout wires, connecting cables and terminals is recommended. Be sure to remove all traces of flux or soldering paste with trichlorethylene.

6. Installation Protection.

Showa strain gauges are encapsulated and therefore are protected from dust and draughts, etc. This encapsulation serves to make any required form of protection all the more efficient. In choosing a protective coating one should study completely the environment in which the installation is to function and the length of time the installation will be required to function in such environment. One should also pay special attention to the wiring especially if the installation is required to be immersed in water.

There are numerous forms of protection available and we will be pleased to advise you on your particular installation.

High Elongation (Yielding) Strain Gauges.

Generally speaking the foregoing instructions apply also for the bonding of high elongation gauges but there are some specific aspects of the technique which should be followed.

- a F3 or 18M cement is recommended, but in each case the layer of cement between the gauge and specimen surface must be as thin and uniform as possible.
- b It is desirable not to apply any coating material to the installation. Silicone rubber, however, may be thinly applied if necessary.
- c Lead-out wires should be raised and looped in order to keep them free from strains taking place in the test object.
- d Terminals should be used and an excessive amount of solder on the terminals should be avoided.

"P" Series Gauge ("Pipe" Gauge)

This series is intended, for measurement, to be inserted into the test object. Care should be exercised for the handling and installation of this gauge especially when carrying the gauge into the hole prepared on the test object. Removal of air bubbles from the adhesive mixture is also very important in order to prevent any damages from taking place on the gauge or to attain the better measuring results.

Brief instructions:—

- a Prepare a hole of 2.3 mm dia. on the test object.
- b F1 or F3 cement is used for "P" Series gauge. Apply a well mixed adhesive eliminating any air bubbles to the internal surface of that hole. Insert the gauge gently into the hole.
- c After having applied adhesive to the hole and placed the gauge in position, the adhesive is left cured as per para. 3.i).
- d Wire the strain gauge leads to terminals placed adjacent to the hole. Care should be given to the fact that the leads, if covered with splashes of adhesive, are likely to be broken.