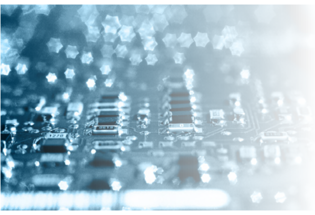
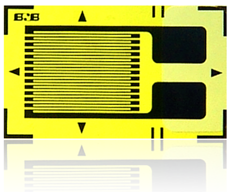
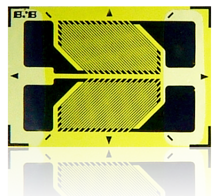
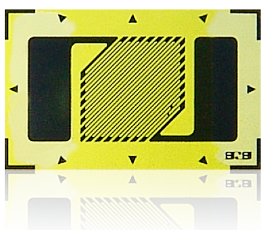
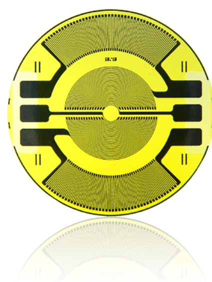










Strain Gauge Catalogue

Company Profile

ZEMIC, founded in 1965 by the Chinese aviation industry (AVIC), has built up a reputation as one of the leading suppliers of load cells, strain gages and sensors in the Asian region and as a manufacturer of many known brand names in the European and American load cell market. This is largely due to the quality and versatility of our products. Furthermore, our customers place increasingly more value on reliable service, from stock deliveries and professional consultancy in the area of application know–how.

We are here to help our European customers with all enquiries and assisting you with your challenges. With 30 years of being active in the field of weighing you can expect from us a professional technical support for your application and we can give you advice for the "best fit" load cell, mounting hardware, strain gage or pressure and torque transducer. Zemic Europe can also offer you your own private label with or without OIML approvals and if our wide range of standard products does not meet your requirements our engineering staff of over 200 engineers is ready to design a special product according to your specifications.

Our Head office in Europe is based in The Netherlands from where we stock thousands of products which can be delivered within 3 days to anywhere in Europe.

CONTENT

Strain Gauge Introduction

ZEMIC was founded in 1965 and its roots come from the Chinese Aviation industry. Today ZEMIC is one of the loading manufacturers of strain gauges. With over 50 years of experience in the development and production of strain gauges, ZEMIC produces a high quality and wide variation of strain gauges in high volume. With our experience and development expertise, ZEMIC has become one of the largest manufacturers of strain gauges. Zemic Europe takes care of the sales, marketing and distribution within Europe. Zemic Europe is a centre of competence within the weighing industry and is able to supply everyone with the best solution for their stress analysis and weighing applications.

ZEMIC strain gauges are produced according to the OIML R62 regulations and the RoHS environmental directives. All ZEMIC strain gauges are in accordance with the needs for sophisticated stress analysis and high–precision strain gauge sensors. With sustainable and efficient technology research and development systems, ZEMIC upkeeps the strict quality assurance system. With professional and reliable technology ZEMIC is able to produce an annual output of over 50 million stable, reliable and first–class quality strain gauges which are divided in more than a dozen series and over a thousand different specifications.

Please note

The Products described in this manual, although ZEMIC has carefully proofread and verified its accuracy and correctness and the information inside is believed to be correct, Specifications and dimensions are subject to change without notice and do not constitute any liability whatsoever. For the application of the products which need specific requirements or in special conditions please advise the supplier for verification and validation of the suitability of the strain gauges in that certain situation. Please note: ZEMIC and ZEMIC Europe attempt to supply the product information and use correctly and up to date. However, if the products are used correctly or incorrectly and cause any direct or indirect damage no liability can be constituted to ZEMIC or ZEMIC Europe.

Security warning for Life Technology applications

If in Life−support systems, components fail or stop functioning correctly it will directly threaten a human life or could cause lifelong damages to a human being. The products described in this catalogue are not to be used or recommended for use in life−support systems. If done anyway the user or customer must carefully understand and be aware of the risks of applying the products displayed in this catalogue. If used the user or customer will voluntarily take all risk resulting from direct or indirect consequences caused by failure of the products described in this catalogue. ZEMIC and ZEMIC Europe will not be constituted any liability whatsoever.

With these warnings, when a user or customer buys products from this catalogue, the customer or user takes full responsibility of possible direct or indirect damages caused by the products.

1. Self-Temperature Compensation

Introduction

Strain gauges are usually installed on a surface whether it is for stress analyses or sensor production, without any external forces applied to the surface. When environmental temperature changes, the resistance of the strain gauge changes accordingly. This phenomenon is called the strain gauges thermal output. This thermal output is the result of interactions and superposition of the resistance temperature coefficient of grid materials, the sensitive grid materials and the linear expansion coefficient. The effects of these factors is described in the formula below:

$$\varepsilon_t=[(\alpha_g/K)+(\beta_S-\beta_g)]\Delta t$$

In this formula α_g and β_g refer to the resistance temperature coefficient of the grid material and the linear expansion coefficient of the strain gauge. K refers to the strain gauges gauge–factor and β_s refers to the linear expansion coefficient of the tested object . Δt refers to the relative change in temperature of the tested subject and environment.

Common strain gauges often have a large thermal output as shown in figure 1. Thermal output is the biggest source of errors in static strain measurements. When temperature increases the dispersion and therefore the thermal output value increases. Ideally the thermal output of strain gauges should be zero. To meet this requirement a self–temperature compensating strain gauge is used. In figure 2 the typical thermal output of a constantan and a self–temperature compensating karma strain gauge are displayed.

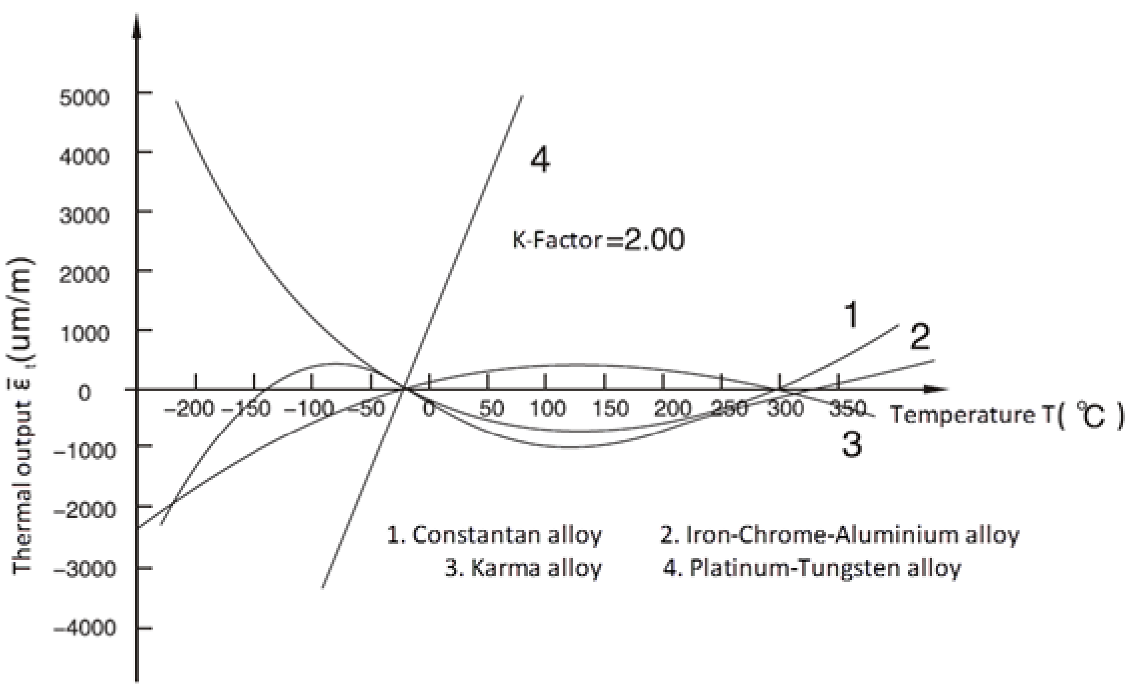


Figure 1: Thermal output curve of strain gauges on different steel materials

Strain gauge compensation theory and method

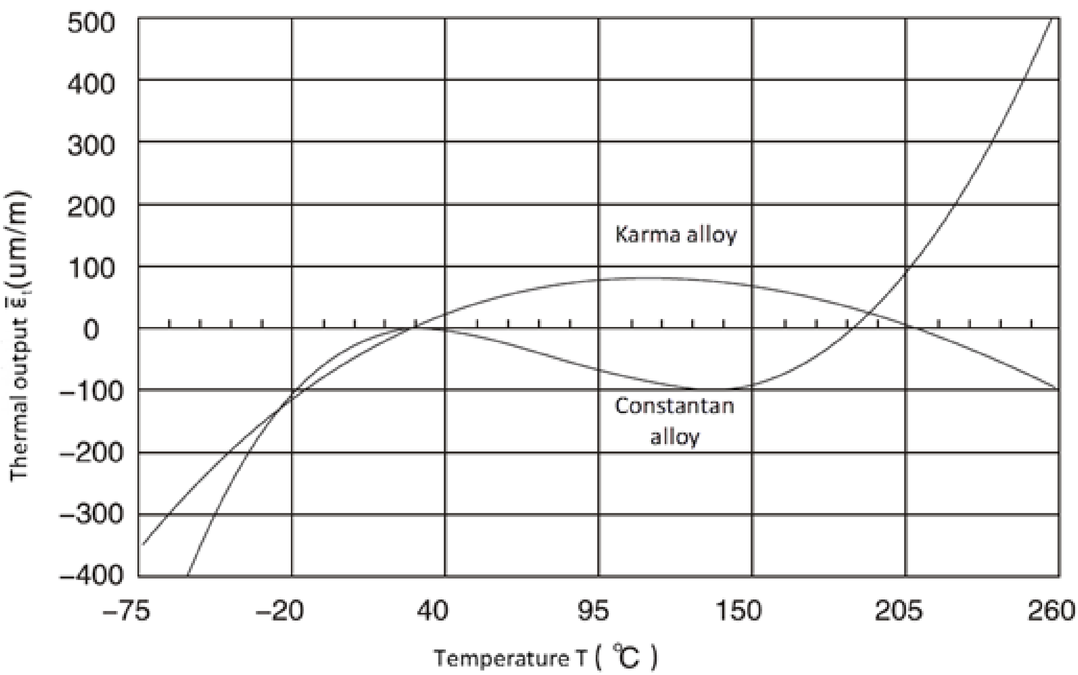


Figure 2: Thermal output for Self−Temperature compensated Karma and Constantan alloy strain gauges

By adjusting the composition ratio of the alloys of the strain gauge sensitivity grid material, and make use of cold rolling and proper heat treatment, the internal crystalline structure of the gauge material can be altered in a way it will compensate the changes of the material due to temperature change. This way the change in Thermal output can be kept very close to zero and the standards for high−precision sensors and stress analysis can be met. Note that the self−temperature compensation is only in a small temperature range from approximately + 20℃ up to +250℃ .

Choice in Self-Temperature compensation

Currently ZEMIC offers a range of different Self−Temperature compensated strain gauges which are divided in ranges of compensations for different materials from which the test surface is made of. ZEMIC currently offers the following:

- 9: Titanium test surfaces with a typical expansion coefficient of 8.8 x 10^{-6} / ℃
- 11: Martensitic, Age hardenable−stainless and alloy steel test surfaces with a typical expansion coefficient of 11.3 x 10^{-6} / ℃
- 16: Copper−based and austenitic stainless steel test surfaces with a typical expansion coefficient of 16 x 10^{-6} / ℃
- 23: Aluminium−alloy test surfaces with a typical expansion coefficient of 23.2 x 10^{-6} / ℃
- 27: Magnesium−alloy test surfaces with a typical expansion coefficient of 26.1 x 10^{-6} / ℃

When the temperature compensation of the strain gauge matches the test surface material, the thermal output of that test surface will be compensated within the temperature range and no further adjustments have to be made to this thermal output.

When the temperature self–compensating strain gauges test surface has a slight difference in material composition, or the self–temperature compensation of the strain gauge does not match the temperature coefficient of the material, a half or full bridge of strain gauges should be used to compensate the thermal output brought influences.

A quarter bridge setup for high precision stress measurements should consist of one strain gauge attached to a compensation object which has the same material as the test surface. In addition the compensation strain gauge and the strain gauge which is applied to the test surface should be of the same lot. The two strain gauges should be under the same temperature and environmental conditions and located next to each other in the Wheatstone bridge.

2. Self-Creep compensation

Introduction

Creep characteristics exist due to the elasticity of a spring element. This is a material characteristic. Due to this characteristic, a transducers output increases with the passing of time (Positive creep). This characteristic is depending on several variables such as the spring element material, structure, strain field, span, heat treatment and test temperature. The backing material of the strain gauges and the bonding adhesive have a very high viscoelasticity which results in an output decrease over time. On the other hand the grid material of the strain gauge has anelastic properties which results in a positive output change over time. The accumulation of these two make that a strain gauge can have either a positive or negative creep under fixed load. The direction and value of this compensation can be adjusted by modifying the design of the grid structure, backing material ratio and key technology parameters. For example, by changing the dimensions of the end grid and fixing the other parameters, a curve as seen in figure 3 can be created. After selecting the material of a spring element, a strain gauge can be selected with the same creep as the element but in the opposite direction. This way the creep can be compensated to a value close to 0. In the same way, during the production of transducers, the creep error which is caused by other factors can be compensated. In this way the creep value could be brought to a minimum and within specifications of the transducer. ZEMIC offers a wide variety of strain gauges for which the creep factor should be decided by the transducers manufacturers. The N* and T* codes in the strain gauge naming system are designated referrals to the creep code. Different codes refer to different creep values. For ZEMIC strain gauges the rule is as follows: the creep difference between two neighbouring codes is 0.01–0.015%FS/30min.

Strain gauge compensation theory and method

N9 > N7 > N5 > N3 > N1 > N0 > N8 > N6 > N4 > N2 > T0 > T2 > T4 > T6 > T8 > T1 > T3 > T5

+ ← Creep → −

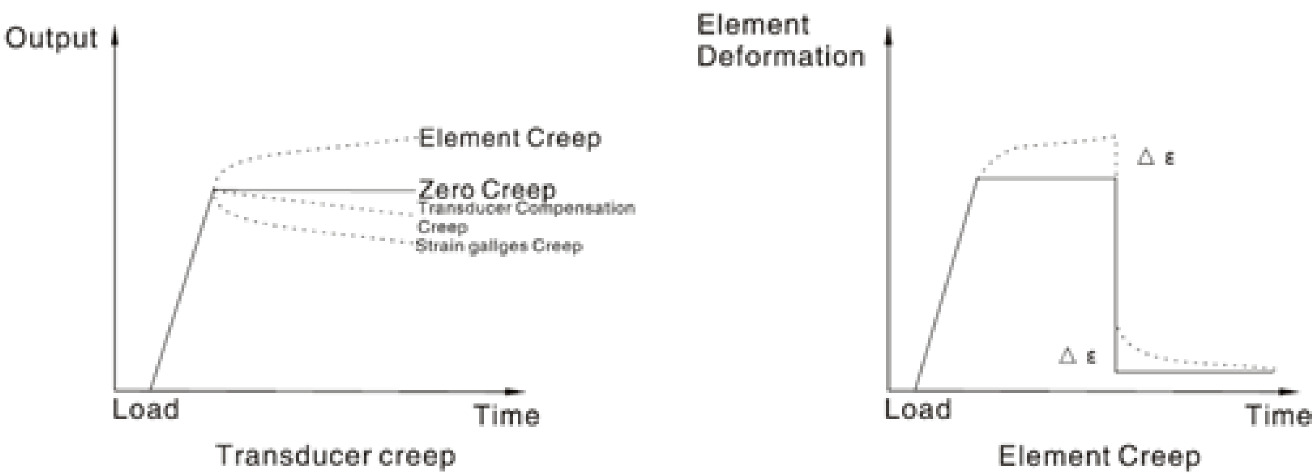


Figure 3: Creep compensation and effect of creep

Choice in Self-Creep compensation

It is advised when using strain gauges for the first time to select one or two models with a great difference in creep values and bond them to the spring element. The actual creep code will be determined according to the actual value of the creep and the difference with the applied strain gauges.

When selecting a strain gauge for transducers with the same spring materials and structure, the smaller the capacity the more positive creep will occur. Therefore the lower the capacity of the transducer, the bigger negative creep code should be chosen.

Different element materials show different creep characteristics. Therefore, different creep codes should be selected for the steel and aluminium transducers with the same capacity and structure.

The creep value of transducers is depending on many variables such as spring elements, strain gauge type, adhesive used as well as the way of sealing, the protective coating etc. The direction and magnitude of the creep however can be predicted to a certain amount and this should therefore be taken into account when selecting a strain gauge creep code.

3. Self-Elastic Modulus compensation

Introduction

With an increase of the ambient temperature around a strain gauge, the elastic modulus of the test subjects material usually decreases. According to Hooke's law, as environmental temperature increases the deformation of a structure will be bigger even of the applied load has not changed. Therefore, the strain which is measured by the strain gauges will also increase. When this happens, the gauge factor of a strain gauge should also decrease with temperature increase. This way the output of the strain gauge will not change with the change of elastic modulus due to temperature change. Strain gauges with a compensation of elastic modulus are called self–elastic modulus compensation strain gauges.
The function of these self–elastic modulus compensation gauges is the same as for normal strain gauges but also have the function of an elastic modulus compensation resistor. It also provides an accurate correction of the sensitivity error of transducers which is caused by the materials change in elastic modulus. If the correct self–elastic modulus compensation strain gauge is matched with the spring materials, the temperature drift of transducers will be less than 0.002%FS/℃ . Compared to commonly used methods, the self–elastic modulus compensating strain gauges have the advantage of having high accuracy in compensation, good stability, higher sensitivity, easier usage and lower cost. However, the thermal output of strain gauges which are only self–elastic modulus compensated is a little bit higher. Therefore zero temperature drift of transducers will be higher, this is a limitation which will improve the further precision of transducers. After many years of research, ZEMIC has been able to produce strain gauges which have both Self–Temperature and Self–Elastic Modulus compensation. This has solved problem which were especially present at half– and full bridge setups.
These strain gauges have become very popular because of their excellent temperature capability.

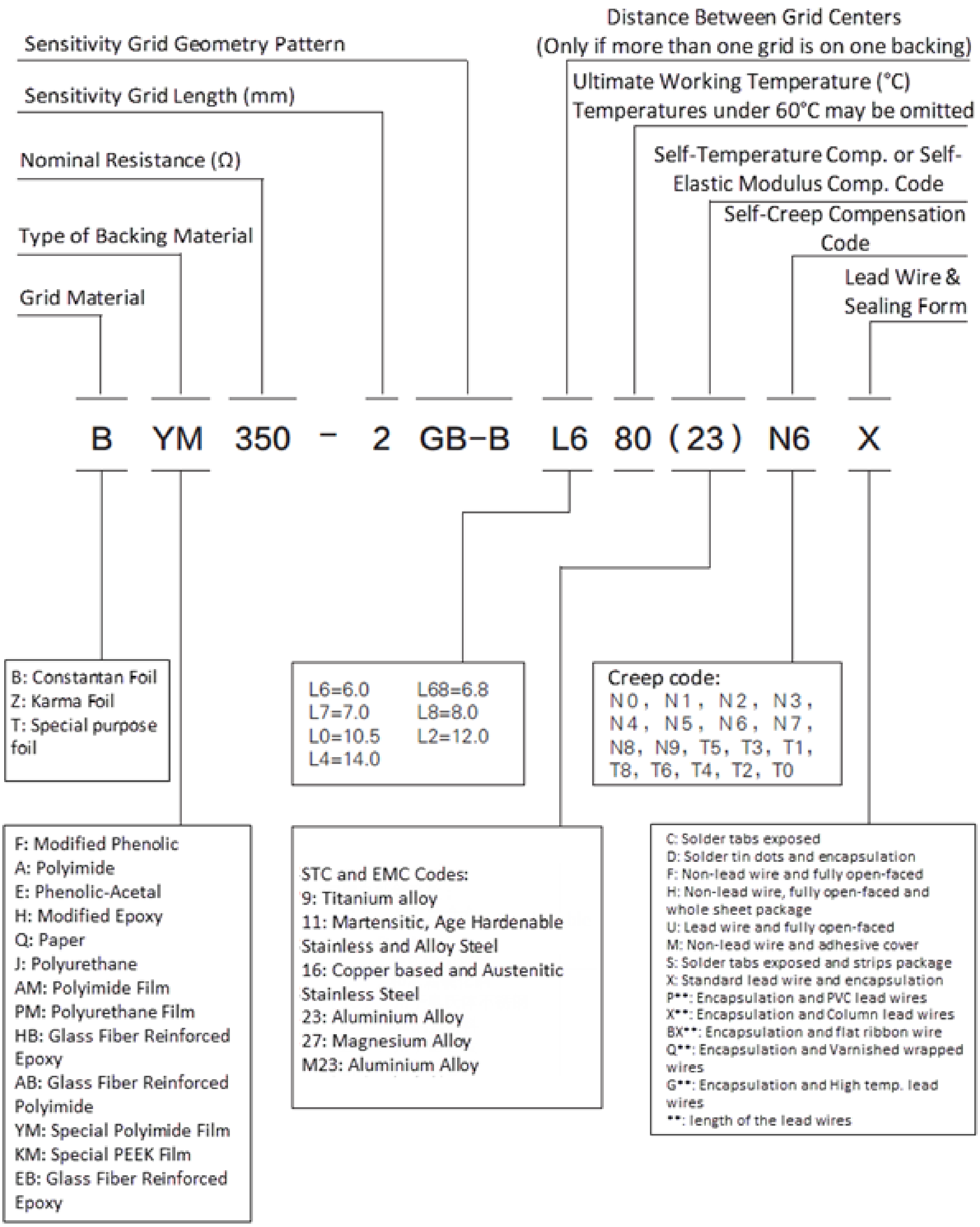
Choice in Self-Elastic Modulus compensation

In order to get a satisfactory compensation result the selected elastic modulus compensating strain gauge should match the elastic modulus change of the transducers spring material. Generally, it is advised to test the strain gauges on at least five different transducers.

For most materials, the self–temperature compensation of the strain gauges has only little effect. This is because the thermal output of the elements material is usually larger than the thermal output of the ordinary self–temperature compensated strain gauges. Therefore it is recommended to use them only for transducers with smaller temperature grads. For transducers with bigger temperature grads, it is better to use a half–bridge or full–bridge setup because this will reduce the zero–temperature drift.

Please note that self–elastic modulus compensation strain gauges are harder to solder than ordinary strain gauges. For soldering this strain gauges a special flux is advised which is available for purchase at ZEMIC and ZEMIC Europe. After soldering with flux please make sure you completely clean the strain gauge.

Strain gauge designation system



Strain Gauge Series Features and Specifications

BF Series

Fully encapsulated Constantan foil strain gauges with modified Phenolic backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy and excellent stability but only at room temperature. Especially suitable for accuracy class 3 transducers. Easy to use and available in a resistance range of 60 up to 1000Ω.

ZF Series

Fully encapsulated Karma foil strain gauges with modified Phenolic backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy and excellent stability over a wide temperature range. Especially suitable for accuracy class 0.02 transducers. Especially suitable for usage with DC/AC electronic weighing instruments.

BA Series

Fully encapsulated Constantan foil strain gauges with a polyimide backing. Offers Self–Temperature compensation. Has a high elongation rate and excellent heat resistance on a wide temperature range. Primarily intended for both stress analysis and normal accuracy transducers with usage of temperatures up to 150℃ .

BAM Series

Fully encapsulated Constantan foil strain gauges with thin polyimide film backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has a high elongation rate and excellent heat resistance on a wide temperature range and low hydroscopicity. Shows good specifications for creep and zero–return. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

BHB Series

Fully encapsulated Constantan foil strain gauges with glass fibre reinforced epoxy backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy and excellent stability over a wide temperature range and high moisture resistant capability. Has a low hydroscopicity and shows good specifications for creep and zero return. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

ZAM Series

Fully encapsulated Karma foil strain gauges with thin polyimide film backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy and excellent stability over a wide temperature range and high moisture resistant capability. Has a low hydroscopicity and shows good specifications for creep and zero return. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

BB (BAB) 250°C Series

Karma foil strain gauges with Glass Fibre Reinforced Polyimide Backing. Offers an excellent heat resistance, good insulation and high stability. The strain gauges are primarily used for both high precision stress analysis and accurate transducers with a usage temperature up to 250℃ .

BYM Series

Fully encapsulated Constantan foil strain gauges with a special thin polyimide film backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has a high elongation rate and excellent heat resistance on a wide temperature range and low hydroscopicity. Shows good specifications for creep and zero–return. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

ZYM Series

Fully encapsulated Karma foil strain gauges with a special thin polyimide film backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy and excellent stability over a wide temperature range and high moisture resistant capability. Has a low hydroscopicity and shows good specifications for creep and zero return. In addition it can realise high resistances with small size strain gauges which makes it excellent for usage in low power devices. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

BKM Series

Fully encapsulation Constantan foil strain gauge with a special PEEK film backing. Offers both Self–Temperature (or elastic modulus) and creep compensation simultaneously. Has high accuracy excellent stability and high moisture resistant capability. Shows good specifications for creep and zero return. The special PEEK film backing has an exceptional high toughness. The strain gauges are primarily intended for high accuracy transducers at class 3 or better.

BEB Series

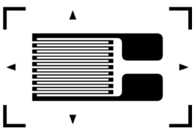
Fully encapsulation Constantan foil strain gauge with a Glass fibre reinforced epoxy backing. Offers both Self–Temperature and creep compensation simultaneously. Has an elastic modulus compensated backing. Has an excellent creep and zero return, responds quickly to applied load and recovers directly to zero. In addition it has a high thermal stability and is used for high precision transducers and high precision aluminium scales.

Strain gauge

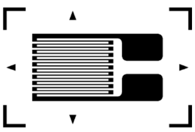
<table>
<tr><th>Series</th><th>Nominal Resistance (Ω)</th><th>Resistance Tolerance to average resistance</th><th>Gauge Factor</th><th>Dispersion of Gauge Factor</th><th>Strain Limit</th><th>Fatigue Life</th><th>STC Codes</th><th>Working temperature Range (℃)</th></tr>
<tr><td>BF Series</td><td rowspan="4">350, 650, 1000</td><td rowspan="7">⩽ ± 0.1%</td><td rowspan="3">2.00 ~ 2.20</td><td rowspan="11">⩽ ± 1%</td><td rowspan="7">2%</td><td rowspan="11">⩾ 10^7 (± 1000)</td><td rowspan="4">9, 11, 16, 23, 27</td><td rowspan="3">−30 ~ +80</td></tr>
<tr><td>BAM Series</td></tr>
<tr><td>BHB Series</td></tr>
<tr><td>BA Series</td><td rowspan="3">1.86 ~ 2.20</td><td>−86 ~ +150</td></tr>
<tr><td>ZF Series</td><td rowspan="2">350, 1000, 2000</td><td>9, 11, 16, 23, 27, M23</td><td rowspan="2">−20 ~ +80</td></tr>
<tr><td>ZAM Series</td><td rowspan="4">9, 11, 16, 23, 27</td></tr>
<tr><td>BB (BAB) 250℃ Series</td><td>120, 350</td><td>⩽ ± 0.15%</td><td>1.86 ~ 1.98</td><td>1.5%</td><td>−269 ~ +250</td></tr>
<tr><td>BYM Series</td><td rowspan="3">350, 650, 1000</td><td rowspan="4">⩽ ± 0.1%</td><td rowspan="3">2.00 ~ 2.20</td><td rowspan="4">2%</td><td rowspan="2">−20 ~ +100</td></tr>
<tr><td>BKM Series</td></tr>
<tr><td>BEB Series</td><td>11, 23</td><td>−20 ~ +80</td></tr>
<tr><td>ZYM Series</td><td>350, 1000, 3000</td><td>1.80 ~ 2.20</td><td>9, 11, 16, 23, 27</td><td>−20 ~ +100</td></tr>
</table>

<table>
<tr><th colspan="8">Strain Gauge Backing Material comparison chart</th></tr>
<tr><th rowspan="2">Series</th><th rowspan="2">Backing thickness(μm)</th><th rowspan="2">Protective layer thickness (μm)</th><th colspan="2">Hydrothermal stability</th><th colspan="2">Absorption rate</th><th rowspan="2">Insulation resistance (MΩ)</th></tr>
<tr><th>25℃ resistance change rate (ppm)</th><th>50℃ resistance change rate (ppm)</th><th>Room temper ature</th><th>50℃</th></tr>
<tr><td>Normal Strain Gauges</td><td>45 ~ 55</td><td>15 ~ 22</td><td>62</td><td>64</td><td>3.0%</td><td>4.0%</td><td>10^5</td></tr>
<tr><td>BYM/ZYM</td><td>30 ~ 31</td><td>13 ~ 15</td><td>28</td><td>29</td><td>0.6%</td><td>0.7%</td><td>10^6</td></tr>
<tr><td>BKM</td><td>30 ~ 31</td><td>25 ~ 27</td><td>23</td><td>25</td><td>0.3%</td><td>0.4%</td><td>10^6</td></tr>
<tr><td>BEB</td><td>30 ~ 40</td><td>20 ~ 30</td><td>33</td><td>36</td><td>0.5%</td><td>0.8%</td><td>10^5</td></tr>
</table>

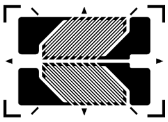
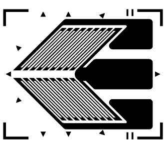
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)100–4AA(**)N*	4.0×1.9	8.0×3.6	T0	
	BYM(BKM、BEB)120–1AA(**)N*	1.0×1.9	4.3×3.5	T0	
	BYM(BKM、BEB)120–2AA(**)N*	1.8×1.8	5.2×3.2	T0	
	BYM(BKM、BEB)120–3AA(**)N*	2.8×2.0	6.4×3.5	T0、N0、N1、N3、N4、N6、N8	
	BYM(BKM、BEB)120–4AA(**)N*	4.0×3.3	7.9×4.6	N6	
	BYM(BKM、BEB)120–5AA(**)N*	5.0×2.0	10.1×4.0	N0	
	BYM(BKM、BEB)120–6AA(**)N*	5.9×2.7	9.8×4.3	N5	
	BYM(BKM、BEB)175–1AA(**)N*	1.5×2.6	4.6×3.6	N0、N6、N8	
	BYM(BKM、BEB)175–2AA(**)N*	2.1×1.9	6.0×3.5	N6	
	BYM(BKM、BEB)175–3AA(**)N*	3.0×2.4	6.8×3.5	N8、N0	
	BYM(BKM、BEB)200–4AA(**)N*	4.0×2.2	8.0×3.6	T0	
	BYM(BKM、BEB)200–6AA(**)N*	6.0×2.2	10.4×4.5	N0、T0	
	BYM(BKM、BEB)200–12AA(**)N*	12.6×4.5	18.0×10.0		
	BYM(BKM、BEB)240–3AA(**)N*	3.2×3.1	7.4×4.4	N8	
	BYM(BKM、BEB)300–2AA–W(**)N*	2.0×2.0	3.8×2.8	T8	
	BYM(BKM、BEB)300–3AA–A(**)N*	3.0×1.9	5.5×2.5	T4	
	BYM(BKM、BEB)350–10AA(**)N*	9.4×4.1	15.4×6.1	N9	
	BYM(BKM、BEB)350–1AA(**)N*	1.5×2.6	4.6×3.6	N0、N1、N2、N3、N4、N6、N7、N8、T0、T1、T2、T3、T4、T5、T6、T8	
	BYM(BKM、BEB)350–1.5AA(**)N*	1.5×4.0	4.9×4.8	N3、N6、T1、T2、T3、T4、T5、T6、T8	
	BYM(BKM、BEB)350–2AA–A(**)N*	2.4×3.0	4.9×4.0	N1、N4、N6、T4、T0	
	BYM(BKM、BEB)350–2AA（**)N*	2.5×3.3	6.4×4.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T5、T6、T8	
	BYM(BKM、BEB)350–2AA–P(**)N*	2.0×2.4	5.0×3.5	N0、N2、N4、T0、T1、T2、T3、T4、T5、T6、T8	

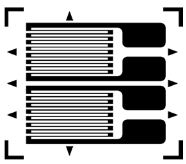
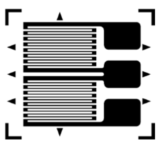
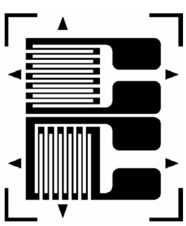
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)350–3AA–A(**)N*	3.2×1.6	6.9×3.1	N0、N6、N8	
	BYM(BKM、BEB)350–3AA(**)N*	3.2×3.1	7.4×4.4	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T5、T6、T8	
	BYM(BKM、BEB)350–3.1AA(**)N*	3.2×1.5	6.9×3.0	N2、N6、T4	
	BYM(BKM、BEB)350–4AA(**)N*	3.8×2.2	8.2×4.2	N0、N2、N6、N9、T6	
	BYM(BKM、BEB)350–5AA(**)N*	5.0×2.9	9.3×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2	
	BYM(BKM、BEB)350–6AA(**)N*	6.1×3.1	10.4×5.4	N0、N6、T0	
	BYM(BKM、BEB)500–4AA(**)N*	4.0×3.3	7.9×4.6	T0、N4、N6	
	BYM(BKM、BEB)650–4AA–A(**)N*	4.0×3.2	7.8×4.2	N6	
	BYM(BKM、BEB)650–4AA(**)N*	4.0×4.4	8.6×6.0	N6	
	BYM(BKM、BEB)650–5AA(**)N*	5.0×3.9	9.0×5.6	N6	
	BYM(BKM、BEB)650–6AA(**)N*	6.0×4.2	10.0×5.2	N6	
	BYM(BKM、BEB)700–3AA(**)N*	3.2×3.1	7.4×4.4	N2、N4、N6、T0、N6	
	BYM(BKM、BEB)840–4AA(**)N*	4.0×3.6	7.9×4.6	N6	
	BYM(BKM、BEB)1000–2AA(**)N*	2.2×4.6	5.8×5.8	N0、N2、N6、T0、T1、T2、T4、T5、T6、T8	
	BYM(BKM、BEB)1000–3AA(**)N*	3.0×5.3	6.7×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T6、T8	
	BYM(BKM、BEB)1000–3.2AA(**)N*	3.2×3.3	7.6×4.5	N0	
	BYM(BKM、BEB)1000–4AA(**)N*	4.0×4.2	7.7×5.4	N8	
	BYM(BKM、BEB)1000–6AA(**)N*	6.0×4.0	9.9×5.4	N6	
	BYM(BKM、BEB)1000–10AA(**)N*	10.0×4.2	14.8×6.0	N0	
	BYM(BKM、BEB)350–2HA(**)N*	2.0×4.4	9.0×5.6	N2、N4、N5、N6、T0、T4	
	BYM(BKM、BEB)350–3HA(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T3、T4、T8	
	BYM(BKM、BEB)350–4HA(**)N*	3.8×4.2	9.0×7.8	N4、N6、T0、T4	
	BYM(BKM、BEB))350–6HA(**)N*	5.7×6.1	10.9×10.5	N4	
	BYM(BKM、BEB)1000–3HA(**)N*	3.0×5.5	9.9×6.2	N4、N8、T2、T6、T8	
	BYM(BKM、BEB)1000–4HA(**)N*	4.0×5.6	9.9×7.5	T0	

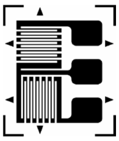
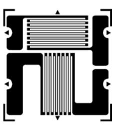
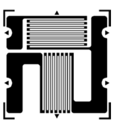
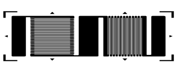
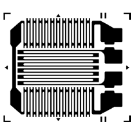
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)350–2HA–A(**)N*	2.0×4.4	9.0×5.6	N2、N4、N6、T0、T4、T8	
	BYM(BKM、BEB)350–3HA–A(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T4、T6、T8	
	BYM(BKM、BEB)350–4HA–A(**)N*	3.8×4.2	9.0×7.8	N4	
	BYM(BKM、BEB)350–6HA–A(**)N*	5.7×6.1	10.9×10.5	N8	
	BYM(BKM、BEB)1000–3HA–A(**)N*	3.0×5.5	9.9×6.2	N2、N4、T2	
	BYM(BKM、BEB)350–2HA–B(**)N*	2.0×2.5	7.2×6.3	N6、N8	
	BYM(BKM、BEB)350–3HA–B(**)N*	3.1×4.0	9.5×7.8	N4、N6、N8、T0、T4	
	BYM(BKM、BEB)350–5HA–B(**)N*	4.8×4.1	10.7×9.3	N4	
	BYM(BKM、BEB)1000–5HA–B(**)N*	4.8×6.5	15.7×9.6	N4	
	BYM(BKM、BEB)350–2HA–C(**)N*	2.0×2.5	7.2×6.3	N0、N2、N4、N6、N8、T2、T4、T8	
	BYM(BKM、BEB)350–3HA–C(**)N*	3.1×4.0	9.5×7.8	N2、N4、N6、N8、N9、T0、T4、T6、T8、T9	
	BYM(BKM、BEB)1000–3HA–C(**)N*	3.1×5.4	10.7×7.8	N4、N8、T0、T4	
	BYM(BKM、BEB)60–3AB(**)N*	3.0×3.0	8.2×5.1	T0	
	BYM(BKM、BEB)120–6AB(**)N*	5.8×5.8	9.7×7.4	N8	
	BYM(BKM、BEB)175–2AB(**)N*	2.0×2.0	6.7×3.7	N8、T0	
	BYM(BKM、BEB)175–3AB(**)N*	3.0×3.0	8.2×5.1	N8	
	BYM(BKM、BEB)350–2AB(**)N*	2.0×2.0	6.7×3.7	N0、N4、N8、T3	
	BYM(BKM、BEB)280–3AB(**)N*	3.0×3.0	8.2×5.1	N0	
	BYM(BKM、BEB)350–3AB(**)N*	3.0×3.0	8.2×5.1	N0、N1、N2、N4、N5、N6、N8、T0、T6	
	BYM(BKM、BEB)350–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	BYM(BKM、BEB)350–6AB(**)N*	5.9×5.9	12.0×8.3	N5	
	BYM(BKM、BEB)350–8AB(**)N*	7.9×7.9	13.3×10.0	N8	
	BYM(BKM、BEB)500–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	BYM(BKM、BEB)1000–3AB–A(**)N*	3.0×7.3	11.0×4.0	N4	

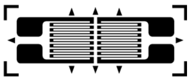
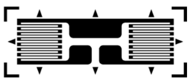
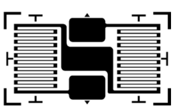
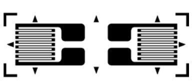
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)350−2FB(**)N*	2.1×2.8	6.4×7.6	N6、T0	
	BYM(BKM、BEB)350−3FB(**)N*	3.2×2.8	7.4×7.4	N0、N1、N2、N3、N4、N5、N6、N8、N9、T0、T2、T4、T8	
	BYM(BKM、BEB)350−4FB(**)N*	4.0×2.4	7.8×6.2	N6、T0	
	BYM(BKM、BEB)350−6FB(**)N*	5.9×2.8	9.8×7.3	N6	
	BYM(BKM、BEB)1000−3FB(**)N*	3.0×5.3	12.1×6.7	T0	
	BYM(BKM、BEB)1000−6FB(**)N*	6.0×4.2	9.8×9.6	T0	
	BYM(BKM、BEB)350−3FB−A(**)N*	3.2×2.5	6.8×6.4	N2	
	BYM(BKM、BEB)100−4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BYM(BKM、BEB)120−2BB(**)N*	1.8×2.4	6.3×5.5	N2	
	BYM(BKM、BEB)120−3BB(**)N*	2.8×3.3	8.5×6.5	N6	
	BYM(BKM、BEB)120−4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BYM(BKM、BEB)240−4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BYM(BKM、BEB)350−1BB(**)N*	2.4×2.1	5.5×5.5	N0	
	BYM(BKM、BEB)350−2BB(**)N*	2.0×2.6	7.2×6.0	N8	
	BYM(BKM、BEB)350−3BB(**)N*	3.0×3.3	8.6×6.6	N2、N8、T4	
	BYM(BKM、BEB)350−4BB(**)N*	4.0×4.1	9.7×7.7	T0	
	BYM(BKM、BEB)350−6BB(**)N*	6.0×6.0	13.8×9.7	T0	
	BYM(BKM、BEB)600−4BB(**)N*	3.9×4.1	9.7×7.7	N6、N0	
	BYM(BKM、BEB)650−4BB(**)N*	4.0×4.4	10.3×7.9	N6	

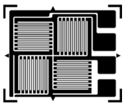
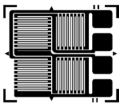
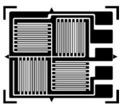
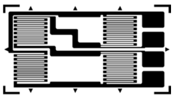
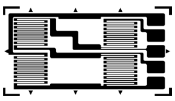
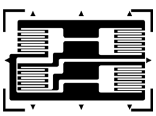
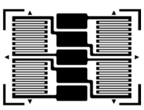
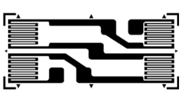
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)120–2BB–A(**)N*	1.8×2.2	6.3×5.4	T0	
	BYM(BKM、BEB)120–3BB–A(**)N*	2.8×3.3	8.5×6.5	N6	
	BYM(BKM、BEB)120–4BB–A(**)N*	4.0×4.4	10.3×7.5	T0	
	BYM(BKM、BEB)350–1.6BB–A(**)N*	1.5×2.0	10.0×6.0	N6	
	BYM(BKM、BEB)350–2BB–A(**)N*	2.0×2.7	6.9×6.0	T4、N0	
	BYM(BKM、BEB)350–2.1BB–A(**)N*	1.8×2.4	5.4×5.3	N2	
	BYM(BKM、BEB)350–3BB–A(**)N*	3.0×3.4	9.8×6.8	N2	
	BYM(BKM、BEB)350–4BB–A(**)N*	4.0×4.1	9.7×7.7	T0、N6	
	BYM(BKM、BEB)350–6BB–A(**)N*	5.9×6.3	14.3×9.6	T0、N6	
	BYM(BKM、BEB)800–2BB–A(**)N*	2.0×3.5	5.8×5.8	T0	
	BYM(BKM、BEB)1000–4BB–A(**)N*	3.6×4.0	9.4×7.0	T0	
	BYM(BKM、BEB)160–5BB(**)N*	4.9×3.0	9.6×9.8	N4	
	BYM(BKM、BEB)600–5BB(**)N*	4.9×3.2	9.6×9.8	T0	
	BYM(BKM、BEB)600–5BB–A(**)N*	4.9×3.2	9.6×9.8	N0、N1、N4、N6、N8、T0	
	BYM(BKM、BEB)700–5BB–A(**)N*	4.9×3.2	9.6×9.8	N0、N4、N6、N8、T0、T2	
	BYM(BKM、BEB)1000–5BB–A(**)N*	4.9×3.2	9.6×9.8	N6	
	BYM(BKM、BEB)120–07BB–B(**)N*	0.7×3.6	15.0×1.3	T8	
	BYM(BKM、BEB)160–5BB–C(**)	5.2×2.6	9.4×8.1		
	BYM(BKM、BEB)350–5BB–C(**)	5.2×2.6	9.4×8.1		
	BYM(BKM、BEB)700–5BB–C(**)	5.2×2.6	9.4×8.1		

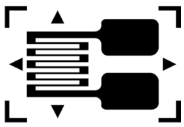
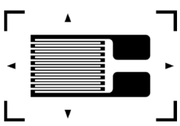
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)350–2GB(**)N*	2.1×3.0	10.8×4.4	T0、N6	2.7
	BYM(BKM、BEB)350–3GB(**)N*	3.1×2.8	12.4×4.4	N4、N6	3.8
	BYM(BKM、BEB)350–4GB(**)N*	4.0×3.8	15.3×5.8	T0	5.0
	BYM(BKM、BEB)350–1GB–AL0(**)N*	1.5×2.5	13.8×3.8	T0	10.5
	BYM(BKM、BEB)350–1.5GB–AL68(**)N*	1.5×3.1	9.8×4.3	N6	6.8
	BYM(BKM、BEB)350–2GB–AL0(**)N*	2.0×3.1	14.4×4.4	N1、N3、N4、N6	10.5
	BYM(BKM、BEB)350–2GB–AL5.5(**)N*	2.0×2.8	8.9×3.8	N8 、T0、T2、T6、T8	5.5
	BYM(BKM、BEB)350–2GB–AL6(**)N*	2.0×2.8	9.4×3.8	N6	6.0
	BYM(BKM、BEB)350–2GB–AL7(**)N*	2.0×3.1	10.8×4.4	N0、N2、N6、T0、T4、T6	7.0
	BYM(BKM、BEB)350–3GB–AL0(**)N*	3.0×2.9	15.4×4.2	N0、N2、N6、T0、T5	10.5
	BYM(BKM、BEB)350–3GB–AL12(**)N*	3.0×2.9	16.9×4.2	N2、N6、T0	12.0
	BYM(BKM、BEB)350–3GB–AL13(**)N*	3.2×4.2	19.0×5.6	T0	13.2
	BYM(BKM、BEB)350–3GB–AL15(**)N*	3.0×2.7	20.0×4.1	N2、N4、N8、T0、T2、T4	15.0
	BYM(BKM、BEB)750–3GB–AL0(**)N*	3.0×3.5	15.2×4.3	N8	10.5
	BYM(BKM、BEB)750–3GB–AL12(**)N*	3.0×3.5	16.7×4.3	T0	12.0
	BYM(BKM、BEB)750–3GB–AL14(**)N*	3.0×3.5	18.7×4.2	N0	14.0
	BYM(BKM、BEB)500–2GB–BL8(**)N*	2.1×5.3	11.3×6.3	N0	8.0
	BYM(BKM、BEB)500–3GB–BL7(**)N*	3.0×4.1	12.0×5.5	T0	7.1
	BYM(BKM、BEB)500–4GB–BL7(**)N*	3.4×4.1	13.0×5.5	N6	7.2
	BYM(BKM、BEB)750–2GB–BL12.8(**)N*	2.5×5.2	16.9×6.0	N0	12.8
	BYM(BKM、BEB)1000–2GB–BL6(**)N*	2.5×5.0	10.1×6.0	N6	6.0
	BYM(BKM、BEB)1000–3GB–BL7(**)N*	3.0×5.5	11.7×6.5	N8、T4	7.0
	BYM(BKM、BEB)350–2GB–CL0(**)N*	2.5×3.3	14.7×4.5	N6、N8、T0、T8	10.5
	BYM(BKM、BEB)350–2GB–CL8(**)N*	2.5×3.3	12.9×4.5	T2、T4	8.0
	BYM(BKM、BEB)350–3GB–CL15(**)N*	3.0×2.8	20.0×4.1	N2、T1、T2、T4	15.0

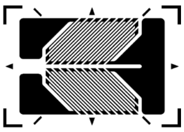
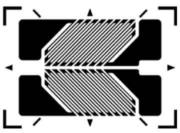
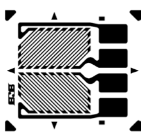
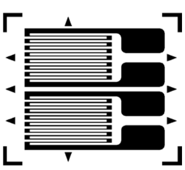
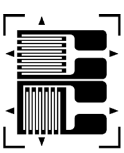
BYM/ BKM/ BEB

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BYM(BKM、BEB)350–2EB(**)N*	2.3×2.7	8.6×7.2	N2	
	BYM(BKM、BEB)350–2EB–B(**)N*	2.3×2.8	8.6×7.4	N2	
	BYM(BKM、BEB)1000–3EB–A(**)–N*	3.2×3.7	9.6×11.1	N4	
	BYM(BKM、BEB)350–2.5EB–A(**)–N*	2.5×2.9	7.9×9.0	T0	
	BYM(BKM、BEB)350–2FG–L8.8(**)N*	2.0×2.7	14.5×6.5	N6	8.8
	BYM(BKM、BEB)350–2FG–L0(**)N*	2.0×2.7	16.2×6.5	N2、T2	10.5
	BYM(BKM、BEB)350–2FG–AL6(**)N*	2.0×2.2	12.0×7.1	N2、T0、T4、T8	6.0
	BYM(BKM、BEB)350–3FG–AL6(**)N*	3.0×2.1	13.0×6.8	T4	6.0
	BYM(BKM、BEB)350–3FG–AL0(**)N*	3.1×3.0	17.9×8.4	N2、T2、T6	10.5
	BYM(BKM、BEB)350–3FG–AL14(**)N*	3.0×2.1	20.5×6.8	N6、T1、T6、T0	14.0
	BYM(BKM、BEB)350–1FG–BL0(**)N*	1.5×2.7	13.7×6.9	T4、T6	10.5
	BYM(BKM、BEB)350–2FG–BL10(**)N*	2.6×2.7	14.8×8.0	N8	10.0
	BYM(BKM、BEB)350–3FG–BL0(**)N*	3.1×2.8	15.5×6.8	T2	10.5
	BYM(BKM、BEB)350–2FG–CL6(**)N*	2.1×2.9	9.8×6.9	T0、T2、T4	6.0
	BYM(BKM、BEB)350–3FG–CL0(**)N*	3.1×2.8	15.3×7.0	N2、N6、T0、T4	10.5
	BYM(BKM、BEB)350–1FG–DL0(**)N*	1.5×2.5	13.9×6.6	T0、T8	10.5
	BYM(BKM、BEB)350–3FG–DL15(**)N*	2.8×2.3	19.0×6.0	T0	15.0

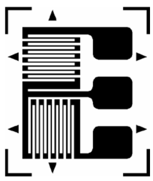
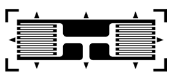
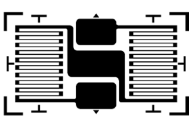
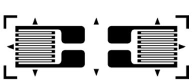
ZYM

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZYM120–3AA–A(**)N*	3.0×0.6	6.3×1.5	T0	
	ZYM175–1AA(**)N*	1.0×1.8	4.5×3.0	T8	
	ZYM300–1AA(**)N*	1.1×1.2	3.6×2.2	T8	
	ZYM200–1AA–W(**)N*	1.0×0.5	2.8×1.8	T8	
	ZYM250–1AA–W(**)N*	1.1×1.0	2.9×2.0	T8	
	ZYM300–2AA–W(**)N*	2.0×1.0	3.8×2.0	T8	
	ZYM300–2AA–A–W(**)N*	2.0×2.0	3.8×2.8	T8	
	ZYM350–1AA–W(**)N*	1.1×1.0	2.9×2.0	T8	
	ZYM350–1.6AA(**)N*	1.6×1.7	9.0×7.9	N9	
	ZYM350–2AA–W(**)N*	2.0×1.0	3.8×2.0	T8	
	ZYM300–3AA–A(**)N*	2.9×1.9	5.5×2.5	T4	
	ZYM350–2AA(**)N*	1.9×2.8	5.7×4.0	N0、N1、N3、N4、N6、N8、T0、T4、T6	
	ZYM350–3AA(**)N*	3.1×2.6	7.0×3.8	N1、N2、N3、N4、N5、N6、N0、T0、T2、T4	
	ZYM350–4AA(**)N*	4.0×2.5	8.0×3.9	N6	
	ZYM350–5AA(**)N*	5.0×2.3	9.0×3.7	N6	
	ZYM350–7AA(**)N*	7.0×2.6	10.8×4.0	N4	
	ZYM1000–1.2AA(**)N*	1.2×3.6	4.5×4.5	T8	
	ZYM1000–1.5AA–A(**)N*	1.5×2.5	4.5×3.1	T4、T8	
	ZYM1000–1.5AA(**)N*	1.5×4.0	4.9×4.8	N3、N6、T1、T2、T3、T4、T5、T6、T8	
	ZYM1000–2AA–T(**)N*	2.1×3.3	5.8×4.5	N0、T4、T8	
	ZYM1000–2AA–W(**)N*	1.8×1.9	3.9×2.5	T8	
	ZYM1000–2AA(**)N*	2.5×3.3	6.4×4.5	N0、N2、N5、N6、T0、T1、T2、T3、T4、T6	
	ZYM1000–3AA–B(**)N*	3.0×3.1	14.3×4.5	N0、N1、N2、N3、N5、N6、N7、T2、T3、T4、T8	
	ZYM1000–3AA(**)N*	3.2×3.2	7.4×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2、T3、T4、T5、T6、T8	
	ZYM1000–4AA(**)N*	3.8×2.2	8.2×4.2	N0、N2、N6、N9、T6	
	ZYM1000–5AA(**)N*	5.0×2.9	9.3×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2	
	ZYM1500–2AA(**)N*	2.5×3.6	6.5×4.7	T2	
	ZYM1500–3AA(**)N*	3.2×3.2	7.4×4.5	N6、N4	
	ZYM2000–2AA–A(**)N*	2.1×4.2	5.4×5.2	T1、T6	
	ZYM2000–2.1AA(**)N*	2.0×3.8	4.8×4.4	N6	
	ZYM2000–3AA(**)N*	3.2×4.0	7.4×5.3	N0、T4	
	ZYM2000–4AA(**)N*	4.0×4.4	8.6×6.0	N6	
	ZYM2500–3AA(**)N*	3.2×3.2	7.4×4.5	N2、N6、N8、T0、T1、T2、T3、T4、T5、T6、T7、T8	
	ZYM2500–6AA(**)N*	6.0×6.4	11.0×8.0	N0	
	ZYM3000–5AA(**)N*	5.2×4.0	8.7×5.2	N6	
	ZYM3000–6AA(**)N*	6.1×3.9	9.8×5.2	T0、T4	
	ZYM5000–3AA(**)N*	3.2×4.6	6.7×5.8	N6	

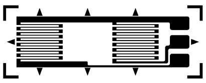
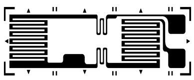
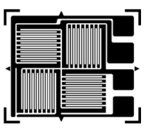
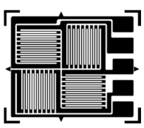
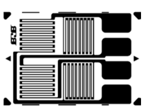
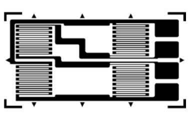
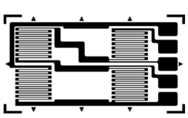
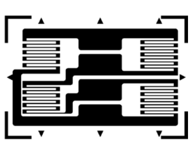
ZYM

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZYM350–2HA(**)N*	1.9×2.2	6.0×4.9	T0	
	ZYM350–3HA(**)N*	3.0×4.4	9.4×6.5	N1、N4、N8	
	ZYM350–4HA(**)N*	3.7×2.0	7.9×7.9	N3	
	ZYM650–4HA(**)N*	3.8×4.2	9.0×7.8	N5	
	ZYM700–4HA(**)N*	3.8×4.2	9.0×7.8	N5	
	ZYM1000–3HA(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T3、T4、T8	
	ZYM1000–4HA(**)N*	3.8×4.2	9.0×7.8	N4、N6、T0、T4	
	ZYM2000–3HA(**)N*	3.0×5.5	9.9×6.2	N4、N8、T2、T6、T8	
	ZYM350–3HA–A(**)N*	3.0×4.4	9.4×6.5	N4、N6、N8、T0	
	ZYM650–3HA–A(**)N*	2.9×4.0	8.5×6.3	T0	
	ZYM1000–3HA–A(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T4、T6、T8	
	ZYM1000–4HA–A(**)N*	3.8×4.2	9.0×7.8	N4	
	ZYM1000–2HA–T(**)N*	2.7×3.5	7.1×6.4	T0	
	ZYM350–3AB(**)N*	3.0×3.0	8.0×5.2	N8	
	ZYM1000–3AB(**)N*	3.0×3.0	8.2×5.1	N0、N1、N2、N4、N5、N6、N8、T0、T6	
	ZYM1000–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	ZYM350–3FB(**)N*	3.0×2.6	7.4×7.2	N6	
	ZYM350–4FB(**)N*	4.0×2.4	7.8×6.2	N6、N2	
	ZYM1000–2FB(**)N*	2.1×2.8	6.4×7.6	N6、T0	
	ZYM1000–3FB(**)N*	3.2×2.8	7.4×7.4	N0、N1、N2、N3、N4、N5、N6、N8、T0、T2、T4、T8	
	ZYM1000–4FB(**)N*	4.0×2.4	7.8×6.2	N6、T0	
	ZYM1000–6FB(**)N*	6.0×2.4	9.5×6.8	N2	
	ZYM1000–2BB(**)N*	2.0×2.6	7.2×6.0	N8	
	ZYM1000–3BB(**)N*	3.0×3.4	8.6×6.6	T4	
	ZYM1000–6BB(**)N*	6.0×6.0	13.8×9.7	T0	

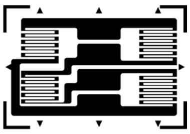
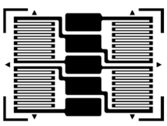
ZYM

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZYM350–2BB–A(**)N*	1.5×2.0	5.9×4.5	T0	
	ZYM800–2BB–A(**)N*	1.7×3.2	5.4×5.4	T0	
	ZYM1000–2BB–A(**)N*	2.0×2.7	6.9×6.0	T4、N0	
	ZYM1000–2.1BB–A(**)N*	1.8×2.4	5.4×5.3	N2	
	ZYM1000–2BB–A(**)–KR	2.6×2.2	5.4×5.4	N4	
	ZYM1000–3BB–A(**)N*	3.0×3.4	9.8×6.8	N2	
	ZYM350–1GB–AL68(**)N*	1.5×3.2	9.8×4.3	N0、N6、T0、T4	6.8
	ZYM350–2GB–AL7(**)N*	2.0×2.7	10.8×3.9	N2、N4、N6、T0	7.0
	ZYM350–1GB–AL8(**)N*	1.5×3.5	11.0×4.3	N2	8.0
	ZYM350–2GB–AL0(**)N*	2.0×2.7	14.4×3.9	N0、N2、N4、N6、T0、T2、T8	
	ZYM350–2GB–AL12(**)N*	2.0×2.7	15.8×3.9	N0、N4	12.0
	ZYM350–2GB–AL15(**)N*	2.0×2.7	18.8×3.9	N2、T4	15.0
	ZYM750–2GB–AL12(**)N*	2.0×3.3	15.8×4.5	N0、T6、T8	12.0
	ZYM1000–1.5GB–AL5.5(**)N*	1.5×2.5	9.1×4.3	N6	5.5
	ZYM1000–1.5GB–AL9(**)N*	1.5×4.0	12.0×5.2	T2、T3、T8	9.0
	ZYM1000–1.6GB–AL0(**)N*	1.6×3.9	13.7×5.1	T1、T4	10.5
	ZYM1000–2GB–AL5(**)N*	2.0×3.3	8.9×4.5	N2	5.3
	ZYM1000–2GB–AL5.5(**)N*	2.0×2.8	8.9×3.8	N6	5.5
	ZYM1000–2GB–AL6(**)N*	2.0×2.8	9.4×3.8	N0、N2、N6、T0、T4、T6	6.0
	ZYM1000–2GB–AL7(**)N*	2.0×3.1	10.8×4.4	N0、N2、N4、N6、T0、T5	7.0
	ZYM1000–2GB–AL0(**)N*	2.5×3.3	14.7×4.5	N0、N2、N3、N4、N5、N6、N8、T1、T6	10.5
	ZYM1000–3GB–AL7(**)N*	3.0×3.2	11.6×4.4	N2	7.0
	ZYM1000–3GB–AL0(**)N*	3.0×3.2	15.4×4.4	N6、T0、T2、T4、T6、T8	10.5
	ZYM1000–3GB–AL14(**)N*	2.9×3.0	18.7×4.2	N0、N1	14.0
	ZYM1100–2GB–AL6(**)N*	2.0×3.0	9.4×4.0	N2	6.0
	ZYM2000–2GB–AL0(**)N*	2.5×4.0	14.7×5.0	T0、T4	10.5
	ZYM500–2GB–BL6(**)N*	2.1×5.0	9.8×6.0	N4	6.0
	ZYM1000–1GB–BL6(**)N*	1.5×4.8	9.1×6.5	T6	6.0
	ZYM1000–2GB–BL6(**)N*	2.1×4.1	9.7×5.5	N0、N2、N6、T0、T1、T2、T3、T4、T5、T6	6.0
	ZYM1000–2GB–BL7(**)N*	2.1×4.1	10.7×5.5	N6、T1、T3、T5、T8	7.0
	ZYM1000–2GB–BL0(**)N*	2.1×4.1	14.2×5.5	T1、T3、T5	10.5
	ZYM1000–3GB–BL6(**)T*	3.0×3.6	10.7×4.8	T0、T2	6.0
	ZYM2000–2GB–BL6(**)N*	2.1×4.2	9.7×5.5	T6	6.0
	ZYM2000–2GB–BL7(**)N*	2.1×5.4	10.8×6.4	N6、T0	7.0
	ZYM1000–2GB–CL8(**)N*	2.5×3.3	12.9×4.5	N2、T1、T2、T4	8.8
	ZYM1000–2GB–CL0(**)N *	2.5×3.3	14.7×4.5	T2、T4	10.5

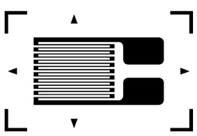
ZYM

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZYM350–3GB–L12(**)N*	3.0×3.3	20.3×4.2	N6	12.0
	ZYM500–3GB–L0(**)N*	3.0×4.8	18.8×5.3	N6	10.5
	ZYM500–3GB–L12(**)N*	3.0×4.8	16.8×5.3	N6	12.0
	ZYM1000–2GB–L6(**)N*	2.1×3.4	11.7×5.2	T4	10.5
	ZYM1000–3GB–L6(**)N*	3.0×3.8	13.2×4.8	T8	6.0
	ZYM1000–3GB–L0(**)N*	3.0×3.8	17.2×4.9	N2、T2、T8	10.5
	ZYM1000–3GB–L12(**)N*	3.1×3.9	18.5×4.9	N2	12.0
	ZYM1000–4GB–L12(**)N*	4.0×2.5	19.5×4.5	N8	12.0
	ZYM2000–3GB–L0(**)N*	3.0×2.8	17.8×4.4	T8	10.5
	ZYM1000–3GB–TL0(**)N*	3.0×3.9	17.5×5.0	N2、N4、N6、N8、T0、T2、T4、T6	
	ZYM350–2EB(**)N*	1.8×2.2	7.4×8.5	N2	
	ZYM1000–2EB(**)N*	2.3×2.7	8.6×7.2	N2	
	ZYM1000–3EB(**)N*	2.7×3.2	9.8×8.4	N2	
	ZYM350–2EB–A(**)N*	1.8×2.3	7.4×8.4	N2	
	ZYM1000–2EB–A(**)N*	2.3×2.7	8.6×7.5	N2	
	ZYM1000–2EB–BT(**)N*	1.8×1.8	7.9×5.2	T6	
	ZYM1200–2EB–BT(**)N*	1.8×1.8	7.9×5.2	T6	
	ZYM350–1FG–L0(**)N*	1.5×2.0	16.0×6.2	T0	
	ZYM350–2FG–L7(**)N*	2.0×1.9	13.4×6.4	T1	
	ZYM350–2FG–L8(**)N*	2.0×1.9	14.3×6.4	T0	
	ZYM1000–3FG–L0(**)N*	3.0×2.5	17.4×6.4	N6、T8	
	ZYM1000–3FG–L12(**)N*	3.1×2.3	18.6×6.8	N0、T8	
	ZYM350–2FG–AL6(**)N*	2.0×2.2	11.9×7.1	T0、N4、N6、N8、T4	6.0
	ZYM350–3FG–AL0(**)N*	3.0×2.0	17.2×6.6	N6	10.5
	ZYM1000–2FG–AL0(**)N*	2.1×2.6	16.9×7.4	T1、T6、T8	10.5
	ZYM1000–3FG–AL0(**)N*	3.1×3.2	17.9×8.4	N2、N6、T0、T2、T4、T6	10.5
	ZYM1000–3FG–AL14(**)N*	3.0×2.1	20.5×6.8	N6、T1、T6、T0	14.0
	ZYM1000–3FG–AL12(**)N *	3.1×2.9	19.4×8.4	T8	12.0
	ZYM350–1FG–BL6(**)N*	1.5×2.2	9.3×6.1	T0、N4	6.0
	ZYM350–1FG–BL0(**)N*	1.5×2.5	13.9×6.4	N0、T0、T8	10.5

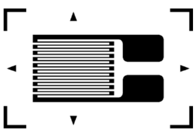
ZYM

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZYM400–1FG–BL68(**)N*	1.5×2.4	9.8×6.1	T8	6.8
	ZYM500–2FG–BL6(**)N*	2.1×2.2	9.7×5.8	T8	6.0
	ZYM1000–1.5FG–BL0(**)T*	1.5×2.8	13.8×6.9	T8	10.5
	ZYM1000–2FG–BL6(**)N*	2.1×2.7	9.8×6.9	N4、N8、T0、T4、T8	6.0
	ZYM1000–2FG–BL0(**)N*	2.1×2.8	14.4×6.9	N2、N6	10.5
	ZYM1000–3FG–BL0(**)T*	3.1×2.8	15.5×6.8	T2	10.5
	ZYM1000–3FG–BL6(**)T*	3.0×2.5	11.0×6.4	T2	6.0
	ZYM1100–2FG–BL0(**)N*	2.1×2.8	14.4×6.9	N2、T8	10.5
	ZYM1100–2FG–BL6(**)N*	2.1×2.8	9.8×6.8	N2	6.0
	ZYM1200–3FG–BL7(**)N*	3.0×2.6	12.0×6.8	T0	7.0
	ZYM2000–2FG–BL0(**)N*	2.0×3.3	14.3×7.8	T8	10.5
	ZYM350–1FG–CL6(**)N*	1.5×2.2	9.2×6.0	T0	6.0
	ZYM350–1FG–CL68(**)N*	1.5×2.4	9.8×6.2	N2	6.8
	ZYM350–1FG–CL0(**)N*	1.5×2.2	13.9×6.4	T2	10.5
	ZYM1000–2FG–CL6(**)N*	2.1×2.9	9.8×6.9	T0、T2、T4	6.0
	ZYM1000–3FG–CL0(**)N*	3.1×2.8	15.3×7.0	N2、N6、T0、T4	10.5
	ZYM1100–2FG–CL6(**)N*	2.1×2.8	9.6×6.8	N2	6.0

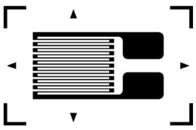
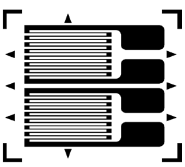
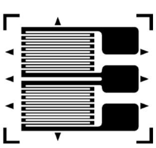
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)100–3AA–A(**)N*	3.0×2.6	8.3×4.7		
	BF(BA)100–3AA–B(**)N*	3.0×2.6	6.8×4.2		
	BF(BA)100–3AA–D(**)N*	3.0×2.6	6.4×3.4		
	BF(BA)100–4AA(**)N*	4.0×1.9	8.0×3.6	T0	
	BF(BA)100–5AA–A(**)N*	5.0×3.6	11.8×5.9		
	BF(BA)100–5AA–C(**)N*	5.0×3.6	9.6×5.3		
	BF(BA)100–10AA–A(**)N*	10.0×2.8	18.5×5.9		
	BF(BA)100–20AA–A(**)N*	20.0×3.4	29.5×4.7		
	BF(BA)119–3AA(**)N*	2.8×2.0	6.4×3.5	T0、N0、N1、N3、N4、N6、N8	
	BF(BA)120–0.5AA(**)N*	0.55×2.3	3.6×3.3	N6	
	BF(BA)120–1AA(**)N*	1.0×2.2	4.3×3.5	T0	
	BF(BA)120–1.5AA(**)N*	1.5×2.4	6.5×4.7	N6、T0	
	BF(BA)120–2AA(**)N*	1.8×1.8	5.2×3.2	T0	
	BF(BA)120–3AA(**)N*	2.8×2.0	6.4×3.5	T0、N0、N1、N3、N4、N6、N8	
	BF(BA)120–3.4AA(**)N*	3.4×3.3	9.1×6.1	N4	
	BF(BA)120–4AA(**)N*	4.0×3.3	7.9×4.6	N6	
	BF(BA)120–5AA(**)N*	5.0×2.0	10.1×4.0	N0	
	BF(BA)120–6AA(**)N*	5.9×2.7	9.8×4.3	N5	
	BF(BA)120–10AA(**)N*	9.8×3.0	15.0×5.0	N0、N2	
	BF(BA)120–20AA(**)N*	20.0×4.1	26.8×5.9		
	BF(BA)160–4AA–T(**)N*	4.0×3.4	8.6×5.8	N0、T0	
	BF(BA)160–6AA–T(**)N*	5.7×6.0	11.4×8.8	N0、T0	
	BF(BA)175–1AA(**)N*	1.5×2.6	4.6×3.6	N0、N6、N8	
	BF(BA)175–2AA(**)N*	2.1×1.9	6.0×3.5	N6	
	BF(BA)175–3AA(**)N*	3.0×2.4	6.8×3.5	N8、N0	
	BF(BA)200–1AA–A(**)N*	1.0×3.0	6.0×4.7		
	BF(BA)200–2AA–A(**)N*	2.0×3.0	6.5×5.0		
	BF(BA)200–3AA–A(**)N*	3.0×2.3	8.3×4.7		
	BF(BA)200–4AA(**)N*	4.0×2.2	8.0×3.6	T0	
	BF(BA)200–5AA–A(**)N*	5.0×2.2	11.8×5.9		
	BF(BA)200–6AA(**)N*	6.0×2.2	10.4×4.5	N0、T0	
	BF(BA)200–10AA–A(**)N*	10.0×3.4	18.5×7.4		
	BF(BA)200–20AA–A(**)N*	20.0×2.7	29.5×4.7		
	BF(BA)240–3AA(**)N*	3.2×3.1	7.4×4.4	N8	
	BF(BA)300–2AA–W(**)N*	2.0×2.0	3.8×2.8	T8	
	BF(BA)300–3AA–A(**)N*	3.0×1.9	5.5×2.5	T4	
	BF(BA)350–1AA(**)N*	1.5×2.6	4.6×3.6	N0、N1、N2、N3、N4、N6、N7、N8、T0、T1、T2、T3、T4、T5、T6、T8	
	BF(BA)350–1.5AA(**)N*	1.5×4.0	4.9×4.8	N3、N6、T1、T2、T3、T4、T5、T6、T8	

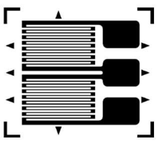
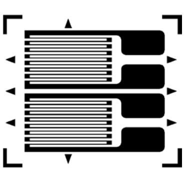
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)350–2AA（**)N*	2.5×3.3	6.4×4.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T5、T6、T8	
	BF(BA)350–2AA–A(**)N*	2.4×3.0	4.9×4.0	N1、N4、N6、T4、T0	
	BF(BA)350–2.2AA(**)N*	2.2×1.8	5.1×2.4	T8	
	BF(BA)350–2AA–P(**)N*	2.0×2.4	5.0×3.5	N0、N2、N4、T0、T1/T2、T3、T4、T5、T6、T8	
	BF(BA)350–3AA–A(**)N*	3.2×1.6	6.9×3.1	N0、N6、N8	
	BF(BA)350–3AA(**)N*	3.2×3.1	7.4×4.4	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T5、T6、T8	
	BF(BA)350–3AA–B(**)N*	3.0×3.1	14.3×4.5	N0、N1、N2、N3、N5、N6、N7、T2、T3、T4、T8	
	BF(BA)350–4AA(**)N*	3.8×2.2	8.2×4.2	N0、N2、N6、N9、T6	
	BF(BA)350–5AA(**)N*	5.0×2.9	9.3×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2	
	BF(BA)350–6AA(**)N*	6.1×3.1	10.4×5.4	N0、N6、T0	
	BF(BA)350–10AA(**)N*	9.4×4.1	15.4×6.1	N9	
	BF(BA)400–2AA–A(**)N*	2.0×3.9	6.5×5.9		
	BF(BA)400–3AA–A(**)N*	3.0×3.0	8.3×4.7		
	BF(BA)400–5AA–A(**)N*	5.0×2.7	11.8×5.9		
	BF(BA)400–10AA–A(**)N*	10.0×4.1	18.5×8.1		
	BF(BA)400–15AA–A(**)N*	15.0×2.8	23.0×5.5		
	BF(BA)440–3AA(**)N*	3.2×3.3	7.4×4.4		
	BF(BA)500–4AA(**)N*	4.0×3.3	7.9×4.6	T0、N4、N6	
	BF(BA)650–4AA–A(**)N*	4.0×3.2	7.8×4.2	N6	
	BF(BA)650–4AA(**)N*	4.0×4.4	8.6×6.0	N6	
	BF(BA)650–5AA(**)N*	5.0×3.9	9.0×5.6	N6	
	BF(BA)650–6AA(**)N*	6.0×4.2	10.0×5.2	N6	
	BF(BA)700–3AA(**)N*	3.2×3.1	7.4×4.4	N2、N4、N6、T0、N6	
	BF(BA)700–3.2AA(**)N*	3.2×2.6	6.5×3.5	T0	
	BF(BA)700–5AA(**)N*	5.0×3.9	9.0×5.6	N4、N6	
	BF(BA)700–10AA–A(**)N*	10.0×4.7	18.5×8.1		
	BF(BA)840–4AA(**)N*	4.0×3.6	7.9×4.6	N6	

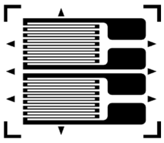
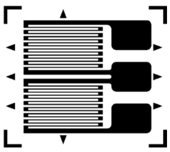
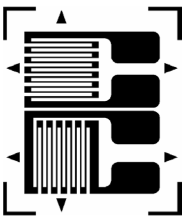
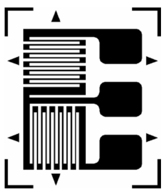
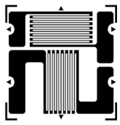
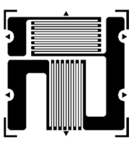
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)1000–2AA(**)N*	2.2×4.6	5.8×5.8	N0、N2、N6、T0、T1、T2、T4、T5、T6、T8	
	BF(BA)1000–3AA(**)N*	3.0×5.3	6.7×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T1、T2、T3、T4、T6、T8	
	BF(BA)1000–4AA(**)N*	4.0×4.2	7.7×5.4	N8	
	BF(BA)1000–6AA(**)N*	6.0×4.0	9.9×5.4	N6	
	BF(BA)1000–10AA(**)N*	10.0×4.2	14.8×6.0	N0	
	BF(BA)175–2HA(**)N*	2.0×4.2	9.0×5.6	N4	
	BF(BA)350–1HA(**)N*	1.2×5.0	8.0×4.0	N6	
	BF(BA)350–2HA(**)N*	2.0×4.4	9.0×5.6	N2、N4、N5、N6、T0、T4	
	BF(BA)350–3HA(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T3、T4、T8	
	BF(BA)350–4HA(**)N*	3.8×4.2	9.0×7.8	N4、N6、T0、T4	
	BF(BA))350–6HA(**)N*	5.7×6.1	10.9×10.5	N4	
	BF(BA))700–3HA(**)N*	3.0×5.4	9.9×6.2	N4	
	BF(BA)1000–3HA(**)N*	3.0×5.5	9.9×6.2	N4、N8、T2、T6、T8	
	BF(BA)1000–4HA(**)N*	4.0×5.6	9.9×7.5	T0	
	BF(BA)60–3HA–A(**)N*	3.0×4.1	9.4×6.5	N4	
	BF(BA)175–2HA–A(**)N*	2.0×4.2	9.0×5.6	N4	
	BF(BA)175–3HA–A(**)N*	3.0×4.4	9.4×6.4	N2	
	BF(BA)350–2HA–A(**)N*	2.0×4.4	9.0×5.6	N2、N4、N6、T0、T4、T8	
	BF(BA)350–3HA–A(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T4、T6、T8	
	BF(BA)350–4HA–A(**)N*	3.8×4.2	9.0×7.8	N4	
	BF(BA)350–6HA–A(**)N*	5.7×6.1	10.9×10.5	N8	
	BF(BA))400–3HA–A(**)N*	3.1×4.7	10.4×7.4	N8	
	BF(BA))700–3HA–A(**)N*	3.0×5.4	9.9×6.2	N4	
	BF(BA)1000–3HA–A(**)N*	3.0×5.5	9.9×6.2	N2、N4、T2	
	BF(BA)350–2HA–B(**)N*	2.0×2.5	7.2×6.3	N6、N8	
	BF(BA)350–3HA–B(**)N*	3.1×4.0	9.5×7.8	N4、N6、N8、T0、T4	

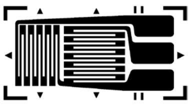
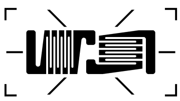
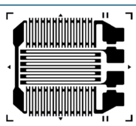
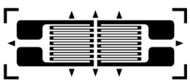
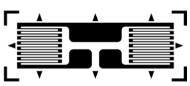
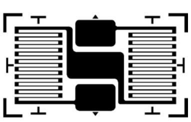
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)350–5HA–B(**)N*	4.8×4.1	10.7×9.3	N4	
	BF(BA))500–3HA–B(**)N*	3.4×8.7	11.4×7.6	N2	
	BF(BA)1000–5HA–B(**)N*	4.8×6.5	15.7×9.6	N4	
	BF(BA)350–2HA–C(**)N*	2.0×2.5	7.2×6.3	N0、N2、N4、N6、N8、T2、T4、T8	
	BF(BA)350–3HA–C(**)N*	3.1×4.0	9.5×7.8	N2、N4、N6、N8、N9、T0、T4、T6、T8、T9	
	BF(BA))350–8HA–C(**)N*	8.0×9.0	13.0×14.4	N0	
	BF(BA)1000–3HA–C(**)N*	3.1×5.4	10.7×7.8	N4、N8、T0、T4	
	BF(BA)120–2HA–D(**)N*	2.0×3.5	7.0×5.6	N8	
	BF(BA)350–2HA–D(**)N*	2.1×4.3	8.9×5.7	N8	
	BF(BA)350–3HA–D(**)N*	2.9×4.0	8.8×6.8	N4 、N8、T0、T1、T4	
	BF(BA)350–4HA–D(**)N*	4.2×2.8	8.3×8.3	N4、N8	
	BF(BA)350–6HA–D(**)N*	5.9×3.7	10.5×11.1	N8	
	BF(BA))400–3HA–D(**)N*	2.9×4.0	8.8×6.8	N4 、N8、T0、T1、T4	
	BF(BA)350–2HA–E(**)N*	2.0×4.3	8.9×5.7	N8	
	BF(BA)350–3HA–E(**)N*	3.0×3.9	8.8×6.8	N4、N8	
	BF(BA)350–4HA–E(**)N*	4.2×2.8	8.3×8.3	N4、N8	
	BF(BA)350–6HA–E(**)N*	5.9×3.7	10.5×11.4	N8	
	BF(BA))700–3HA–D(**)N*	3.4×6.3	8.5×7.6	N2	
	BF(BA)60–3AB(**)N*	3.0×3.0	8.2×5.1	T0	
	BF(BA)120–3AB(**)N*	3.0×3.0	8.4×4.8	T0	
	BF(BA)120–6AB(**)N*	5.8×5.8	9.7×7.4	N8	
	BF(BA)175–2AB(**)N*	2.0×2.0	6.7×3.7	N8、T0	
	BF(BA)175–3AB(**)N*	3.0×3.0	8.2×5.1	N8	
	BF(BA)350–2AB(**)N*	2.0×2.0	6.7×3.7	N0、N4、N8、T3	
	BF(BA)280–3AB(**)N*	3.0×3.0	8.2×5.1	N0	
	BF(BA)350–3AB(**)N*	3.0×3.0	8.2×5.1	N0、N1、N2、N4、N5、N6、N8、T0、T6	
	BF(BA)350–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	BF(BA)350–6AB(**)N*	5.9×5.9	12.0×8.3	N5	
	BF(BA)350–8AB(**)N*	7.9×7.9	13.3×10.0	N8	
	BF(BA)500–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	BF(BA)120–3AB–B(**)N*	3.0×3.0	10.2×5.0	T0	
	BF(BA)120–2FB(**)N*	2.0×2.0	5.6×5.2	N2、T0	
	BF(BA)350–2FB(**)N*	2.1×2.8	6.4×7.6	N6、T0	
	BF(BA)350–3FB(**)N*	3.2×2.8	7.4×7.4	N0、N1、N2、N3、N4、N5、N6、N8、N9、T0、T2、T4、T8	
	BF(BA)350–4FB(**)N*	4.0×2.4	7.8×6.2	N6、T0	

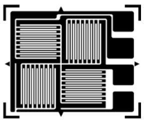
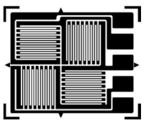
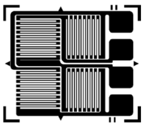
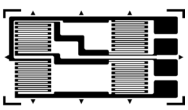
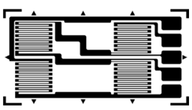
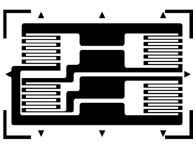
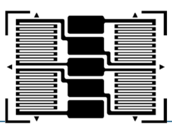
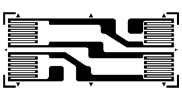
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)350–6FB(**)N*	5.9×2.8	9.8×7.3	N6	
	BF(BA)350–10FB(**)N*	10.0×2.2	13.8×6.1	N8	
	BF(BA)350–20FB(**)N*	20.0×3.6	24.7×8.8		
	BF(BA)1000–3FB(**)N*	3.0×5.3	12.1×6.7	T0	
	BF(BA)350–3FB–A(**)N*	3.2×2.5	6.8×6.4	N2	
	BF(BA)100–4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BF(BA)120–2BB(**)N*	1.8×2.4	6.3×5.5	N2	
	BF(BA)120–3BB(**)N*	2.8×3.3	8.5×6.5	N6	
	BF(BA)120–4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BF(BA)175–6BB(**)N*	5.4×6.2	13.8×9.4	N6	
	BF(BA)240–4BB(**)N*	4.0×4.4	10.3×7.5	T0	
	BF(BA)350–1BB(**)N*	2.4×2.1	5.5×5.5	N0	
	BF(BA)350–2BB(**)N*	2.0×2.6	7.2×6.0	N8	
	BF(BA)350–3BB(**)N*	3.0×3.3	8.6×6.6	N2、N8、T4	
	BF(BA)350–4BB(**)N*	4.0×4.1	9.7×7.7	T0	
	BF(BA)350–6BB(**)N*	6.0×6.0	13.8×9.7	T0	
	BF(BA)480–3BB(**)N*	3.0×3.3	8.6×6.6	N2、N8、T4	
	BF(BA)600–4BB(**)N*	3.9×4.1	9.7×7.7	N6、N0	
	BF(BA)650–4BB(**)N*	4.0×4.4	10.3×7.9	N6	
	BF(BA)120–2BB–A(**)N*	1.8×2.2	6.3×5.4	T0	
	BF(BA)120–3BB–A(**)N*	2.8×3.3	8.5×6.5	N6	
	BF(BA)120–4BB–A(**)N*	4.0×4.4	10.3×7.5	T0	
	BF(BA)350–2BB–A(**)N*	2.0×2.7	6.9×6.0	T4、N0	
	BF(BA)350–3BB–A(**)N*	3.0×3.4	9.8×6.8	N2	
	BF(BA)350–4BB–A(**)N*	4.0×4.1	9.7×7.7	T0、N6	
	BF(BA)350–6BB–A(**)N*	5.9×6.3	14.3×9.6	T0、N6	
	BF(BA)800–2BB–A(**)N*	2.0×3.5	5.8×5.8	T0	
	BF(BA)1000–4BB–A(**)N*	3.6×4.0	9.4×7.0	T0	
	BF(BA)160–5BB(**)N*	4.9×3.0	9.6×9.8	N4	
	BF(BA)600–5BB(**)N*	4.9×3.2	9.6×9.8	T0	
	BF(BA)600–5BB–A(**)N*	4.9×3.2	9.6×9.8	N0、N1、N4、N6、N8、T0	
	BF(BA)700–5BB–A(**)N*	4.9×3.2	9.6×9.8	N0、N4、N6、N8、T0、T2	
	BF(BA)1000–5BB–A(**)N*	4.9×3.2	9.6×9.8	N6	

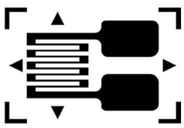
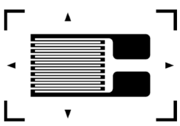
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)350–2BB–L(**)N*	2.1×2.1	7.8×4.0	N4	
	BF(BA)700–5BB–L(**)N*	4.8×3.6	11.6×6.8	N0	
	BF(BA)200–3BB–B(**)	3.0×3.6	14.3×7.3		
	BF(BA)200–5BB–B(**)	5.0×6.0	22.1×9.5		
	BF(BA)200–10BB–B(**)	10.0×10.8	30.7×13.0		
	BF(BA)400–3BB–B(**)	3.0×3.4	14.3×7.3		
	BF(BA)400–5BB–B(**)	5.0×6.0	22.1×9.5		
	BF(BA)160–5BB–C(**)	5.2×2.6	9.4×8.1		
	BF(BA)350–5BB–C(**)	5.2×2.6	9.4×8.1		
	BF(BA)700–5BB–C(**)	5.2×2.6	9.4×8.1		
	BF(BA)350–2GB(**)N*	2.1×3.0	10.8×4.4	T0、N6	2.7
	BF(BA)350–3GB(**)N*	3.1×2.8	12.4×4.4	N4、N6	3.8
	BF(BA)350–4GB(**)N*	4.0×3.8	15.3×5.8	T0	5.0
	BF(BA)350–1GB–AL0(**)N*	1.5×2.5	13.8×3.8	T0	10.5
	BF(BA)350–1.5GB–AL12(**)N*	1.5×2.6	15.0×4.0	N4	12.0
	BF(BA)350–1.5GB–AL68(**)N*	1.5×3.1	9.8×4.3	N6	6.8
	BF(BA)350–2GB–AL0(**)N*	2.0×3.1	14.4×4.4	N1、N3、N4、N6	10.5
	BF(BA)350–2GB–AL5.5(**)N*	2.0×2.8	8.9×3.8	N8 、T0、T2、T6、T8	5.5
	BF(BA)350–2GB–AL6(**)N*	2.0×2.8	9.4×3.8	N6	6.0
	BF(BA)350–2GB–AL7(**)N*	2.0×3.1	10.8×4.4	N0、N2、N6、T0、T4、T6	7.0
	BF(BA)350–3GB–AL0(**)N*	3.0×2.9	15.4×4.2	N0、N2、N6、T0、T5	10.5
	BF(BA)350–3GB–AL12(**)N*	3.0×2.9	16.9×4.2	N2、N6、T0	12.0
	BF(BA)350–3GB–AL13(**)N*	3.2×4.2	19.0×5.6	T0	13.2
	BF(BA)350–3GB–AL14(**)N*	3.0×3.0	18.8×4.2	N0、T0	14.0
	BF(BA)350–3GB–AL15(**)N*	3.0×2.7	20.0×4.1	N2、N4、N8、T0、T2、T4	15.0
	BF(BA)750–3GB–AL0(**)N*	3.0×3.5	15.2×4.3	N8	10.5
	BF(BA)750–3GB–AL12(**)N*	3.0×3.5	16.7×4.3	T0	12.0
	BF(BA)750–3GB–AL14(**)N*	3.0×3.5	18.7×4.2	N0	14.0
	BF(BA)500–2GB–BL6(**)N*	2.1×5.0	9.8×6.0	N4	6.0
	BF(BA)500–2GB–BL8(**)N*	2.1×5.3	11.3×6.3	N0	8.0
	BF(BA)500–3GB–BL7(**)N*	3.0×4.1	12.0×5.5	T0	7.1
	BF(BA)500–4GB–BL7(**)N*	3.4×4.1	13.0×5.5	N6	7.2
	BF(BA)750–2GB–BL12.8(**)N*	2.5×5.2	16.9×6.0	N0	12.8
	BF(BA)1000–2GB–BL6(**)N*	2.5×5.0	10.1×6.0	N6	6.0
	BF(BA)1000–3GB–BL7(**)N*	3.0×5.5	11.7×6.5	N8、T4	7.0

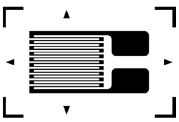
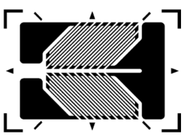
BF/ BA

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	BF(BA)350–2GB–CL0(**)N*	2.5×3.3	14.7×4.5	N6、N8、T0、T8	10.5
	BF(BA)350–2GB–CL5(**)N*	2.0×4.1	10.3×5.5	T0	5.0
	BF(BA)350–2GB–CL8(**)N*	2.5×3.3	12.9×4.5	T2、T4	8.0
	BF(BA)350–3GB–CL12(**)N*	3.0×2.9	16.9×4.2	N0、T0	12.0
	BF(BA)240–2EB(**)N*	2.0×3.0	10.0×10.0	N2	
	BF(BA)350–2EB(**)N*	2.3×2.7	8.6×7.2	N2	
	BF(BA)350–2EB–A(**)N*	2.3×2.7	8.6×7.5	N2	
	BF(BA)350–1.8EB–B(**)N*	1.8×2.0	6.7×5.7	T6	
	BF(BA)350–2EB–B(**)N*	2.3×2.8	8.6×7.4	N2	
	BF(BA)350–2FG–L8.8(**)N*	2.0×2.7	14.5×6.5	N6	8.8
	BF(BA)350–2FG–L0(**)N*	2.0×2.7	16.2×6.5	N2、T2	10.5
	BF(BA)350–2FG–AL6(**)N*	2.0×2.2	12.0×7.1	N2、T0、T4、T8	6.0
	BF(BA)350–3FG–AL6(**)N*	3.0×2.1	13.0×6.8	T4	6.0
	BF(BA)350–3FG–AL0(**)N*	3.1×3.0	17.9×8.4	N2、T2、T6	10.5
	BF(BA)350–3FG–AL14(**)N*	3.0×2.1	20.5×6.8	N6、T1、T6、T0	14.0
	BF(BA)350–1FG–BL0(**)N*	1.5×2.7	13.7×6.9	T4、T6	10.5
	BF(BA)350–2FG–BL10(**)N*	2.6×2.7	14.8×8.0	N8	10.0
	BF(BA)350–3FG–BL0(**)N*	3.1×2.8	15.5×6.8	T2	10.5
	BF(BA)350–2FG–CL6(**)N*	2.1×2.9	9.8×6.9	T0、T2、T4	6.0
	BF(BA)350–3FG–CL0(**)N*	3.1×2.8	15.3×7.0	N2、N6、T0、T4	10.5
	BF(BA)350–1FG–DL0(**)N*	1.5×2.5	13.9×6.6	T0、T0、T8	10.5
	BF(BA)350–3FG–DL15(**)N*	2.8×2.3	19.0×6.0	T0	15.0

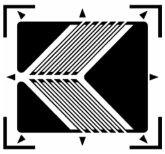
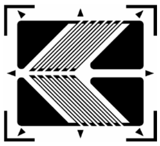
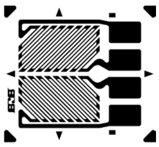
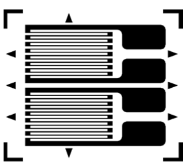
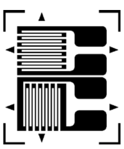
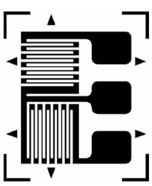
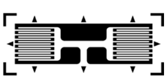
ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF120–03AA(**)N*	0.3×2.1	2.7×2.7		
	ZF120–1AA–W(**)N*	1.0×1.5	4.0×2.7		
	ZF175–1AA(**)N*	1.0×1.8	4.5×3.0	T8	
	ZF300–1AA(**)N*	1.1×1.2	3.6×2.2	T8	
	ZF200–1AA–W(**)N*	1.0×0.5	2.8×1.8	T8	
	ZF250–1AA–W(**)N*	1.1×1.0	2.9×2.0	T8	
	ZF300–2AA–W(**)N*	2.0×1.0	3.8×2.0	T8	
	ZF300–2AA–A–W(**)N*	2.0×2.0	3.8×2.8	T8	
	ZF350–08AA(**)N*	0.8×1.6	3.1×2.6		
	ZF350–1AA–W(**)N*	1.1×1.0	2.9×2.0	T8	
	ZF350–2AA–W(**)N*	2.0×1.0	3.8×2.0	T8	
	ZF1000–2AA–W(**)N*	1.8×1.9	3.9×2.5		
	ZF120–3AA–A(**)N*	3.0×0.6	6.3×1.5	T0	
	ZF350–1AA(**)N*	1.0×3.1	4.5×4.2		
	ZF350–1AA–A(**)N*	1.0×2.1	2.9×2.6		
	ZF300–3AA–A(**)N*	2.9×1.9	5.5×2.5	T4	
	ZF350–2AA(**)N*	1.9×2.8	5.7×4.0	N0、N1、N3、N4、N6、N8、T0、T4、T6	
	ZF350–3AA(**)N*	3.1×2.6	7.0×3.8	N1、N2、N3、N4、N5、N6、N0、T0、T2、T4	
	ZF350–4AA(**)N*	4.0×2.5	8.0×3.9	N6	
	ZF350–5AA(**)N*	5.0×2.3	9.0×3.7	N6	
	ZF350–7AA(**)N*	7.0×2.6	10.8×4.0	N4	
	ZF500–2AA–T(**)N*	2.3×0.7	4.2×1.4		
	ZF600–1.5AA(**)N*	1.5×1.8	4.0×2.5		
	ZF700–2AA(**)N*	2.5×3.3	6.4×4.5		
	ZF1000–1AA(**)N*	1.4×3.4	5.2×4.5		
	ZF1000–1.2AA(**)N*	1.2×3.6	4.5×4.5	T8	
	ZF1000–1.5AA–A(**)N*	1.5×2.5	4.5×3.1	T4、T8	
	ZF1000–1.5AA(**)N*	1.5×4.0	4.9×4.8	N3、N6、T1、T2、T3、T4、T5、T6、T8	
	ZF1000–2AA–T(**)N*	2.1×3.3	5.8×4.5	N0、T4、T8	
	ZF1000–2AA–A(**)N*	2.4×3.0	4.9×4.0		
	ZF1000–2AA(**)N*	2.5×3.3	6.4×4.5	N0、N2、N5、N6、T0、T1、T2、T3、T4、T6	
	ZF1000–3AA–B(**)N*	3.0×3.1	14.3×4.5	N0、N1、N2、N3、N5、N6、N7、T2、T3、T4、T8	
	ZF1000–3AA(**)N*	3.2×3.2	7.4×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2、T3、T4、T5、T6、T8	
	ZF1000–4AA(**)N*	3.8×2.2	8.2×4.2	N0、N2、N6、N9、T6	

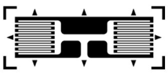
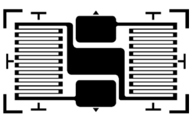
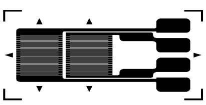
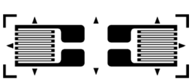
ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF1000–4AA–A(**)N*	3.8×2.5	8.2×4.2		
	ZF1000–5AA(**)N*	5.0×2.9	9.3×4.5	N0、N1、N2、N3、N4、N6、N8、T0、T2	
	ZF1500–3AA(**)N*	3.2×3.2	7.4×4.5	N6、N4	
	ZF2000–2AA–A(**)N*	2.1×4.2	5.4×5.2	T1、T6	
	ZF2000–3AA(**)N*	3.2×4.0	7.4×5.3	N0、T4	
	ZF2000–4AA(**)N*	4.0×4.4	8.6×6.0	N6	
	ZF2500–3AA(**)N*	3.2×3.2	7.4×4.5	N2、N6、N8、T0、T1、T2、T3、T4、T5、T6、T7、T8	
	ZF2500–6AA(**)N*	6.0×6.4	11.0×8.0	N0	
	ZF3000–5AA(**)N*	5.2×4.0	8.7×5.2	N6	
	ZF3000–6AA(**)N*	6.1×3.9	9.8×5.2	T0、T4	
	ZF5000–3AA(**)N*	3.2×4.6	6.7×5.8	N6	
	ZF350–2HA(**)N*	1.9×2.2	6.0×4.9	T0	
	ZF350–3HA(**)N*	3.0×4.4	9.4×6.5	N1、N4、N8	
	ZF350–4HA(**)N*	3.7×2.0	7.9×7.9	N3	
	ZF700–4HA(**)N*	3.8×4.2	9.0×7.8	N5	
	ZF1000–2HA(**)N*	2.0×4.4	9.0×5.6	N2、N4、N5、N6、T0、T4	
	ZF1000–3HA(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T3、T4、T8	
	ZF1000–4HA(**)N*	3.8×4.2	9.0×7.8	N4、N6、T0、T4	
	ZF2000–3HA(**)N*	3.0×5.5	9.9×6.2	N4、N8、T2、T6、T8	
	ZF350–3HA–A(**)N*	3.0×4.42	9.4×6.5	N4、N6、N8、T0	
	ZF650–3HA–A(**)N*	2.9×4.0	8.5×6.3	T0	
	ZF1000–2HA–A(**)N*	2.0×4.4	9.0×5.6	N2、N4、N6、T0、T4、T8	
	ZF1000–3HA–A(**)N*	3.0×4.5	9.4×6.5	N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T4、T6、T8	
	ZF1000–4HA–A(**)N*	3.8×4.2	9.0×7.8	N4	
	ZF2000–4HA–A(**)N*	4.0×5.7	10.8×8.0	N4	
	ZF1000–2HA–B(**)N*	2.0×2.5	7.2×6.3	N6、N8	
	ZF1000–3HA–B(**)N*	3.1×4.0	9.5×7.8	N4、N6、N8、T0、T4	
	ZF200–05HA–W(**)N*	0.5×1.4	3.8×2.0	T4	
	ZF250–1HA–W(**)N*	1.0×1.3	3.8×2.8	T4	
	ZF300–2HA–W(**)N*	2.0×1.2	4.0×4.0	T8	
	ZF350–1HA–W(**)N*	1.0×1.3	3.8×2.8	T4	
	ZF350–2HA–W(**)N*	2.0×1.2	4.0×4.0	T8	

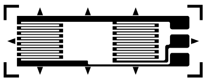
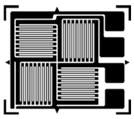
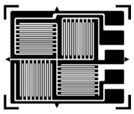
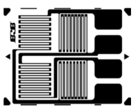
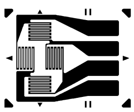
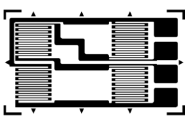
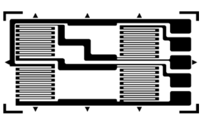
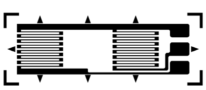
ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF350–4HA–D(**)N*	3.9×2.3	8.3×8.3	N8	
	ZF650–4HA–D(**)N*	3.8×2.5	7.5×7.5	N1、N8、T0	
	ZF700–4HA–D(**)N*	3.8×2.5	7.5×7.5	N1、N8、T0	
	ZF700–4HA–E(**)N*	3.8×2.5	7.5×7.5	N1、N8、T0	
	ZF1000–2HA–T(**)N*	2.7×3.5	7.1×6.4	T0	
	ZF350–3AB(**)N*	3.0×3.0	8.0×5.2	N8	
	ZF1000–2AB(**)N*	2.0×2.0	6.7×3.7	N0、N4、N8、T3	
	ZF1000–3AB(**)N*	3.0×3.0	8.2×5.1	N0、N1、N2、N4、N5、N6、N8、T0、T6	
	ZF1000–4AB(**)N*	4.0×4.0	9.1×5.8	N8	
	ZF350–3FB(**)N*	3.0×2.6	7.4×7.2	N6	
	ZF350–4FB(**)N*	4.0×2.4	7.8×6.2	N6、N2	
	ZF1000–2FB(**)N*	2.1×2.8	6.4×7.6	N6、T0	
	ZF1000–3FB(**)N*	3.2×2.8	7.4×7.4	N0、N1、N2、N3、N4、N5、N6、N8、T0、T2、T4、T8	
	ZF1000–4FB(**)N*	4.0×2.4	7.8×6.2	N6、T0	
	ZF1000–6FB(**)N*	6.0×2.4	9.5×6.8	N2	
	ZF1000–2BB(**)N*	2.0×2.6	7.2×6.0	N8	
	ZF1000–3BB(**)N*	3.0×3.4	8.6×6.6	T4	
	ZF1000–6BB(**)N*	6.0×6.0	13.8×9.7	T0	
	ZF350–2BB–A(**)N*	1.5×2.0	5.9×4.5	T0	
	ZF800–2BB–A(**)N*	1.7×3.2	5.4×5.4	T0	
	ZF1000–2BB–A(**)N*	2.0×2.7	6.9×6.0	T4、N0	
	ZF1000–2BB–A(**)–KR	2.6×2.2	5.4×5.4	N4	
	ZF1000–3BB–A(**)N*	3.0×3.4	9.8×6.8	N2	
	ZF1050–3BB–A(**)N*	3.0×3.4	9.8×6.8	N2	
	ZF1000–4BB–A(**)N*	3.8×4.3	10.3×7.8	N4	
	ZF2000–3BB–A(**)N*	3.1×3.5	8.8×6.5		
	ZF350–1GB–AL68(**)N*	1.5×3.2	9.8×4.3	N0、N6、T0、T4	6.8
	ZF350–2GB–AL7(**)N*	2.0×2.7	10.8×3.9	N2、N4、N6、T0	7.0

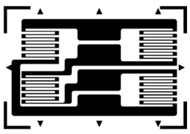
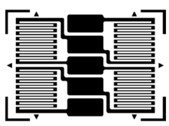
ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF350–1GB–AL8(**)N*	1.5×3.5	11.0×4.3	N2	8.0
	ZF350–2GB–AL0(**)N*	2.0×2.7	14.4×3.9	N0、N2、N4、N6、T0、T2、T8	10.5
	ZF350–2GB–AL12(**)N*	2.0×2.7	15.8×3.9	N0、N4	12.0
	ZF350–2GB–AL15(**)N*	2.0×2.7	18.8×3.9	N2、T4	15.0
	ZF750–2GB–AL12(**)N*	2.0×3.3	15.8×4.5	N0、T6、T8	12.0
	ZF1000–1.5GB–AL5.5(**)N*	1.5×2.5	9.1×4.3	N6	5.5
	ZF1000–1.5GB–AL9(**)N*	1.5×4.0	12.0×5.2	T2、T3、T8	9.0
	ZF1000–1.6GB–AL0(**)N*	1.6×3.9	13.7×5.1	T1、T4	10.5
	ZF1000–2GB–AL5(**)N*	2.0×3.3	8.9×4.5	N2	5.3
	ZF1000–2GB–AL5.5(**)N*	2.0×2.8	8.9×3.8	N6	5.5
	ZF1000–2GB–AL6(**)N*	2.0×2.8	9.4×3.8	N0、N2、N6、T0、T4、T6	6.0
	ZF1000–2GB–AL7(**)N*	2.0×3.1	10.8×4.4	N0、N2、N4、N6、T0、T5	7.0
	ZF1000–2GB–AL0(**)N*	2.5×3.3	14.7×4.5	N0、N2、N3、N4、N5、N6、N8、T1、T6	10.5
	ZF1000–3GB–AL7(**)N*	3.0×3.2	11.6×4.4	N2	7.0
	ZF1000–3GB–AL0(**)N*	3.0×3.2	15.4×4.4	N6、T0、T2、T4、T6、T8	10.5
	ZF1000–3GB–AL14(**)N*	2.9×3.0	18.7×4.2	N0、N1	14.0
	ZF1100–2GB–AL6(**)N*	2.0×3.0	9.4×4.0	N2	6.0
	ZF2000–2GB–AL0(**)N*	2.5×4.0	14.7×5.0	T0、T4	10.5
	ZF500–2GB–BL6(**)N*	2.1×5.0	9.8×6.0	N4	6.0
	ZF1000–1GB–BL6(**)N*	1.5×4.8	9.1×6.5	T6	6.0
	ZF1000–2GB–BL6(**)N*	2.1×4.1	9.7×5.5	N0、N2、N6、T0、T1、T2、T3、T4、T5、T6	6.0
	ZF1000–2GB–BL7(**)N*	2.1×4.1	10.7×5.5	N6、T1、T3、T5、T8	7.0
	ZF1000–2GB–BL0(**)N*	2.1×4.1	14.2×5.5	T1、T3、T5	10.5
	ZF1000–3GB–BL6(**)T*	3.0×3.6	10.7×4.8	T0、T2	6.0
	ZF2000–2GB–BL6(**)N*	2.1×4.2	9.7×5.5	T6	6.0
	ZF2000–2GB–BL7(**)N*	2.1×5.4	10.8×6.4	N6、T0	7.0
	ZF650–4GB–CL6(**)N*	4.0×3.2	20.0×6.0	N6	
	ZF650–5GB–CL7(**)N*	5.0×2.4	27.0×4.0	T0	
	ZF1000–2GB–CL8(**)N*	2.5×3.3	12.9×4.5	N2、T1、T2、T4	8.8
	ZF1000–2GB–CL0(**)N *	2.5×3.3	14.7×4.5	T2、T4	10.5

ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF350–3GB–L12(**)N*	3.0×3.3	20.3×4.2	N6	
	ZF500–3GB–L0(**)N*	3.0×4.8	18.8×5.3	N6	
	ZF500–3GB–L12(**)N*	3.0×4.8	16.8×5.3	N6	
	ZF1000–2GB–L6(**)N*	2.1×3.4	11.7×5.2	T4	
	ZF1000–3GB–L6(**)N*	3.0×3.8	13.2×4.8	T8	
	ZF1000–3GB–L0(**)N*	3.0×3.8	17.2×4.9	N2、T2、T8	
	ZF1000–3GB–L12(**)N*	3.1×3.9	18.5×4.9	N2	
	ZF1000–4GB–L12(**)N*	4.0×2.5	19.5×4.5	N8	
	ZF350–2EB(**)N*	1.8×2.2	7.4×8.5	N2	
	ZF1000–2EB(**)N*	2.3×2.7	8.6×7.2	N2	
	ZF1000–3EB(**)N*	2.7×3.2	9.8×8.4	N2	
	ZF350–2EB–A(**)N*	1.8×2.3	7.4×8.4	N2	
	ZF1000–2EB–A(**)N*	2.3×2.7	8.6×7.5	N2	
	ZF1000–2EB–B(**)N*	2.3×2.7	8.6×7.4	N2	
	ZF1000–2EB–BT(**)N*	1.8×1.8	7.9×5.2	T6	
	ZF1200–2EB–BT(**)N*	1.8×1.8	7.9×5.2	T6	
	ZF350–1EB–T(**)N*	1.3×1.3	8.2×6.4	T0、T8	
	ZF1000–2EB–T(**)N*	1.8×1.8	8.2×7.7	T8	
	ZF350–1FG–L0(**)N*	1.5×2.0	16.0×6.2	T0	10.5
	ZF350–2FG–L7(**)N*	2.0×1.9	13.4×6.4	T1	7.0
	ZF350–2FG–L8(**)N*	2.0×1.9	14.3×6.4	T0	8.0
	ZF1000–2FG–L0(**)N*	2.0×1.6	16.2×6.5	N2、T2	10.5
	ZF1000–3FG–L0(**)N*	3.0×2.5	17.4×6.4	N6、T8	10.5
	ZF1000–3FG–L12(**)N*	3.1×2.3	18.6×6.8	N0、T8	12.0
	ZF350–2FG–AL6(**)N*	2.0×2.2	11.9×7.1	T0、N4、N6、N8、T4	6.0
	ZF350–3FG–AL0(**)N*	3.0×2.0	17.2×6.6	N6	10.5
	ZF1000–2FG–AL0(**)N*	2.1×2.6	16.9×7.4	T1、T6、T8	10.5
	ZF1000–3FG–AL0(**)N*	3.1×3.2	17.9×8.4	N2、N6、T0、T2、T4、T6	10.5
	ZF1000–3FG–AL14(**)N*	3.0×2.1	20.5×6.8	N6、T1、T6、T0	14.0
	ZF1000–3FG–AL12(**)N *	3.1×2.9	19.4×8.4	T8	12.0
	ZF350–3GB–L12(**)N*	3.0×3.3	20.3×4.2	N6	12.0
	ZF500–3GB–L0(**)N*	3.0×4.8	18.8×5.3	N6	10.5
	ZF500–3GB–L12(**)N*	3.0×4.8	16.8×5.3	N6	12.0
	ZF1000–2GB–L6(**)N*	2.1×3.4	11.7×5.2	T4	10.5
	ZF1000–3GB–L6(**)N*	3.0×3.8	13.2×4.8	T8	6.0
	ZF1000–3GB–L0(**)N*	3.0×3.8	17.2×4.9	N2、T2、T8	10.5
	ZF1000–3GB–L12(**)N*	3.1×3.9	18.5×4.9	N2	12.0
	ZF1000–4GB–L12(**)N*	4.0×2.5	19.5×4.5	N8	12.0
	ZF2000–3GB–L0(**)N*	3.0×2.8	17.8×4.4	T8	10.5

ZF

Product Geometry	Product code	Grid size Length (L) × Width (W) (mm)	Backing size Length (L) × Width (W) (mm)	Available creep codes	Pitch (mm)
	ZF350–1FG–BL6(**)N*	1.5×2.2	9.3×6.1	T0、N4	6.0
	ZF350–1FG–BL0(**)N*	1.5×2.5	13.9×6.4	N0、T0、T8	10.5
	ZF400–1FG–BL68(**)N*	1.5×2.4	9.8×6.1	T8	6.8
	ZF500–2FG–BL6(**)N*	2.1×2.2	9.7×5.8	T8	6.0
	ZF1000–1.5FG–BL0(**)T*	3.0×2.8	13.8×6.9	T8	10.5
	ZF1000–2FG–BL6(**)N*	2.1×2.7	9.8×6.9	N4、N8、T0、T4、T8	6.0
	ZF1000–2FG–BL0(**)N*	2.1×2.8	14.4×6.9	N2、N6	10.5
	ZF1000–3FG–BL0(**)T*	3.1×2.8	15.5×6.8	T2	10.5
	ZF1100–2FG–BL0(**)N*	2.1×2.8	14.4×6.9	N2、T8	10.5
	ZF1100–2FG–BL6(**)N*	2.1×2.8	9.8×6.8	N2	6.0
	ZF1200–3FG–BL7(**)N*	3.0×2.6	12.0×6.8	T0	7.0
	ZF2000–2FG–BL0(**)N*	2.0×3.3	14.3×7.8	T8	10.5
	ZF350–1FG–CL6(**)N*	1.5×2.2	9.2×6.0	T0	6.0
	ZF350–1FG–CL68(**)N*	1.5×2.4	9.8×6.2	N2	6.8
	ZF350–1FG–CL0(**)N*	1.5×2.2	13.9×6.4	T2	10.5
	ZF1000–2FG–CL6(**)N*	2.1×2.9	9.8×6.9	T0、T2、T4	6.0
	ZF1000–3FG–CL0(**)N*	3.1×2.8	15.3×7.0	N2、N6、T0、T4	10.5
	ZF1100–2FG–CL6(**)N*	2.1×2.8	9.6×6.8	N2	6.0

Please Note:

1.N* and T* are creep codes, different creep codes have different creep values.

2.L* stands for the grid interval codes. For example L0 refers to a 10.5 mm grid interval and L6 refers to a 6mm grid interval.

3.In the list above, the code BYM(BKM, BEB) represents that the strain gauge is available in 3 series which are; BYM350–3AA–A(**)N*, BKM350–3AA–A(**)N* and BEB350–3AA–A(**)N* respectively. This goes for all series of strain gauges with different types noted between brackets.

4.When a strain gauge with grid pattern HA–D or HA–E is selected with encapsulation option, please note they are only available with pre–attached lead wires.

5.For strain gauges with a KA pattern goes:

When the nominal resistance is 120 Ω, the resistance range is: nominal value +2.0/–1.0 Ω and the resistance difference of the grids is ⩽ 0.4 Ω.

When the nominal resistance is 350Ω, the resistance range is: nominal value +2.0/–2.0 Ω and the resistance difference of the grids is ⩽ 0.8 Ω.

When the nominal resistance is 1000 Ω, the resistance range is: nominal value +100.0/–50.0 Ω and the resistance difference of the grids is ⩽ 1.0 Ω.

When the nominal resistance is > 1500 Ω, the resistance range is: nominal value ± 10% Ω and the resistance difference of the grids is ⩽ 1% Ω.

6.For strain gauges with a FG or EB pattern goes:

When the nominal resistance is 350 Ω, the resistance range is: 350 ± 50 Ω and the Zero balance is ⩽ 0.5 mV/V.

When the nominal resistance is 1000 Ω, the resistance range is: 1000 ± 10 % and the Zero balance is ⩽ 1.0 mV/V.

7.Except for the models listed above, it is also possible to produce high precision transducers that use strain gauge with any shape and size according to samples or drawings supplied by the customer.

Pressure sensor resistance strain gauges KA series

Backing size diameter (mm)

Sensitivity Grid Length (mm)

Nominal Resistance (Ω)

Type of Backing Material

Grid Material

Sensitivity Grid Geometry Pattern

Ultimate Working Temperature (°C)
Temperatures under 60°C may be omitted

Self-Temperature Comp. or Self-Elastic Modulus Comp. Code

Lead Wire & Sealing Form

B F 350 – (7 – B10) KA 80 (11) – X

B: Constantan Foil
Z: Karma Foil
T: Special purpose foil

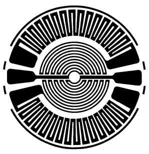
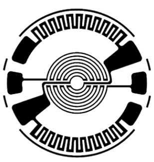
F: Modified Phenolic
A: Polyimide
E: Phenolic-Acetal
H: Modified Epoxy
Q: Paper
J: Polyurethane
AM: Polyimide Film
PM: Polyurethane Film
HB: Glass Fiber Reinforced Epoxy
AB: Glass Fiber Reinforced Polyimide
YM: Special Polyimide Film
KM: Special PEEK Film
EB: Glass Fiber Reinforced Epoxy

If the grid size is the same as the backing size this content will be omitted

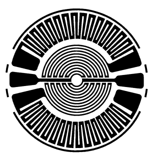
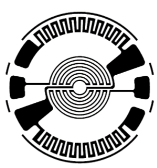
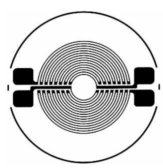
STC and EMC Codes:
9: Titanium alloy
11: Martensitic, Age Hardenable Stainless and Alloy Steel
16: Copper based and Austenitic Stainless Steel
23: Aluminium Alloy
27: Magnesium Alloy
M23: Aluminium Alloy

C: Solder tabs exposed
D: Solder tin dots and encapsulation
F: Non-lead wire and fully open-faced
H: Non-lead wire, fully open-faced and whole sheet package
U: Lead wire and fully open-faced
M: Non-lead wire and adhesive cover
S: Solder tabs exposed and strips package
X: Standard lead wire and encapsulation
P**: Encapsulation and PVC lead wires
X**: Encapsulation and Column lead wires
BX**: Encapsulation and flat ribbon wire
Q**: Encapsulation and Varnished wrapped wires
G**: Encapsulation and High temp. lead wires
**: length of the lead wires

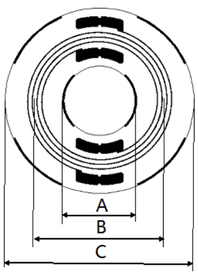
KA

Product Geometry	Product code	Grid size Diameter (mm)	Backing size Diameter (mm)	Available creep codes	Pitch (mm)
	BF(BYM、BA)120–（10）KA(**)	Φ8.9	Φ10.0		
	BF(BYM、BA)350–（10）KA(**)	Φ9.0	Φ10.0	T0、T2、T6	
	BF(BYM、BA)350–（13）KA(**)	Φ12.0	Φ13.0		
	BF(BYM、BA)350–（8）KA(**)	Φ7.4	Φ8.0		
	BF(BYM、BA)350–（9）KA(**)	Φ9.4	Φ10.0		
	BF(BYM、BA)350–（12）KA(**)	Φ11.4	Φ12.0		
	BF(BYM、BA)350–（14）KA(**)	Φ12.8	Φ14.0	T0、N3、N6	
	BF(BYM、BA)350–（15）KA(**)	Φ14.0	Φ15.0		
	BF(BYM、BA)350–（20）KA(**)	Φ18.6	Φ20.0		
	BF(BYM、BA)350–（8.5）KA–B(**)	Φ8.1	Φ9.0		
	BF(BYM、BA)350–（18）KA–B(**)	Φ16.6	Φ18.0		
	BF(BYM、BA)350–（20）KA–C(**)	Φ19.0	Φ20.0		
	BF(BYM、BA)350–（22）KA–C(**)	Φ19.8	Φ22.2	N4、T0	
	BF(BYM、BA)350–（16–B18）KA–C(**)	Φ16.0	Φ18.0		
	BF(BYM、BA)350–（17–B19）KA–C(**)	Φ17.5	Φ19.5		
	BF(BYM、BA)350–（18–B20）KA–C(**)	Φ18.5	Φ20.5		
	BF(BYM、BA)120–(10–B13)KA(**)	Φ9.0	Φ13.0		
	BF(BYM、BA)350–(7–B10)KA(**)	Φ6.4	Φ9.9		

KA/ KB

Product Geometry	Product code	Grid size Diameter (mm)	Backing size Diameter (mm)	Available creep codes	Pitch (mm)
	ZF(ZYM)350–(14)KA(**)	Φ12.8	Φ14.0		
	ZF(ZYM)350–(20)KA(**)	Φ19.0	Φ20.0		
	ZF(ZYM)1000–(14)KA(**)	Φ12.8	Φ14.0	N6、N3、T0	
	ZF(ZYM)1000–(15)KA(**)	Φ14.0	Φ15.0		
	ZF(ZYM)1000–(20)KA(**)	Φ18.6	Φ20.0		
	ZF(ZYM)2000–(14)KA(**)	Φ13.2	Φ14.0	T0、T4	
	ZF(ZYM)2000–(15)KA(**)	Φ14.2	Φ15.0		
	ZF(ZYM)3000–(14)KA(**)	Φ13.2	Φ14.0		
	ZF(ZYM)350–(6.5)KA(**)	Φ5.3	Φ6.5		
	ZF(ZYM)350–(9)KA(**)	Φ9.4	Φ10.0		
	ZF(ZYM)350–(25)KA(**)	Φ23.4	Φ25.0		
	ZF(ZYM)1000–(10)KA(**)	Φ9.0	Φ10.0	T0、T2、T6	
	ZF(ZYM)1000–(13)KA(**)	Φ12.0	Φ13.0		
	ZF(ZYM)1500–(10)KA(**)	Φ9.0	Φ10.0		
	ZF(ZYM)1500–(11)KA(**)	Φ10.0	Φ10.8		
	ZF(ZYM)2000–(17)KA(**)	Φ16.0	Φ17.0		
	ZF(ZYM)2000–(18)KA(**)	Φ17.0	Φ18.0		
	ZF(ZYM)2500–(20)KA(**)	Φ19.0	Φ20.0		
	ZF(ZYM)350–(6–B10)KA(**)	Φ6.4	Φ10.0		
	ZF(ZYM)420–(7–B10)KA(**)	Φ6.4	Φ9.9		
	ZF(ZYM)1200–(7–B10)KA(**)	Φ6.4	Φ9.9		
	ZF(ZYM)1000–(10–B13)KA(**)	Φ9.0	Φ13.0		
	ZF(ZYM)1000–(7–B10)KA(**)	Φ6.4	Φ9.9		
	ZF(ZYM)1000–(7–B9)KA(**)	Φ6.4	Φ8.7		
	ZF(ZYM)1650–(10–B13)KA(**)	Φ9.4	Φ13.0		
	ZF(ZYM)2000–(10–B13)KA(**)	Φ9.4	Φ13.0		
	ZF(ZYM)350–(6)KA–B(**)	Φ5.3	Φ6.0		
	ZF(ZYM)350–(8–B10)KA–B(**)	Φ8.0	Φ10.0		
	ZF(ZYM)500–(6)KA–B(**)	Φ5.3	Φ6.0		
	ZF(ZYM)550–(6–B10)KA–B(**)	Φ5.3	Φ9.8		
	ZF(ZYM)700–(6)KA–B(**)	Φ5.4	Φ6.0		
	ZF(ZYM)1000–(10)KA–B(**)	Φ9.0	Φ10.0		
	ZF(ZYM)2000–(12)KA–B(**)	Φ11.2	Φ12.0		
	ZF(ZYM)350–(8)KA–C(**)	Φ8.2	Φ9.0		
	ZF(ZYM)350–(10)KA–C(**)	Φ9.2	Φ10.0		
	ZF(ZYM)350–(20)KA–C(**)	Φ19.0	Φ20.0		
	ZF(ZYM)350–(22)KA–C(**)	Φ20.0	Φ22.0		
	ZF(ZYM)750–(20)KA–C(**)	Φ19.0	Φ20.0		
	ZF(ZYM)1000–(20)KA–C(**)	Φ19.0	Φ20.0		
	ZF(ZYM)1500–(13–B16)KA–C(**)	Φ13.2	Φ16.0		
	ZF(ZYM)2000–(13–B16)KA–C(**)	Φ13.3	Φ16.0		
	ZF(ZYM)1000–(11)KB(**)	Φ6.7	Φ11.0	T0、T2	

JA

Product Geometry	Product code	Sensitive grid size B(mm)	Backing size (mm)	
			Inner Diameter A	Outer diameter C
	BF(BYM)1000–(38)JA–A	Φ34	Φ30.6	Φ37.4
	BF(BYM)1000–(50)JA–A	Φ45	Φ40.6	Φ49.4
	BF(BYM)1000–(60)JA–A	Φ55	Φ50.6	Φ59.4
	BF(BYM)1000–(80)JA–A	Φ75	Φ70.6	Φ79.4
	BF(BYM)1000–(100)JA–A	Φ95	Φ90.6	Φ99.4
	ZYM4000–(37)JA–A	Φ31.5	Φ26.6	Φ36.4
	ZYM4000–(55)JA–A	Φ49	Φ43.6	Φ54.4

Please Note:

1. N* and T* are creep codes, different creep codes have different creep values.
2. L* stands for the grid interval codes. For example L0 refers to a 10.5 mm grid interval and L6 refers to a 6mm grid interval.
3. In the list above, the code BYM(BKM, BEB) represents that the strain gauge is available in 3 series which are; BYM350–3AA–A(**)N*, BKM350–3AA–A(**)N* and BEB350–3AA–A(**)N* respectively. This goes for all series of strain gauges with different types noted between brackets.
4. When a strain gauge with grid pattern HA–D or HA–E is selected with encapsulation option, please note they are only available with pre–attached lead wires.
5. For strain gauges with a KA pattern goes:

When the nominal resistance is 120 Ω, the resistance range is: nominal value +2.0/–1.0 Ω and the resistance difference of the grids is ⩽ 0.4 Ω.

When the nominal resistance is 350Ω, the resistance range is: nominal value +2.0/–2.0 Ω and the resistance difference of the grids is ⩽ 0.8 Ω.

When the nominal resistance is 1000 Ω, the resistance range is: nominal value +100.0/–50.0 Ω and the resistance difference of the grids is ⩽ 1.0 Ω.

When the nominal resistance is > 1500 Ω, the resistance range is: nominal value ± 10% Ω and the resistance difference of the grids is ⩽ 1% Ω.

6. For strain gauges with a FG or EB pattern goes:

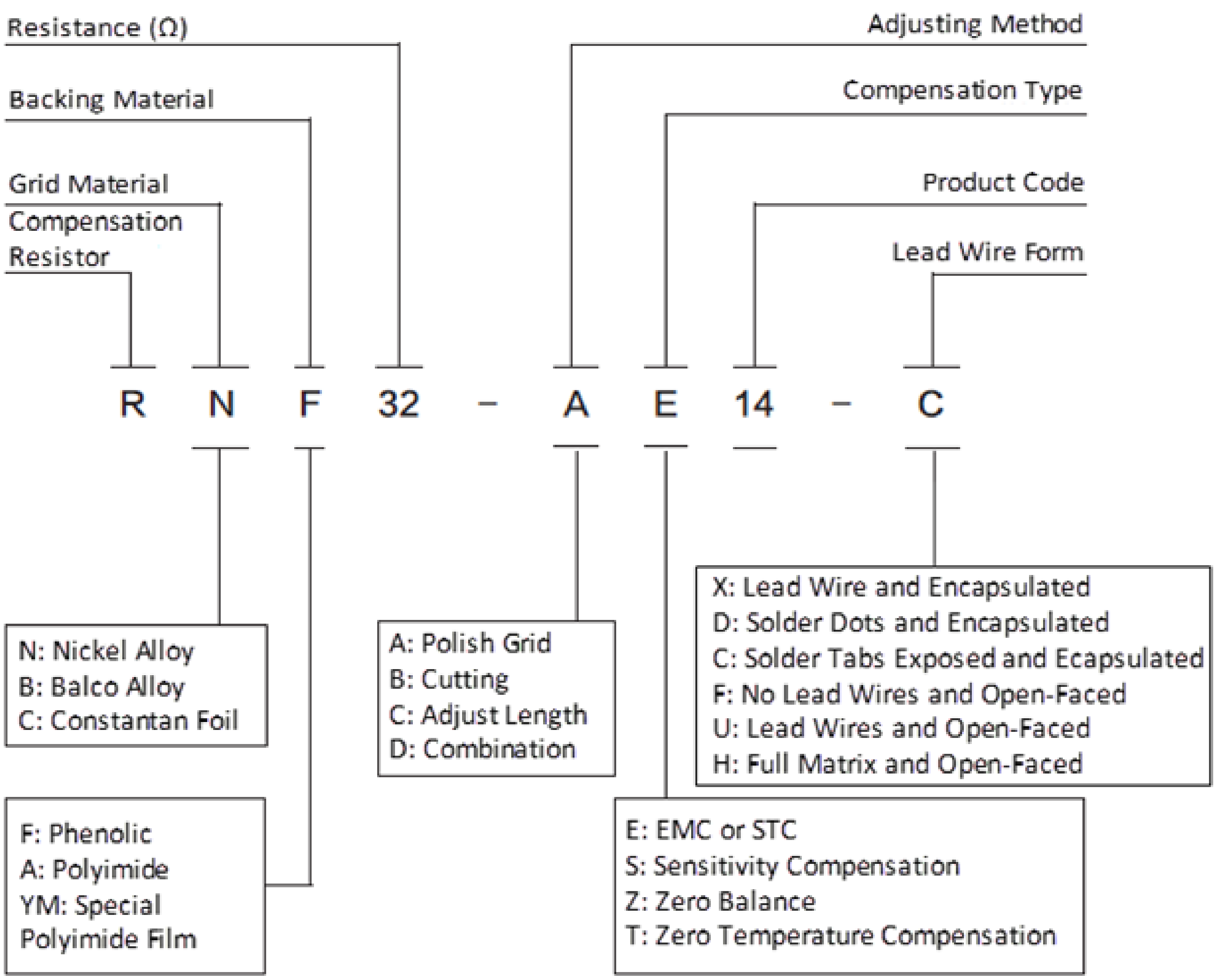
When the nominal resistance is 350 Ω, the resistance range is: 350 ± 50 Ω and the Zero balance is ⩽ 0.5 mV/V.

When the nominal resistance is 1000 Ω, the resistance range is: 1000 ± 10 % and the Zero balance is ⩽ 1.0 mV/V.

7. Except for the models listed above, it is also possible to produce high precision transducers that use strain gauge with any shape and size according to samples or drawings supplied by the customer.

Compensation Resistor designation and selection method

High accuracy transducers not only need high accuracy strain gauges to achieve their specifications but also need series compensation and adjustment resistors. ZEMICs R series compensation resistors is a kind of bondable adjustable compensation resistor. The resistors can be used to improve a transducers specifications like output sensitivity, temperature effect on sensitivity, zero output, zero output drift due to temperature and other technical specifications. In addition it has several other advantages; the resistors can be easily installed by easy bonding, they are easy to adjust, the temperature change is the same as the temperature change of the spring elements material due to the Self–temperature compensation and can reach very high compensation accuracy.



Choice in Compensation Resistors

During the production of high accuracy transducers, a series of compensations should be done in order to improve the specifications of transducers. This is done mainly to compensate the temperature effect on sensitivity , the overall sensitivity, zero balance and the temperature effect on zero balance. Following is an introduction to the possible compensation methods and a guide to

choose the correct compensation resistor:

1. Temperature effect on sensitivity compensation (i.e. Elastic Modulus Compensation) usually adopts RNF or RBF series compensation resistors. When the transducers environmental temperature changes, the elastic modulus of the spring element and the strain gauges gauge factor will also change accordingly. This causes an error in measurements. This is the reason that for high accuracy transducers, this has to be compensated. The method is as follows: To connect the compensation resistor in a serial connection with the input excitation circuit. The compensation resistor will change with the same temperature effect characteristics as the transducer will but in opposite direction which will therefore compensate the change back to a minimum.
To know what compensation resistance value is necessary, this should be calculated with the following formula:

$$R_m \approx [(S_1 - S_2) \cdot R_{in}] / \{[1+\alpha_c (T_1 - T_2)] \cdot S_1 - S_2\}$$

Wherein R_m refers to the resistance value of the compensation resistor, S_1 and S_2 refer to the transducers sensitivity at temperature values T_1 and T_2 respectively. R_{in} refers to the input resistance of the bridge when the temperature value is T_1. α_c refers to the temperature resistance coefficient of the compensation resistor. These coefficients are as follows: For the RNF resistors: $5.5 \times 10^{-3}/℃$ and for the RBF resistors: $4.3 \times 10^{-3}/℃$. Further, S (transducer sensitivity) is calculated as follows: $S=E_0/V$ in which E_0 is the bridge output voltage and V is the supply excitation voltage.
Generally spoken, steel transducers usually use a RNF series 20 Ω compensation resistor. For aluminium transducers a RNF series 32 Ω compensation resistor is usually chosen. The specific compensation resistance value however, should be confirmed by testing and adjusting the compensation resistor according to the transducers' accuracy.

2. Sensitivity compensation usually adopt RCF series compensation resistors or thin wires with a lower resistance temperature coefficient than the transducers. Because the spring elements material differences, process variation and gauge factor dispersion combined together (which is usually lower than 1%), the dispersion between transducers sensitivity would occur and therefore make it harder to interchange transducers. During the production of transducers, the sensitivity of transducers is generally a little bit higher than intended. So that at the end of the process it can be adjusted to the correct value according to test results. The specific method is as follows: The compensation resistor with smaller resistance temperature coefficient into the excitation circuit with the intention to lower the real excitation voltage of the transducer will be connected into the input circuit. This way the sensitivity of the transducer is decreased. The compensation resistance value can be calculated with the following formula:

$$R_C \approx ((S_1 - S_2))/(S_1 \cdot R)$$

R_C refers to the resistance value of the compensation resistor. S_1 and S_2 refer to the sensitivity before adjustment and the sensitivity after adjustment. R refers to the input resistance of the bridge.

3. Zero Balance Compensation usually adopts RCF compensation resistors or varnished wrapped wires with lower resistance temperature coefficient. They will be applied into one of the arms of the bridge to make sure the transducers strain gauge bridge output is as close to zero as possible without any load applied. In this way measuring errors can be prevented and zero adjustments by indicators are easy to perform. Usually, polishable, cutable and length adjustable compensation resistors are used. This way, the bridge zero can be easily and neatly adjusted. Resistance value of polisable compensation resistors can be adjusted by carefully polishing the grid with an abrasive. Cutable compensation resistors can be adjusted by carefully cutting the grid on designated places. The resistance value of length adjustable compensation resistors can be adjusted by changing the length of the resistor.

A small example of how this works is shown below:

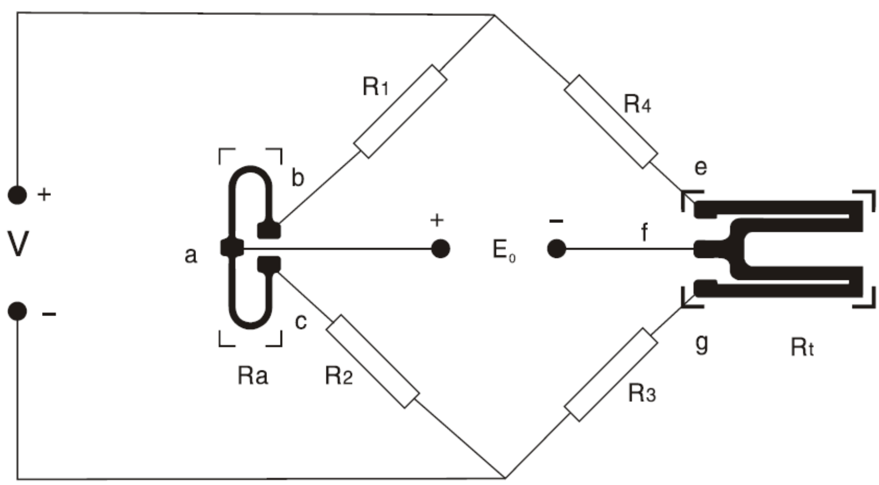


Figure 4: Zero balance compensation

When strain gauge R_1 and R_3 receive compressive strain and R_2 and R_4 receive tensile strain and the zero output is positive, terminal A–B should be having an increased resistance. For polishable compensation strain resistors this means the grid should be polished, for cutable compensation resistors, the grid should be cut to increase the resistance and for a length adjustable compensation resistor the length should be increased. Meanwhile it is important to keep an eye on the bridge output. The intention is to get the bridge output to zero. When too much is polished, cut or the length too long, another adjustment has to be made. To return the value back to zero the same procedure should be executed on terminal A–C. This will compensate the other way until the zero balance reaches zero again. Please not that this adjustment method can't be performed unlimited times. Eventually the resistance will break or no cutting can be done or the length adjustable resistor will be too long.

4. Zero Temperature Compensation usually adopts an RNF or varnished wrapped pure copper wire or a varnished wrapped nickel wire with larger temperature resistance coefficient. It will be applied into one of the arms of the bridge. With no load applied the output of the transducer should be close to zero. When a transducers' surrounding temperature and therefore the temperature of the

transducer itself changes, the spring element, bonding adhesive and strain gauge itself will change and therefore the resistance will change. All those factors will affect the transducers zero output, even self–temperature compensating and full bridge setups can't prevent the signal to shift. This is because of a certain small dispersion between the strain gauges. This will affect the zero output and has to be compensated. The usual method to do this is as follows:
The first thing to do is to test the transducer temperature performance, this means to see what the temperature coefficient is and what values the transducer has at certain temperature levels. After this is determined, a compensation resistor can be applied into one of the arms. The value of compensation resistor can be calculated with the formula below:

$$R_t = |R(U_2 - U_1)| / (|250 \cdot \alpha_c \cdot U_{in} (T_2 - T_1)|)$$

5. In this formula, R_t refers to the resistance value of the compensation resistor which should be used. R refers to the bridge resistance and U_{in} to the excitation voltage; α_c refers to the temperature coefficient of the compensation resistor. U_1 and U_2 refer to the transducers zero output voltage at temperature values $T_1$and T_2 respectively. Usually, polishable, cutable and length adjustable compensation resistors are used. The theory of zero temperature compensation is very similar to the zero balance compensation, however, the zero temperature must be adjusted during different temperature changes.

A small example of how this works is shown below:

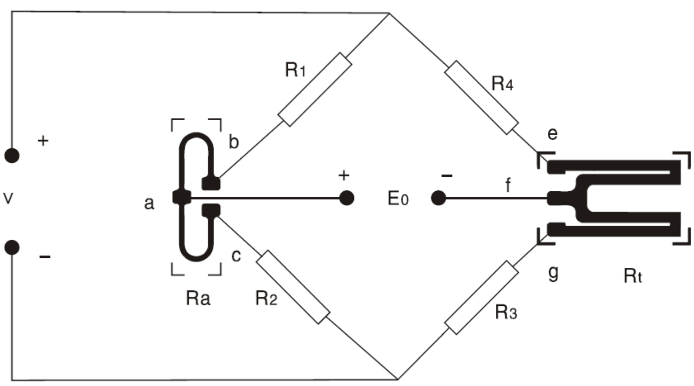
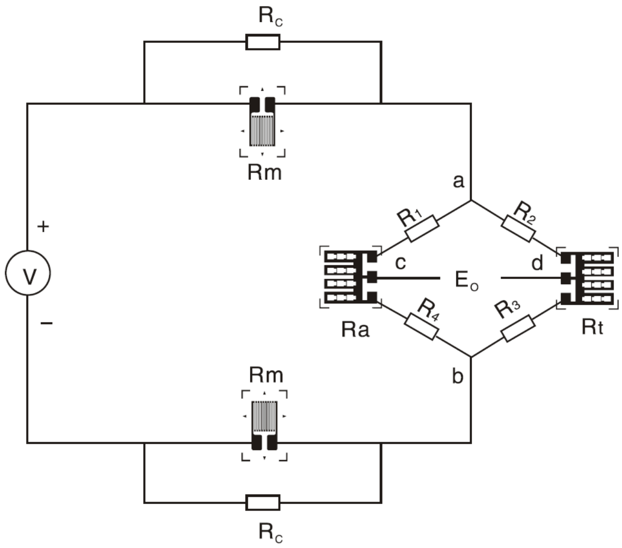


Figure 5: Zero temperature compensation

6. When strain gauge R_1 and R_3 receive compressive strain and R_2 and R_4 receive tensile strain and the zero temperature output is positive (The positive output is the difference between the zero output at normal temperature and at higher temperature), terminal F–G should be having an increased resistance. For polishable compensation strain resistors this means the grid should be polished, for cutable compensation resistors, the grid should be cut to increase the resistance and for a length adjustable compensation resistor the length should be increased. Meanwhile it is important to keep an eye on the bridge output. The intention is to get the bridge output to zero. When too much is polished, cut or the length too long, another adjustment has to be made. To return the value back to zero the same procedure should be executed on terminal E–F. This will compensate the other way until the zero balance reaches zero again. Please not that this adjustment method can't be performed unlimited times. Eventually the resistance will break or no cutting can be done or the length adjustable resistor will be too long.

Basic drawing of transducers wiring compensation

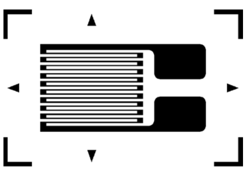


$R_1 \sim R_4$ ------ Strain Gauges
R_t ------ Zero Temperature compensation resistor
R_a ------ Adjustable Zero output resistor
R_m ------ Temperature sensitivity compensation resistor (or elastic modulus resistor)
R_c ------ Linearity compensation resistor
V ------ Excitation voltage
E_0 ------ Bridge output (or measuring output)

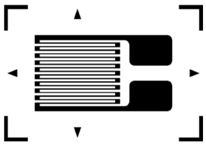
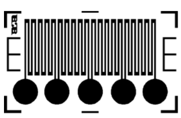
Compensation Resistor Specification

Specification	RNF Series	RBF Series	RCF Series
Resistance tolerance to average resistance (23 ℃)	$\leqslant \pm 0.5\%$		
Resistance temperature coefficient	5.5×10^{-3}/℃	4.3×10^{-3}/℃	
Temperature range (℃)	–30 ~ +60		
Adhesive	H–610、H–600、X–602		
Wiring	X (may be omitted), C, D, F, H, U		

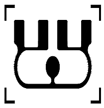
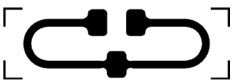
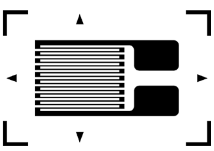
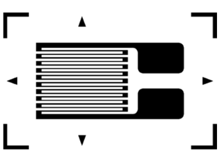
RBF/RNF/RCF/RNA/RNYM

Product Geometry	Product code	Nominal Resistance (Ω)	Backing Size: Length (L) x Width (W) (mm)
	RBF15–AE95	15.0	5.5×3.6
	RBF15–AE56	15.0	3.0×2.0
	RBF20–AE26	20.0	6.2×3.6
	RBF25–AE05	25.0	6.2×3.9
	RBF30–AE45	30.0	6.2×4.0
	RBF35–AE45	35.0	6.2×4.0
	RBF50–AE06	50.0	5.8×3.8
	RBF60–AE07	60.0	5.9×3.8
	RBF65–AE66	65.0	5.9×3.8
	RBF70–AE08	70.0	6.0×3.8
	RBF81–AE14	81.0	6.8×4.4
	RBF90–AE14	90.0	6.8×4.4
	RBF96–AE10	96.0	6.5×4.2
	RBF100–AE11	100.0	6.8×4.0
	RBF110–AE11	100.0	6.8×4.0
	RBF130–AE22	130.0	7.1×4.2
	RBF150–AE23	150.0	7.1×4.6
	RBF180–AE25	180.0	7.1×4.6
	RBF200–AE58	200.0	6.9×4.0
	RBF200–AE13	200.0	7.6×4.8
	RBF234–AE13	234.0	7.6×4.8
	RBF330–AE74	330.0	12.0×6.0
	RNF5–AE12	5	5.7×4.4
	RNF5.5–AE12	5.5	5.7×4.4
	RNF9–AE05	9	6.2×3.9
	RNF10–AE05	10	6.2×3.9
	RNF12–AE45	12	6.2×4.0
	RNF13–AE45	13	6.2×4.0
	RNF13.5–AE97	13.5	8.0×5.0
	RNF15–AE16	15	5.6×3.8
	RNF16–AE57	16	7.6×4.3
	RNF16–AE16	16	5.6×3.8
	RNF18–AE06	18	5.8×3.8
	RNF18–AE73	18	5.8×3.8
	RNF18–AE57	18	7.6×4.3
	RNF20–AE07	20	5.9×3.8
	RNF19.5–AE07	20	5.9×3.8
	RNF22–AE07	22	5.9×3.8
	RNF23.5–AE66	23.5	5.9×3.8
	RNF24–AE66	24	5.9×3.8
	RNF26–AE08	26	6.0×3.8
	RNF26.5–AE08	26.5	6.0×3.8
	RNF28–AE09	28	6.1×4.0
	RNF30–AE09	30	6.1×4.0
	RNF32–AE14	32	6.8×4.4
	RNF35.5–AE10	35.5	6.5×4.2
	RNF40–AE11	40	6.8×4.0

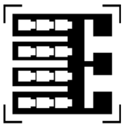
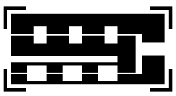
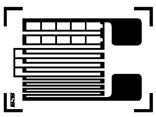
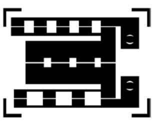
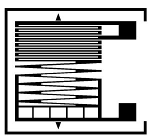
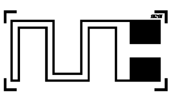
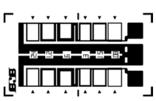
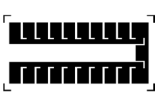
Compensation resistor

Product Geometry	Product code	Nominal Resistance (Ω)	Backing Size: Length (L) x Width (W) (mm)
	RNF42–AE11	42	6.8×4.0
	RNF50–AE22	50	7.1×4.2
	RNF53.5–AE60	53.5	5.2×4.8
	RNF54–AE28	54	7.1×4.4
	RNF55–AE62	55	7.2×3.0
	RNF60–AE23	60	7.1×4.6
	RNF64–AE31	64	7.1×4.6
	RNF65.4–AE25	65.4	7.1×4.6
	RNF70–AE25	70	7.1×4.6
	RNF73–AE25	73	7.1×4.6
	RNF76–AE13	76	7.6×4.8
	RNF81–AE13	81	7.6×4.8
	RNF90–AE13	90	7.6×4.8
	RNF112–AE59	112	8.0×8.0
	RNF120–AE61	120	6.5×3.9
	RNF300–AE64	300	8.6×5.3
	RNA4.5–AE12	4.5	5.7×4.4
	RNA12–AE45	12.0	6.2×4.0
	RNA15–AE16	15.0	5.6×3.8
	RNA19–AE06	19.0	5.8×3.8
	RNA20–AE07	20.0	5.9×3.8
	RNA20–AE15	20.0	10.4×6.0
	RNA25–AE66	25.0	5.9×3.8
	RNA30–AE09	30.0	6.1×4.0
	RNF20–AE15	20.0	10.4×6.0

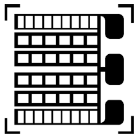
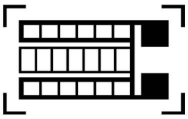
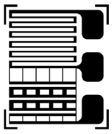
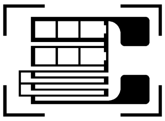
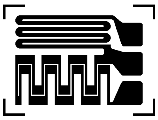
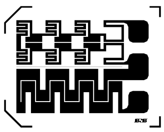
Compensation resistor

Product Geometry	Product code	Nominal Resistance (Ω)	Backing Size: Length (L) x Width (W) (mm)
	RBF4–AT69	3.4	10.0×6.5
	RNF035–AT03	0.65	10.6×5.5
	RNF1–AT02	0.9	8.5×5.4
	RCF2–AZ01	2.0	
	RNF3–AT03	3.0	11.5×5.0
	RCF5–AZ04	5.0	
	RCF1–AZ63	1.0	4.8×1.6
	RCF2–AS55	2.6	11.2×5.2
	RNA4.5–AE12	4.5	5.7×4.4
	RNA12–AE45	12.0	6.2×4.0
	RNA15–AE16	15.0	5.6×3.8
	RNA19–AE06	19.0	5.8×3.8
	RNA19.5–AE07	19.5	5.9×3.8
	RNA20–AE07	20.0	5.9×3.8
	RNA20–AE15	20.0	10.4×6.0
	RNA25–AE66	25.0	5.9×3.8
	RNA30–AE09	30.0	6.1×4.0
	RNA32–AE14	32.0	6.8×4.4
	RNA40–AE11	40.0	6.8×4.0
	RNA50–AE22	50.0	7.1×4.2
	RNA76–AE13	76.0	7.6×4.8
	RNYM19–AE06	19.0	5.8×3.8
	RNYM25–AE66	25.0	5.9×3.8
	RNYM50–AE22	50.0	7.1×4.2

Compensation resistor

Product Geometry	Product code	Nominal Resistance (Ω)		Backing Size: Length (L) x Width (W) (mm)
		Initial Resistance	Adjustable up to	
	RNF02–BT18	0.2	1.6	6.4 × 6.4
	RCF05–BE17	1.3	10.0	
	RNF02–CT44	0.45	0.07	15.0 × 9.0
	RNF1–CT41	1.0	0.04	7.6 × 3.8
	RNF5–BE75	6.8	14.0	8.0 × 5.5
	RNF5–CT41	2.0	0.05	8.1 × 5.9
	RNF9–BE37	9.5	33.0	7.9 × 7.8
	RNF15–BE32	15.0	25.5	8.2 × 7.3
	RNF10–CT41	13.0	2.0	6.4 × 3.2
	RCF70–CS41	75.0	6.3	
	RCF01–BZ62	17.5	29.0	14.3 × 7.8
	RCF02–CS46	5.3	1.0	20.0 × 10.0

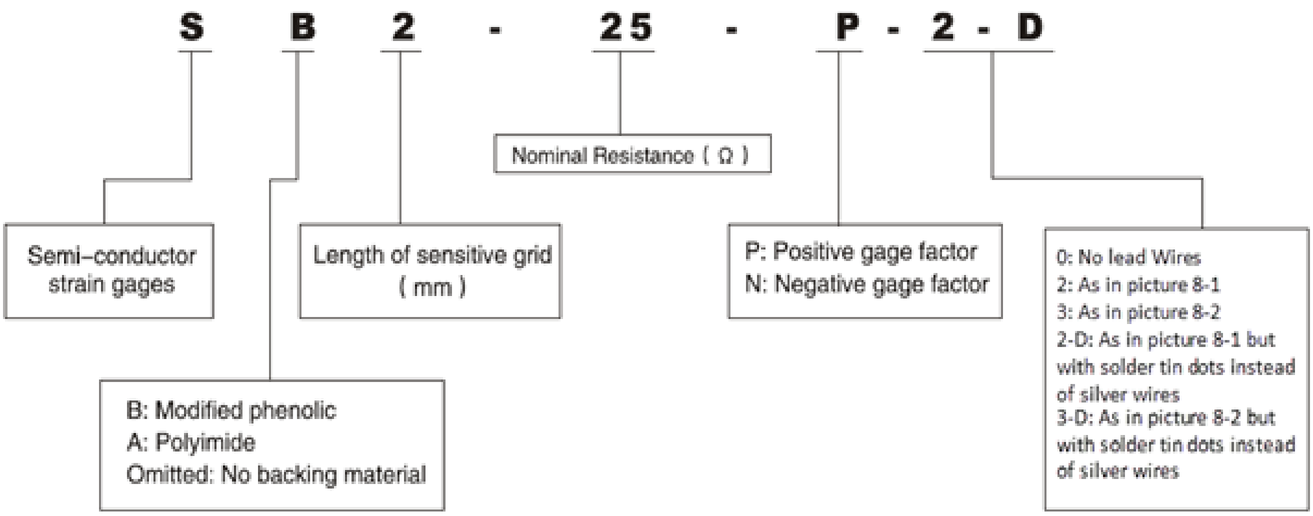
Compensation resistor

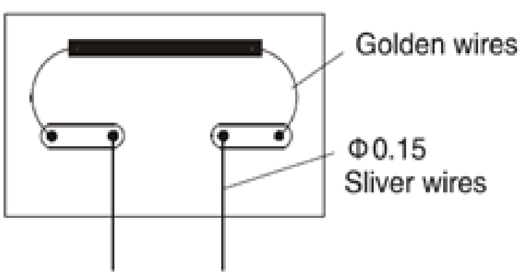
Product Geometry	Product code	Nominal Resistance (Ω)		Backing Size: Length (L) x Width (W) (mm)
		Initial Resistance	Adjustable up to	
	RCF1–BS24	2.0	42.5	8.4 × 8.4
	RCF5–BS27	6.0	52	8.5 × 8.5
	RCF1–CS60	2.3	0.6	7.4 × 5.4
	RCF2–BS19	2.0	22.0	6.6 × 3.6
	RNF05–BT20	0.3	3.3	8.0 × 5.0
	RCF5–BS56	55	74	9.4 × 7.8
	RCF10–BS30	11.0	36.5	7.7 × 5.4
	RCF25–DS61	37.0	16.0	10.5 × 7.7
	RCF28 – CS47	36.0	8.5	14.0 × 11.0
	RCF30–CS42	41.5	8.0	15.0 × 10.0

Semi-Conductor Strain Gauges

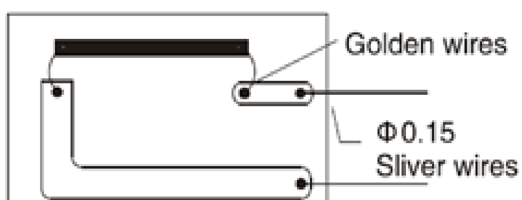
Semi–Conductor strain gauges are primarily produced from Silicon, Germanium, Antimony steel, Gallium Phosphide and other materials with a large sensitivity factor and therefore have a far larger signal output that ordinary strain gauges. It has a small transverse effect factor, small mechanical hysteresis, small size and are easy to use with the manufacturing of large and small transducers.

Semi-Conductor Designation





Picture 8–1



Picture 8–2

Linear Compensation Principle of Semi-Conductor Strain Gauges

Due to unbalance caused by transverse (Poisson Strain) and axial strain in a column or similar structure transducers elements, a non–linearity error arises in the bridge output. On top of that the non–linearity between load and strain, material non–linearity and transverse load non–linearity will cause a severe accuracy error of column or similar structure transducers. Therefore a correction has to be made to meet the high accuracy required for production of high precision transducers.

Semi-conductor stain gauge

Non–Linear compensation is done by changing the actual supply voltage of the bridge to compensate the transducers linear accuracy. The amount of voltage has to increase when load on the transducer is increased. Generally 2 semi–conductors are bonded symmetrically and opposite of each other in the direction of the applied load and in the strain area of the transducer. This is displayed in Figure 6 where the semi–conductor is displayed as RL. The semi–conductors will decrease in resistance when load is applied and this will result in a higher voltage being applied to the bridge. The way to assemble these into the electrical circuit is as follows: Connect two semi–conductors with the (required value of the semi conductor)/2 into the electric circuit in both the Input + and Input – branches. These are the last resistors the input voltage goes through before entering the bridge. This is displayed in Figure 7.

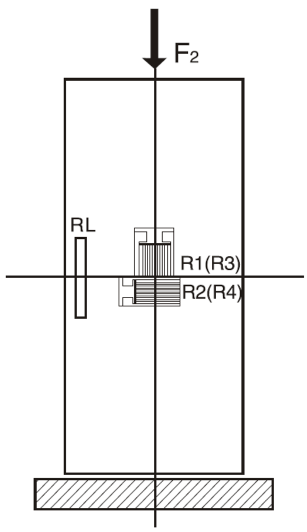


Figure 6: Semi–Conductor bonding location

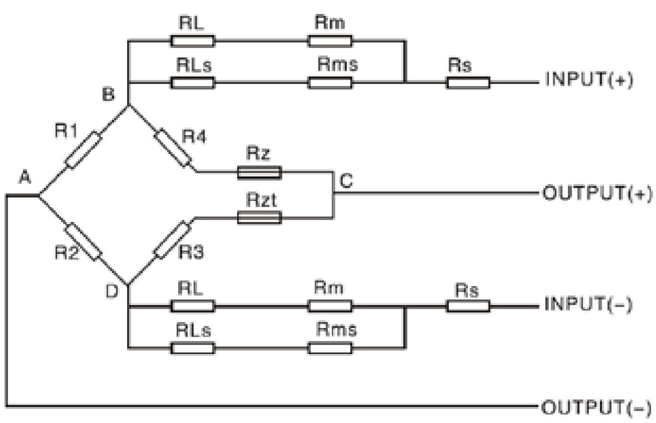


Figure 7: Linear Compensations location in a full bridge sketch

Semi-conductor stain gauge

A non–linearity error in a column or similar structure transducer has a curve in the form of a digressive parabola. This means that when the load is increased the output will change less and less. Due to the input voltage of the bridge increasing the change of output will be increased again and by compensating this the real output of the transducer will be a straight line again.

Model	Backing Dimensions (mm)	Grid dimensions (mm)	Nominal Resistance (Ω)	Sensitivity coefficient K	Resistance temperature coefficient (1/°C)	Sensitivity temperature coefficient (1/°C)	Maximum working temperature (°C)	Maximum working current (mA)	Maximum strain (με)
SB5–15–P–2	6×4	5×0.32×0.05	15	80±5%	<0.06%	<0.10%	<80	20	6000
SB5–25–P–2	6×4	5×0.32×0.05	25	80±5%	<0.06%	<0.10%	<80	20	6000
SB5–30–P–2	6×4	5×0.32×0.05	30	80±5%	<0.06%	<0.10%	<80	20	6000
SB5–60–P–2	6×4	5×0.32×0.05	60	100±5%	<0.08%	<0.12%	<80	15	6000
SB5–120–P–2	6×4	5×0.32×0.05	120	110±5%	<0.15%	<0.15%	<80	15	6000
SB3.8–15–P–2	5×3	3.8×0.24×0.05	15	80±5%	<0.06%	<0.10%	<80	20	6000
SB3.8–30–P–2	5×3	3.8×0.24×0.05	30	80±5%	<0.06%	<0.10%	<80	20	6000
SB3.8–60–P–2	5×3	3.8×0.24×0.05	60	100±5%	<0.08%	<0.12%	<80	15	6000
SB3.8–120–P–2	5×3	3.8×0.24×0.05	120	110±5%	<0.15%	<0.15%	<80	15	6000
SB5–15–P–2	6×4, 8×4	5×0.32×0.05	15	80±5%	<0.06%	<0.10%	<80	20	6000
SB5–30–P–2	6×4, 8×4	5×0.32×0.05	30	80±5%	<0.06%	<0.10%	<80	20	6000
SB5–60–P–2	6×4, 8×4	5×0.32×0.05	60	100±5%	<0.08%	<0.12%	<80	15	6000
SB5–120–P–2	6×4, 8×4	5×0.30×0.05	120	110±5%	<0.15%	<0.15%	<80	15	6000
SB5–350–P–2	6×4, 8×4	5×0.28×0.04	350	130±5%	<0.35%	<0.28%	<80	10	6000
SB5–1000–P–2	6×4, 8×4	5×0.24×0.04	1000	150±5%	<0.40%	<0.30%	<80	5	6000
SB3.8–15–P–2	5×3	3.8×0.24×0.05	15	80±5%	<0.06%	<0.10%	<80	20	6000
SB3.8–30–P–2	5×3	3.8×0.24×0.05	30	80±5%	<0.06%	<0.10%	<80	20	6000
SB3.8–60–P–2	5×3	3.8×0.24×0.05	60	100±5%	<0.08%	<0.12%	<80	15	6000
SB3.8–120–P–2	5×3	3.8×0.24×0.04	120	100±5%	<0.15%	<0.15%	<80	15	6000
SB3.8–350–P–2	5×3	3.8×0.22×0.05	350	130±5%	<0.35%	<0.28%	<80	10	6000
SB3.8–1000–P–2	5×3	3.8×0.22×0.05	1000	150±5%	<0.40%	<0.30%	<80	5	6000

Terminal Tabs

Terminal Tabs are made of copper foil with a polyimide, special polyimide film or glass fibre reinforced epoxy backing and are used for soldering the strain gauge to wires. Solder tabs can be used to attach larger lead wires to the strain gauge than would be possible if the lead wires are directly attached to the strain gauge itself.

DTA Series

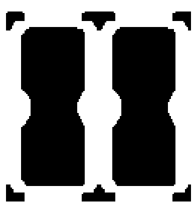
The DTA Series are made out of a pure copper foil and have a polyimide backing. It has a high flexibility, good insulation and is humidity and heat resistant. It is highly reliable and can be used in relatively curved conditions.

DTB Series

The DTB Series are made out of a pure copper foil and have a glass fibre reinforced epoxy backing. It has a high resistance against breaking. In addition it has a good bonding performance.

DHA Series

The DTA Series are made out of a pure copper foil and have a special polyimide film backing. It has a high flexibility, good insulation and is humidity and heat resistant. It can be used at higher temperatures up to 250℃ .

Terminal tab geometry	Terminal tab model	Grid size Length (L) x Width (W) (mm)	Backing size Length (L) x Width (W) (mm)
	DTA(DTB、DHA)$_0$–G$_1$	2.2×0.5	4.5×3.2
	DTA(DTB、DHA)$_1$–G$_1$	3.0×1.2	4.0×4.2
	DTA(DTB、DHA)$_2$–G$_1$	3.2×1.2	5.0×4.0
	DTA(DTB、DHA)$_3$–G$_1$	5.0×2.0	6.0×6.0
	DTA(DTB、DHA)$_6$–G$_1$	6.4×2.6	8.0×8.0
	DTA(DTB、DHA)$_{10}$–G$_1$	10.0×4.0	12.0×12.0

Terminal Tabs

Terminal tab geometry	Terminal tab model	Grid size Length (L) x Width (W) (mm)	Backing size Length (L) x Width (W) (mm)
	DTA(DTB、DHA)$_3$–G$_2$	5.0×1.4	7.0×6.0
	DTA(DTB、DHA)$_4$–G$_2$	4.0×1.5	7.5×4.4
	DTA(DTB、DHA)$_5$–G$_2$	5.0×1.0	6.0×5.0
	DTA(DTB、DHA)$_6$–G$_2$	7.0×1.6	8.0×8.0
	DTA(DTB、DHA)$_7$–G$_2$	7.0×1.5	9.6×8.0
	DTA(DTB、DHA)$_{10}$–G$_2$	9.7×3.0	13.0×12.0
	DTA(DTB、DHA)$_3$–G$_3$	5.0×2.0	6.0×6.0
	DTA(DTB、DHA)$_6$–G$_3$	6.4×2.6	8.0×8.0
	DTA(DTB、DHA)$_{10}$–G$_3$	10.0×3.0	12.0×12.0
	DTA(DTB、DHA)$_3$–G$_4$	5.0×1.4	7.0×6.0
	DTA(DTB、DHA)$_6$–G$_4$	6.5×1.6	8.0×8.0
	DTA(DTB、DHA)$_{10}$–G$_4$	10.0×4.0	12.0×14.0

Terminal Tabs

Terminal tab geometry	Terminal tab model	Grid size Length (L) x Width (W) (mm)	Backing size Length (L) x Width (W) (mm)
	DTA(DTB、DHA)$_3$–G$_5$	5.0×2.0	6.0×6.0
	DTA(DTB、DHA)$_6$–G$_5$	6.0×2.5	8.0×8.0
	DTA(DTB、DHA)$_{10}$–G$_5$	10.0×3.0	10.0×12.0
	DTA(DTB、DHA)$_3$–G$_6$	Φ1.0	5.0×3.0
	DTA(DTB、DHA)$_6$–G$_6$	Φ2.0	8.0×4.0
	DTA(DTB、DHA)$_{10}$–G$_6$	Φ4.0	12.0×6.0

Please note:
In the list above, the code DTA(DTB, DHA) represents that the terminal tab is available in 3 series which are; DTA0–G1, DTB0–G1 and DHA0–G1 respectively. This goes for all series of terminal tabs with different types noted between brackets.

High Precision Transducers Gauge Bonding adhesives

ZEMIC and ZEMIC Europe provides high quality strain gauge bonding adhesives for transducers manufacturing. At present ZEMIC and ZEMIC Europe provide two common gauge bonding adhesives for this application which are H-610 and H-600 respectively. Following is a description of several bonding adhesives and some protective coatings.

Application of the H-610 Adhesive

Characteristics and Application

H-610 is a high performance two component adhesive which is characterised by its low hysteresis, small creep, good repeatability, low viscosity, and a wide working temperature. The adhesive is mainly used for long term gauge bonding.

The operating temperature for this adhesive is:

- For long term: -269℃ up to +250℃
- For short term: -269℃ up to +300℃

H-610 is suitable for all strain gauges and compensation resistors. It is highly recommended for high precision transducer sensors for temperatures up to 250℃ . It is also suitable for TJ series underwater strain gauges and TA series strain gauges for great precision stress analysis.

Storage

ZEMIC and ZEMIC Europe's H-610 adhesive is composed of 2 components, A and B. Make sure that, before usage, the components are taken out of the refrigerator and are given 1 to 2 hours to get to room temperature. The next step is to mix components A and B in a A:B = 1:2 ratio. To mix the components use a glass rod, screw the cap back on the mixture and sway the bottle for 2 to 5 minutes and then set the mixture aside for 1 hour. When the mixture has turned into a light yellow or yellowish orange liquid it is ready to use.

The H-610 adhesive has a storage life of 6 months under a temperature of 24℃ and a 12 months storage life when kept in 2℃ to 6℃. Please note not to freeze the adhesive. After mixing, the adhesive can be kept for 7-10 days at room temperature and 1 month when kept in 2℃ to 6℃ .

Method of application

1. The surface where the gauge will be attached should be sand-blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the strain gauge is going to be attached with H-610 adhesive and let it dry for 2 to 5 minutes. When temperature is lower than room temperature, this should take less time. When the temperature is very low, this step can be skipped.
4. Bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.1- 0.3 MPa and put the element with the gauge pressured on it in the oven.
6. Heat up the oven to 135 ℃ at a speed of 2 ℃ /minute. Keep the gauge in the oven for two hours. After cooling the element and gauges to room temperature take off the clamp, metal plate, rubber and Teflon film. After this, put the element with gauge back in the oven and heat it up to 165 ℃ at a speed of 2 ℃ /minute. Now keep the element at this temperature for two hours. After this cool the element back down to room

temperature.
7. The H–610 adhesive is now suitable to be used in an environment in which the humidity is less than 65%.

Caution

1. Make sure to take the H–610 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. When mixing the components, make sure to mix all of the component B with all of the component A. When this is not done, it will cause a disproportional mixture and this could influence the adherent force of the adhesive. In addition make sure the two components are mixed well so a homogenous adherent force will occur.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive solvent reacting with higher temperature and light to volatize faster.
4. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the solvent and the curing agent separating out will be avoided. When this is not done, the separating of the curing agent might cause very fine particles to arise in the adhesive which will affect the adhesive for next use.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.
6. When a bottle of adhesive is used up and the adhesive becomes thicker or little particles arise in the adhesive (caused by dust). The adhesive is not suitable for use of strain gauge bonding anymore. However, it is still fine to use for compensation resistors or terminal tab bonding.

Application of the H-600 Adhesive

Characteristics and Application

H–600 is a high performance two component epoxy adhesive which is used as a replacement for H–610. H–600 is characterised by its low hysteresis, small creep, good repeatability, low viscosity, and a wide working temperature. The adhesive is mainly used for short term gauge bonding.

The operating temperature for this adhesive is:
- For long term: –269℃ up to +250℃
- For short term: –269℃ up to +300℃

H–600 is suitable for all strain gauges and compensation resistors. It is highly recommended for high precision transducer sensors for temperatures up to 250℃. It is NOT suitable for TJ series underwater strain gauges and TA series strain gauges for great precision stress analysis.

Storage

ZEMIC and ZEMIC Europe's H–600 adhesive is composed of 2 components, A and B. Make sure that, before usage, the components are taken out of the refrigerator and are given 1 to 2 hours to get to room temperature. The next step is to mix components A and B in a A:B = 1:2 ratio. To mix the components, use a glass rod, screw the cap back on the mixture and sway the bottle for 2 to 5 minutes and then set the mixture aside for 1 hour. When the mixture has turned into a light yellow or yellowish orange liquid it is ready to use.
The H–600 adhesive has a storage life of 6 months under a temperature of 24℃ and a 12 months storage life when kept in 2℃ to 6℃. Please note not to freeze the adhesive. After mixing, the adhesive can be kept for 7–10 days at room temperature and 1 month when kept in 2℃ to 6℃.

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the strain gauge is going to be attached with H–600 adhesive and apply the gauge immediately. The time between applying the adhesive and gauge bonding shouldn't exceed 2 minutes.
4. Bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.1– 0.3 MPa and put the element with the gauge pressured on it in the oven.
6. For Gauges up to a temperature of 150 ℃ : Heat up the oven to 135 ℃ at a speed of 2 ℃ /minute. Keep the gauge in the oven for two hours. After cooling the element and gauges to room temperature take off the clamp, metal plate, rubber and Teflon film. After this, put the element with gauge back in the oven and heat it up to 165℃ at a speed of 2℃ /minute. Now keep the element at this temperature for two hours. After this cool the element back down to room temperature.
For Gauges up to a temperature of 250℃ : Heat up the oven to 150℃ at a speed of 2℃ /minute. Keep the gauge in the oven for two hours. After cooling the element and gauges to room temperature take off the clamp, metal plate, rubber and Teflon film. After this, put the element with gauge back in the oven and heat it up to 175℃ at a speed of 2℃ /minute. Now keep the element at this temperature for two hours. After this cool the element back down to room temperature.
7. The H–600 adhesive is now suitable to be used in an environment in which the humidity is less than 65%.

Caution

1. Make sure to take the H–600 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. When mixing the components, make sure to mix all of the component B with all of the component A. When this is not done, it will cause a disproportional mixture and this could influence the adherent force of the adhesive. In addition make sure the two components are mixed well so a homogenous adherent force will occur.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive solvent reacting with higher temperature and light to volatize faster.
4. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the solvent and the curing agent separating out will be avoided. When this is not done, the separating of the curing agent might cause very fine particles to arise in the adhesive which will affect the adhesive for next use.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.
6. When a bottle of adhesive is used up and the adhesive becomes thicker or little particles arise in the adhesive (caused by dust). The adhesive is not suitable for use of strain gauge bonding anymore. However, it is still fine to use for compensation resistors or terminal tab bonding.

Application of the A-713 Adhesive

Characteristics and Application

A–713 Adhesive is a high temperature adhesive and is made out of a short chain imide and mixed with a modified phenolic resin. It has a low linear expansion coefficient, wide temperature range, high strain limit, small creep and low hysteresis. By its stable performance it is suitable for the manufacturing and bonding of gauges and for great strain analysis.

The operating temperature for this adhesive is:

- From –60℃ up to +150℃

A–713 is suitable for BA and TA medium temperature strain gauges with a max. elongation of 20%.

Storage

A–713 is a one component adhesive. Before using the adhesive, shake the bottle for 2 to 3 minutes until no bubbles can be seen in the adhesive anymore. A–713 should be stored at low temperatures to avoid degradation under normal or high temperatures. Tighten the bottles cap to avoid humidity from reaching the adhesive. The A–713 adhesive has a storage life of 12 months when kept in 2℃ to 6℃ .

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the strain gauge is going to be attached with A–713 adhesive and bake the adhesive for 30 minutes with an infrared or filament lamp which is positioned at a distance of 30mm from the coated surface.
4. Coat and bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.1– 0.3 MPa and put the element with the gauge pressured on it in the oven.
6. Heat up the oven to 120℃ at a speed of 2℃ /minute. Keep the gauge in the oven for one hour. After cooling the element and gauges to room temperature take off the clamp, metal plate, rubber and Teflon film. After this, put the element with gauge back in the oven and heat it up to 180℃ at a speed of 2℃ /minute. Now keep the element at this temperature for three hours. After this cool the element back down to room temperature.
7. The A–713 adhesive is now suitable to be used in an environment in which the humidity is less than 65%.

Caution

1. Make sure to shake the bottle for 2 to 3 minutes before using and make sure there are no bubbles in the adhesive anymore.
2. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive reacting with higher temperature and light to volatize faster.
3. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the adhesive is avoided and the coating quality is not degraded.
4. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.
5. Due to degradation, A–713 Adhesive will become thinner when stored for a longer period of time.

Application of the F-601 Adhesive

Characteristics and Application

F–601 adhesive is a high temperature adhesive and is made out of an epoxy resin and mixed with a modified phenolic resin. It has a low linear expansion coefficient, wide temperature range, high insulation, small creep and low hysteresis. By its stable performance it is suitable for the bonding of gauges on ceramics and glass.

The operating temperature for this adhesive is:

- From –60℃ up to +250℃

F–601 is suitable for BA 150℃ and BB and BAB 250℃ high temperature strain gauges.

Storage

F–601 is a one component adhesive which has an orange colour. F–601 has a solid filler in it and has to be stirred before usage. When the adhesive is too thick, a little butanone has to be added to make it thinner. F–601 should be stored at low temperatures to avoid degradation under normal or high temperatures which will turn it into a sort of gel. Tighten the bottles cap to avoid humidity from reaching the adhesive. The F–601 adhesive has a storage life of 8 months when kept at 10℃ .

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the strain gauge is going to be attached with F–601 adhesive and let it dry for 20 minutes. Now apply a another layer of F–601 and let it dry for 4 hours. Now put it in the oven, heat the oven to 60℃ from room temperature at a speed of 2℃ /minute. Keep the element at this temperature for 1 hour. Now let it cool down and after this, put the element back in the oven and heat it up to 150℃ at a speed of 2℃ / minute. Keep at this temperature for 1 hour. Now let it cool down to 80℃
4. Now take the element out of the oven and coat and bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.1– 0.3 MPa and put the element with the gauge pressured on it in the oven.
6. For Gauges up to a temperature of 150℃ : Heat up the oven to 100℃ at a speed of 2℃ /minute. Keep the gauge in the oven for one hour. After this, heat it up to 150℃ at a speed of 2℃ /minute. Now keep the element at this temperature for three hours. After this cool the element back down to room temperature and release the clamp and metal plate, rubber and Teflon film. Then, heat it up to 170℃ at a speed of 2℃ /minute. Now keep the element at this temperature for two hours. Now cool the element down to room temperature.
7. For Gauges up to a temperature of 250℃ : Heat up the oven to 100℃ at a speed of 2℃ /minute. Keep the gauge in the oven for one hours. After this cool the element back down to room temperature and release the clamp and metal plate, rubber and Teflon film. Then, heat it up to 150℃ at a speed of 2℃ /minute. Now keep the element at this temperature for two hours. Then, heat it up to 250℃ at a speed of 2℃ /minute. Now keep the element at this temperature for 4 hours. Now cool the element down to room temperature
8. The F–601 adhesive is now suitable to be used in an environment in which the humidity is less than 65%.

Caution

1. Make sure to take the F–601 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. Make sure the adhesive is homogenous otherwise this might influence the bonding characteristics of the adhesive.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive reacting with higher temperature and light to volatize faster.
4. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the adhesive is avoided and the coating quality is not degraded.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.

Application of the H-611 Adhesive

Characteristics and Application

H–611 is a two component normal temperature adhesive which is made of glycidol epoxy resin, bisphenol A epoxy resin, low polysulfide rubber and modified amine curing agent and is characterised by its excellent bond ability, curing under room temperature and has a low creep and high insulation resistance.

The operating temperature for this adhesive is:

- –30℃ up to +60℃

H–611 is suitable for most strain gauges and compensation resistors. It is highly recommended for compensation resistors and terminal tabs and for bonding gauges on inconvenient or difficult places under normal temperature and pressure conditions.

Storage

ZEMIC and ZEMIC Europe's H–611 adhesive is composed of 2 components, A and B. Make sure that, before usage, the components are taken out of the refrigerator and are given 1 to 2 hours to get to room temperature. Mix components A and B in a A:B = 1:2 ratio. To mix the components, use a stirring rod made out of glass or a toothpick, screw the cap back on the mixture and sway the bottle for 2 to 5 minutes. The mixture can be used immediately but make sure to use the adhesive within one hour.
The H–611 adhesive has a storage life of 10 months at room temperature.

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Put a thin layer of H–611 on the bonding surface after heating it up to 40 to 60℃ . If no heating is done to the test surface, the viscosity of the H–611 is high and more difficult to bond. In addition the curing time is longer.
4. Put a thin layer of H–611 on the gauge and bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.1– 0.3 MPa.

6. The test piece can be tested after curing the adhesive for 24 hours at normal temperature or after 2 hours curing in 60 to 80℃ .
7. The H–611 adhesive is now suitable to be used in an environment in which the humidity is less than 65%.

Caution

1. Make sure to take the H–611 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. When mixing the components, make sure to mix all of the component B with all of the component A. When this is not done, it will cause a disproportional mixture and this could influence the adherent force of the adhesive. In addition make sure the two components are mixed well so a homogenous adherent force will occur.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive solvent reacting with higher temperature and light to volatize faster.
4. Due to the short term using of the amine curing agent it is advised to use all the adhesive within 1 hour. After one hour, the adhesive degrades very fast and can't be used anymore.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.

Application of the AZ-709 Adhesive

Characteristics and Application

AZ–709 is a polyurethane two component adhesive which is characterised by its water resistance, anti–humidity, anti–fungus and high insulation resistance. In addition to curing at room temperature

The operating temperature for this adhesive is:

- –30℃ up to +60℃

AZ–709 is suitable for TJ series underwater strain gauges and suitable for the protection of other strain gauges against humidity.

Storage

ZEMIC and ZEMIC Europe's AZ–709 adhesive is composed of 2 components, A and B. Make sure that, before usage, the components are taken out of the refrigerator and are given 1 to 2 hours to get to room temperature. The next step is to mix components A and B in a A:B = 45:55 ratio. And for protection the ratio should be A:B = 48:52. To mix the components, component A should be poured in an empty bottle, then component B should be added. Screw on the cap of the bottle and sway the bottle very lightly for 2 minutes and then set the mixture aside for 1 hour. Check if no bubbles are visible in the adhesive.
The AZ–709 adhesive has a storage life of 12 months under a temperature of 24℃ Please note not to freeze the adhesive. After mixing, the adhesive can be kept for 4–8 hours under a temperature of 24℃ and 2–4 days when kept in 2℃ to 6℃ .

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.

Bonding adhesive

2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the strain gauge is going to be attached with AZ–709 adhesive and let it dry for 20 minutes
4. Now apply AZ–709 to the gauge and bond the gauge in the right position, cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.05– 0.1 MPa.
6. After 24 hours put the element in the oven and heat up the oven to 80℃ at a speed of 2℃ /minute. Keep the gauge in the oven for two hours. After cooling the element and gauges to room temperature take off the clamp, metal plate, rubber and Teflon film.
7. When the AZ–709 is used for protection only, it should be applied on a wider area than the gauges are placed on and the same sequence should be followed but after the 24 hours of room temperature curing no further actions have to be taken.

Caution

1. Make sure to take the AZ–709 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. When mixing the components, make sure to mix all of the component B with all of the component A. When this is not done, it will cause a disproportional mixture and this could influence the adherent force of the adhesive. In addition make sure the two components are mixed well so a homogenous adherent force will occur.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive solvent reacting with higher temperature and light to volatize faster.
4. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the solvent and the curing agent separating out will be avoided. When this is not done, the separating of the curing agent might cause very fine particles to arise in the adhesive which will affect the adhesive for next use.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.

Application of the AZ-710 Adhesive

Characteristics and Application

AZ–710 is a polyurethane two component adhesive and protective coating which is characterised by its water resistance, anti–humidity, anti–fungus and high insulation resistance. In addition to curing at room temperature

The operating temperature for this adhesive is:

- –40℃ up to +150℃

AZ–710 is suitable for protecting all strain gauges series from humidity.

Storage

ZEMIC and ZEMIC Europe's AZ–710 adhesive is composed of 2 components, A and B. Make sure that, before usage, the components are taken out of the refrigerator and are given 1 to 2 hours to get to room temperature. The next step is to mix components A and B in a A:B = 50:46 ratio. To mix the components, component A should be poured in an empty bottle, then component B should be added. Screw on the cap of the bottle and sway the bottle very lightly for 2 minutes and then set the mixture aside for 1 hour. Check if no bubbles are visible in the adhesive.

The AZ–710 adhesive has a storage life of 12 months under a temperature of 24℃ Please note not to freeze the adhesive. After mixing, the adhesive can be kept for 4–8 hours under a temperature of 24℃ and 2–4 days when kept in 2℃ to 6℃ .

Method of application

1. The surface where the gauge will be attached should be sand–blasted or polished and cleaned well with acetone and butanone.
2. Use anhydrous ethyl alcohol to clean the tools, Teflon film and the strain gauge which will be bonded.
3. Coat the area where the protection is needed with AZ–710 adhesive and let it dry for 20 minutes
4. Now apply AZ–710 again and cover it with Teflon film and squeeze out the bubbles or spare adhesive from under the gauge. This is done in the axial direction of the gauge.
5. Cover the Teflon film with a rubber and a metal plate as soon as possible and apply a pressure of 0.05– 0.1 MPa.
6. After 24 hours the metal plate, rubber and Teflon film can be take off and the protection is ready.

Caution

1. Make sure to take the AZ–710 adhesive out of the refrigerator 2 hours prior to using it and try using it only when the liquids temperature is the same as the environmental temperature
2. When mixing the components, make sure to mix all of the component B with all of the component A. When this is not done, it will cause a disproportional mixture and this could influence the adherent force of the adhesive. In addition make sure the two components are mixed well so a homogenous adherent force will occur.
3. During usage, the adhesives bottle should be as far away from heat and light sources. This is due to the adhesive solvent reacting with higher temperature and light to volatize faster.
4. When done using the adhesive it is advised to screw the bottle cap on as soon as possible. This way volatizing of the solvent and the curing agent separating out will be avoided. When this is not done, the separating of the curing agent might cause very fine particles to arise in the adhesive which will affect the adhesive for next use.
5. Clean the tools used after bonding the gauges. This way contamination and impurities by external factors can be avoided at next use.

Application of the G-D04 Adhesive

Characteristics and Application

G–D04 is a room temperature vulcanized silicone rubber adhesive and protective coating which is characterised by its high insulation resistance, wide bond area, anti–corrosive abilities, and due to its transparency it is very suitable for application with electronic components as a protective layer.G–D04 has an excellent bonding characteristic with glass, metal, ceramics and other resin enforced products. G–D04 is mainly used as adhesive and sealing compound.

The operating temperature for this adhesive is:

– –70℃ up to +200℃

G–D04 is suitable for protecting all strain gauges series and compensation resistors from humidity and heat in high precision load cell manufacturing.

Storage

G–D04 is a one component adhesive. After usage it is advised to directly screw the bottle cap back on and store it. When using the next time first remove the crust from the nozzle. If this is not done, this could cause serious degradation to the applied adhesive and will result in bad performance. Under room temperature the G–D04 can be stored up to 12 months.

Method of application

1. Thoroughly clean the bonding material, remove rust, dust and oil.
2. Open the bottle, squeeze enough adhesive out of the bottle and spread it over the bonding surface homogeneously. Make sure the whole bonding area is covered and make sure it can cure in that way.
3. Place the bonded component in an area which is in room temperature. When the temperature is too low or the bonding area is very deep, the process of curing could take much longer. The curing process will start at the surface and will later cure further into the deeper parts.
4. To make sure everything is cured a curing time of 144 hours should be considered.
5. The longer the bonded component is placed in room temperature the better the curing will be.

Caution

1. G–D04s curing is based on contact with air at room temperature, therefore it is advised to close the bottle as soon as possible after use.
2. Remove the crust from the bottle before using to make sure the best results and best performance will be given by the G–D04.
3. During operation, if it takes some time between steps it is advised to close the bottle after each step to prevent the G–D04 to cure in the bottle.

Application of the G-704 Adhesive

Characteristics and Application

G–704 is a room temperature white liquid vulcanized silicone rubber adhesive and protective coating which is characterised by its high insulation resistance, wide bond area, anti–corrosive abilities, good aging resistance performance and excellent performance under low and high temperatures. It is mainly used as a protective layer for strain gauges and transducers.

The operating temperature for this adhesive is:

– –50℃ up to +250℃

G–704 is suitable for protecting all strain gauges series and compensation resistors from humidity and heat in high precision load cell manufacturing.

Storage

G–704 is a one component adhesive. After usage it is advised to directly screw the bottle cap back on and store it. When using the next time first remove the crust from the nozzle. If this is not done, this could cause serious degradation to the applied adhesive and will result in bad performance. Under room temperature the G–D04 can be stored up to 12 months.

Method of application

1. Thoroughly clean the bonding material, remove rust, dust and oil.
2. Open the bottle, squeeze enough adhesive out of the bottle and spread it over the bonding surface homogeneously. Make sure the whole bonding area is covered and make sure it can cure in that way.
3. Place the bonded component in an area which is in room temperature. When the temperature is too low or the bonding area is very deep, the process of curing could take much longer. The curing process will start at the surface and will later cure further into the deeper parts. At normal room temperature approximately 2 – 4 mm of adhesive is cured in 24 hours.
4. The longer the bonded component is placed in room temperature the better the curing will be.
5. When a larger anti–humidity is required it is advised to cure the adhesive in an oven with a temperature of 50 to 150℃ for 4 to 12 hours.

Caution

1. G–704s curing is based on contact with air at room temperature, therefore it is advised to close the bottle as soon as possible after use.
2. Remove the crust from the bottle before using to make sure the best results and best performance will be given by the G–704.
3. During operation, if it takes some time between steps it is advised to close the bottle after each step to prevent the G–704 to cure in the bottle.

Bonding and Protection of Strain Gauges

Introduction

For strain gauge installation, the most common way is strain gauge bonding with an adhesive. The quality of the bonding is one of the key factors to influence the strain test to be a success or not. Therefore, when bonding a strain gauge to a spring element, ZEMIC and ZEMIC Europe strongly advise to follow the bonding and protecting procedures stated below.

1. Selecting strain gauges
2. Selecting Bonding adhesive
3. Sanding elements
4. Lining and location
5. Surface cleaning
6. Gauge cleaning
7. Applying adhesive
8. Gauge bonding
9. Heat curing
10. Quality check after curing
11. Soldering lead wires
12. Quality check of soldering
13. Compensating at normal temperature and temperature performance
14. Quality check of compensation
15. Testing and testing performance
16. Applying protection

Selecting Strain Gauges

The choice of strain gauge is based on the usage, the important technical parameters and the options available per series and geometry. Most important is the required accuracy which you want to achieve. For experimental stress analysis, the testing conditions are also key to choosing a strain gauge.

After machining an element it is important to undertake stabilizing treatments to release any residual stress or internal stress to make the performance more stable. In addition it is important to realise that different adhesives require different workmanship skills. For the best advise it is always possible to contact ZEMIC or ZEMIC Europe and they will help you find the best solution.

When Strain gauges are chosen and delivered it is important to check them before starting the gauge bonding. First of all it is important to check the gauges for possible damages to the backing, grid lines or any other part of the strain gauge. It is also advised to check the strain gauge resistance which should be accurate up to 0.1Ω.

Selecting Bonding Adhesive

Selecting the correct adhesive is just as important as choosing the right strain gauge. The decision of adhesive is very dependent on what the strain gauges are used for, what the external conditions of use are and for what period of time. ZEMIC and ZEMIC Europe advise H−610 or H−600 for the production of load cells. For the best advise it is always possible to contact ZEMIC or ZEMIC Europe and they are glad to help you find the best solution.

Bonding and Protection of Strain Gauges

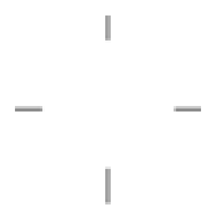
When adhesive is chosen an delivered it is important to check the adhesive before starting the gauge bonding. Firstly it is important to check what the expiration date of the adhesive is. Please not that sometimes the date indicated on the bottles is the production date. When the expiration date has passed the adhesive has lost its bonding strength. Secondly it is important, when a two−component adhesive is ordered if both components are delivered. Thirdly it is wise to check when a two component adhesive is delivered if the ratio is correctly noted on the bottles. The correct ratios can be found on in this catalogue or on the adhesives datasheet.

Sanding Elements

In order to properly bond a strain gauge it is important to prepare the surface before bonding. The first step in surface preparation is to degrease the surface. This can be done by applying some isopropyl alcohol and lightly abrade the surface. After this the remaining alcohol is removed with an absorbing cotton swab. Now an area about 3 to 5 times the size of the strain gauge should be sanded. This could be done mechanically or by hand. When this is done by hand make sure the sandpaper is between 220 – 400 and you have some absolute alcohol on the abrading surface. While doing this make sure to polish the location of the strain gauge with an 45° angle with the bonding direction of the strain gauge.

Lining and Location

There are several ways of lining out a strain gauge. The most common used way is to make a small mark on the surface on which the strain gauge will be bonded. This mark is usually in the form of a cross so 4 lines can be matched to the alignment marks. It is recommended to use a ball pen without ink to make this mark but a simple pencil will also suffice. Please try not to mark the element on the exact place on which the strain gauge will be bonded since this can influence the performance due to the damage which will be caused under the backing of the strain gauge. The marking should look like the figure on the right.



Surface Cleaning

Surface cleaning is done with use of a cotton swab. The cleaning can best be performed with absolute ethyl alcohol, trichloroethane, Isopropyl alcohol or other organic solvent. Put some of the organic solvent on the sanded area and now swipe off the solvent from the centre to the outside of the sanded area. Make sure to get a clean cotton as soon as you see dirt on it, this can already be after the first swipe. Repeat this process from the application of the solvent to swiping it off as long until no dirt comes of the area anymore.

By getting a new cotton every time and swiping from the centre to the outside no pollution or other contamination of the clean area can occur. It is also important not to touch the area after the cleaning is done. After cleaning use acetone to neutralise the solvent. This is done in the same way as the cleaning, apply acetone to the cleaned area and swipe from the centre to the outside.

Gauge Cleaning

Before cleaning the strain gauges make sure the tools you are using are also cleaned. First of all, clean the tweezers and other tools with acetone. Now open the package of strain gauge and take the strain gauge out carefully. Make sure not to touch the grid or solder tabs with the tweezers. It is advised to pick up the strain gauge at the solder tabs end of the backing with the tweezers. It is a good idea to get a glass plate, plastic plate or Teflon film and put some acetone on it and put the strain gauge on the acetone. Under any circumstance do NOT touch the grid with the tweezers, hands or any sharp object.

Bonding and Protection of Strain Gauges

Applying Adhesive

Before applying any adhesive it is important to note that there is a golden rule while applying adhesive. The thinner the adhesive film the better performance the strain gauge is going to have. In addition make sure the adhesive covers the whole backing of the strain gauge. The adhesive has to be applied according to the description of the adhesive given in the previous chapter. If things are unclear feel free to contact ZEMIC or ZEMIC Europe with any questions and they are happy to assist.

Gauge Bonding

The strain gauge bonding is the most important step in the whole process and has the biggest impact on the strain gauge measuring accuracy. It is advised to use a bit of transparent tape and put it over the strain gauge and pull it up under a small slope and in the corner where the tape is attached to the specimen. Now position the tape, with the strain gauge underneath it over the test specimen and position the strain gauge in the right way. When this is done pull up one end of the tape and lift it up under a small slope. When the strain gauge is lifted and a part of the tape is still sticking to the specimen, turn over the tape and apply some adhesive to the bottom of the strain gauge. Now hover the tape back over the specimen and get a cotton geese and apply pressure and swipe the tape with strain gauge back on the specimen in one movement. This is how a small adhesive film is homogeneously formed under the strain gauge and it is in the right position. At this point apply the recommended pressure which is described in the adhesive specifications as can be read in the previous chapter.

Heat Curing

After the gauge bonding, heat curing is done if necessary. Temperature, time and pressure are the key factors in this part of the process. It's a must that these three key factors strictly follow the requirements for curing the adhesive. The required steps for each adhesive are different and are described in their own description which can be found in the previous chapter. If things are unclear feel free to contact ZEMIC or ZEMIC Europe with any questions and they are happy to assist.

Quality Check After Curing

After curing the adhesive it is important to perform a quality check. Check if there is backing damage, any grid deformations, an open circuit, a short circuit, a correct bonding position if there are air bubbles noticeable under the backing of the strain gauge, any resistance has changed, if the insulation resistance is still conform specifications and if the strain gauge is bonded completely. If any of these factors is at hand, the strain gauge is not usable and the strain gauge should be discarded.

Soldering Lead Wires

When pre-attached lead wires are chosen as option this step can be skipped. The lead wires will be connected to the solder tabs or the terminal tab which should be located at the solder tabs end of the strain gauge. When soldering the lead wires make sure the ends of the lead wires are stripped and twisted. Now first make sure to very lightly abrade the solder tab or terminal tab, this way the solder can easily be attached to the tabs. Now apply a small amount of solder to the tabs. If karma strain gauges are used make sure that a little flux is applied to the solder tabs of the karma strain gauge. Now put the wires on the solder tab and push with the soldering iron and hold for 2 seconds. Make sure this is not done longer than 2 seconds because the heat of the soldering iron can damage the strain gauge. After soldering clean the solder tabs, terminal tabs and strain gauge with acetone to make sure any residue and flux is removed.

If performed correctly the solder should look like a small dot. For soldering goes the same rule as for adhesive, the less solder the more accurate the strain gauge measurement will be.

Quality Check of Soldering

After soldering it is important to check if the strain gauge is not damaged, if the solders are not connected to each other or any other inconsistencies have occurred. In addition make sure the lead wires are attached correctly and aren't loose. If there are damages to the strain gauge, the gauge can't be used anymore and has to be discarded. When the solders aren't correct this can be fixed by soldering again.

Compensating at Normal Temperature and Temperature Performance

After the soldering of the strain gauges has been checked, it is advised to compensate for temperature changes. This is done by bonding and connecting the right compensation resistor and connect this to the electrical circuit. If you need help selecting the right compensation resistor please contact ZEMIC or ZEMIC Europe to advise you on which resistor is the best choice.

Quality Check of Compensation

After the installation of compensation resistors, it is advised to test the specimen by running it through a heat test for several hours, increasing and decreasing the temperature with a vast amount and read out the measurements, this way confirmation can be gained whether or not the right compensation resistors are chosen. If the correct compensation resistors are chosen, the process can continue, if not, the compensation has to be adjusted and this quality check has to be done again.

Testing and Testing Performance

First of all the transducers have to be tested with load applied. If strain gauges are attached correctly and the compensation is conform specifications the installation is correct. The best way of testing this is by mechanical testing in which a machine reads out the values measured and applies load in a pre-set sequence. If the performance is out of specification, a check should be made to the transducer to see if any strain gauge or other components are damaged or a wire is loose. When a strain gauge is damaged then the transducer must be discarded. Any other problem might be solvable and has to be dealt with accordingly.

Applying Protection

When the strain gauge is performing according to specifications, it is time to apply protection on the strain gauges or transducer. Usually this is done by encapsulating them in a silicone rubber. The main reason of protection is to keep the environmental conditions like humidity or temperature away from the strain gauge, the second reason is to protect the strain gauge from any force being directly applied to it like bumping it into something. When applying protection, don't touch the strain gauge with hands or any sharp object. After this, give the protection time to dry before using the strain gauge or transducer.

Most common problems with strain gauges and countermeasures

1. Zero drift:

The most common problem which can occur after the application of strain gauge is the drifting of the zero value. This means the output value of the strain gauge is changing when no load is applied. The biggest problem with zero drift is to find the cause of the problem.

I. Effect of insulation resistance

The insulation resistance is an important specification for strain gauges. The zero drift could be caused due to the insulation resistance being low or gone as a whole. The insulation resistance refers to the resistance between the gauges grid and the tested object or element. If the insulation is decreased, the current which runs through the grid leaks to the element. This way the output value changes and zero drift occurs.

a. A reason why the insulation resistance is diminished could be due to not properly cleaning the strain gauge after installation. An example of this is flux which is in fact an acid which, if not properly cleaned, bites through the backing of the gauge and eventually make the grid touch the test object or element.

b. If the soldering is not done correctly it could cause the soldering iron tip to burn through the backing which will cause the insulation resistance to be lower or completely disappear. To make sure this does not happen, the soldering iron can't be warmer than 250℃ and can't be used more than 2 seconds at once.

c. When the strain gauges have been in contact with moisture it is possible that, through this moist the current in the grid leaks to the test subject or element. To prevent this it is key to protect the strain gauge and to make sure that the strain gauge doesn't get in contact with moist before protecting it. In addition, the humidity in the area of use shouldn't be higher than 65%.

d. During installation, a sharp object or a fingernail could have penetrated the backing of the strain gauge which will cause electrical leakage.

II. Effects that are caused during the strain gauge bonding process

These are the effects on the zero drift due to things which could have happened during the bonding process and which cause zero shift.

a. If the backing is not bonded completely flat on the test object or element, this could cause zero shift. For example when an eyelash is under the backing of a strain gauge there is a small dent under the back this could cause the zero value to change. In addition due to the backing not being on the element completely, when a temperature change occurs the heat transfer from the element or test object will not be homogenously transferred to the strain gauge and this will cause a zero drift.

b. When too much adhesive is used, this could cause the backing of the strain gauge to be not completely flat. This could, in the same way as described above, affect the strain gauges performance.

III. Effects on the strain gauge grids or encapsulation

These are the effects on the strain gauge grid or encapsulation which could be the cause for zero drifting of the zero value.

a. The strain gauge grids are twisted or deformed, this can only be checked under a microscope and is therefore hard to ascertain. When the gauge has been in contact with water or, the cleaning solvent contained too much water, this could result in the grid lines to shift or twist which will cause the zero value to drift.

b. The encapsulation of the strain gauge has fallen off. This could happen because the strain gauge and the encapsulation has not bonded correctly due to unequal heat dispersion during the curing of the encapsulation.

2. Resistance change after bonding:

Usually the resistance of a strain gauge only changes very little after bonding. However in some cases the resistance value changes too much. Possible causes of this problem are displayed below:

I. The pressure needed during the curing process has been too high. When the strain gauge is installed and not under the amount of pressure during the curing process, the gridlines have the chance to expand a little which will cause the resistance value to change. It is recommended to use a pressure of 0.15 up to 0.3 MPa during the curing process.

II. The pressure during the curing process has not been evenly divided over the gauge and has caused deformation in the grid. The most probable cause of this is that the fixture used is not used correctly or the fixture is not correct for use with strain gauges. For example; the fixture, which is use to clamp the strain gauge has a small radius in it which causes an uneven pressure distribution.

III. The resistance changes after some time, this could be caused by air bubbles behind the grid or dents or holes underneath the backing of the strain gauge.

www.zemiceurope.com

Zemic Europe B.V.

Leerlooierstraat 8
4871 EN Etten–Leur The Netherlands

T +31 (0)76 503 94 80
F +31 (0)76 503 94 81
E info@zemic.nl