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Aviation Industry Cooperation of China

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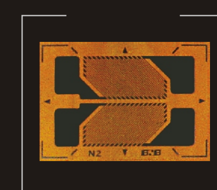

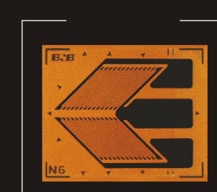

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Measuring Excellence Worldwide

# Strain Gages for Transducer

No.34, 2010


Aviation Industry Cooperation of China

Zhonghang Electronic Measuring Instruments Co., Ltd.

# Introduction

Established in 1965, Zhonghang Electronic Measuring Instruments Co., Ltd (Its former name is Zhongyuan Electrical Measuring Instruments Factory) has the history of developing and producing strain gages for 30 years. It is one of the biggest strain gages manufactures in the world that offers strain gages with high quality, various kinds, biggest sales and best reputation.

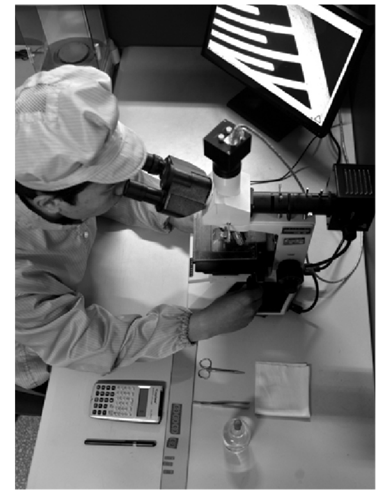
"BB" brand foil strain gages are produced according to the OIML International Recommendation62# Metallic Resistance Strain Gage's Performance Characteristics and the P.R.C. National Standard GB/T13992-92 Resistance Strain Gages, has passed the European Environmental Protection Directives RoHS approval. In fulfilling the requirements for high-precision load cell manufacturing and meeting demands for accurate stress analysis, ZEMIC sets up specialized testing conditions such as environmental testing, adhesive testing and intension testing, lays solid foundations for researching and developing of excellent strain gages with national brand. With the managing philosophy of "Create TopRank, Complete Internationally", relying on the rapid developed technology and perfect & precise quality assurance system and specialized workmanship, ZEMIC has insured the annual yield of 20 million pieces & over ten series & thousands specified strain gages with reliable and excellent quality.

Bearing the ideology of Measuring Excellence Worldwide, ZEMIC will spare no pains in the scientific innovation and technical progress, always adhering to the company tenet of "Pursue Perfect, Create Super Excellence", offer strong support and perfect service for transducers manufacture and strain analysis, and push electromotive technology to continuously develop forward.

Strain gages for Transducer are mainly developed for Transducer with higher accuracy requirements. ZEMIC aims at offering the manufacturers better strain gages with higher performance .

**Key features :**

-Consistency thickness of backing. Thus provides with small creep expansion.
-Coherent dimensions of backing . Thus ensures the exactness of positioning in gages application.
-Self-temperature compensation function.
-Self-creep compensation function.

## Quality policy

Customers First
Developing and Improving Continuously
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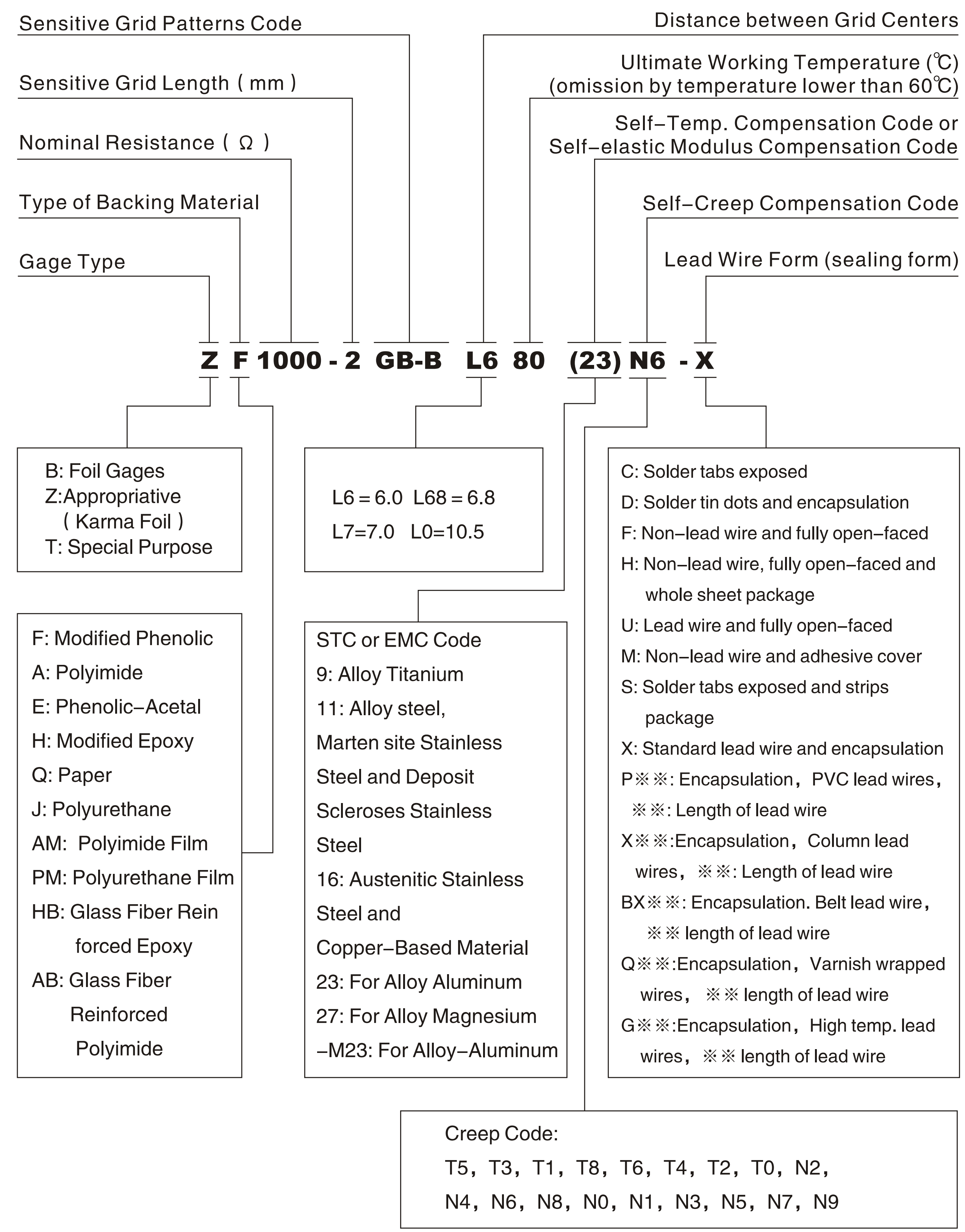
# Directory

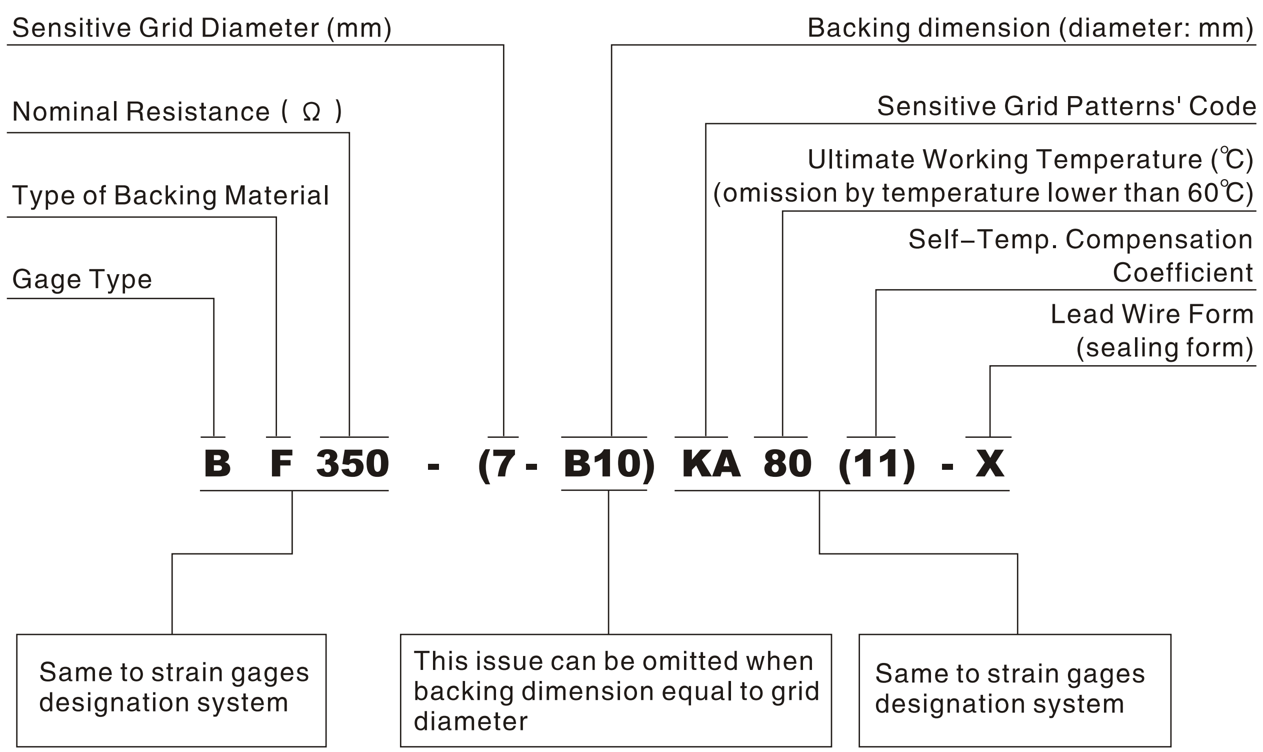




## Designation System for Strain Gage



## Strain Gage's Designation System (KA series)




## 1.Self-Temperature Compensation strain gages

Introduction:

The strain gages are installed on surface of a tested object without outside force, when environmental temperature changes, the resistance value will be changed accordingly. This phenomenon is called strain gages thermal output. It is resulted by interactions and superposition of resistance temperature coefficient of grid materials, sensitive grid materials and linear dilatability coefficient of the tested objects. It is shown as the formula below:

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

In the above formula, $\alpha_g$ and $\beta_g$ refer to resistance temperature coefficient of the grid materials and linear dilatability of strain gages respectively; K refers to gage factor; $\beta_s$ refers to linear dilatability coefficient of the tested object; $\Delta t$ refers to relative temperature changes of reference departure temperature.

Thermal output of common strain gages is as large as shown in Picture 1. It is the largest error resource of strain measurement in static state. With increase of the temperature effect, the decentralization of thermal output will also be increased. If there are temperature grads or instant changes during test, the difference will become larger. Therefore, the ideal circumstance is that strain gages thermal output value is close to zero. The strain gages that fulfill this requirement are called self-temperature compensation strain gages.



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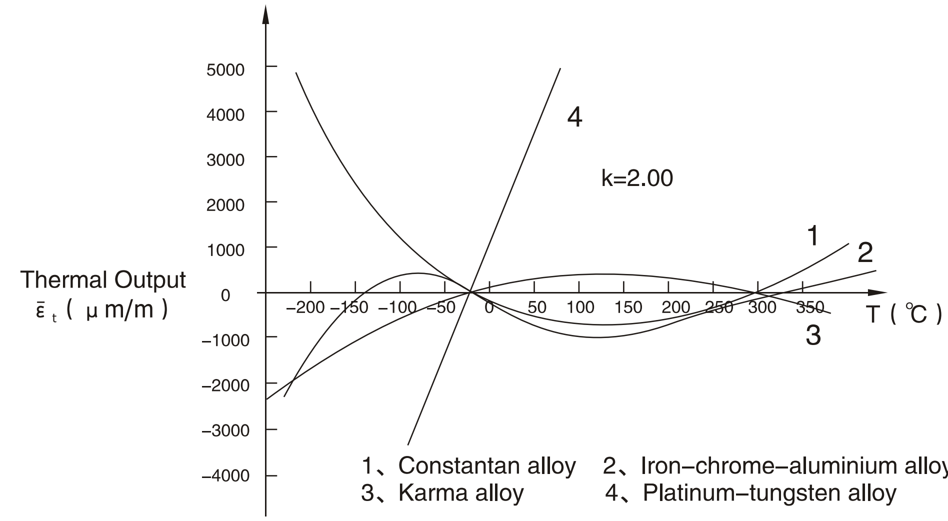
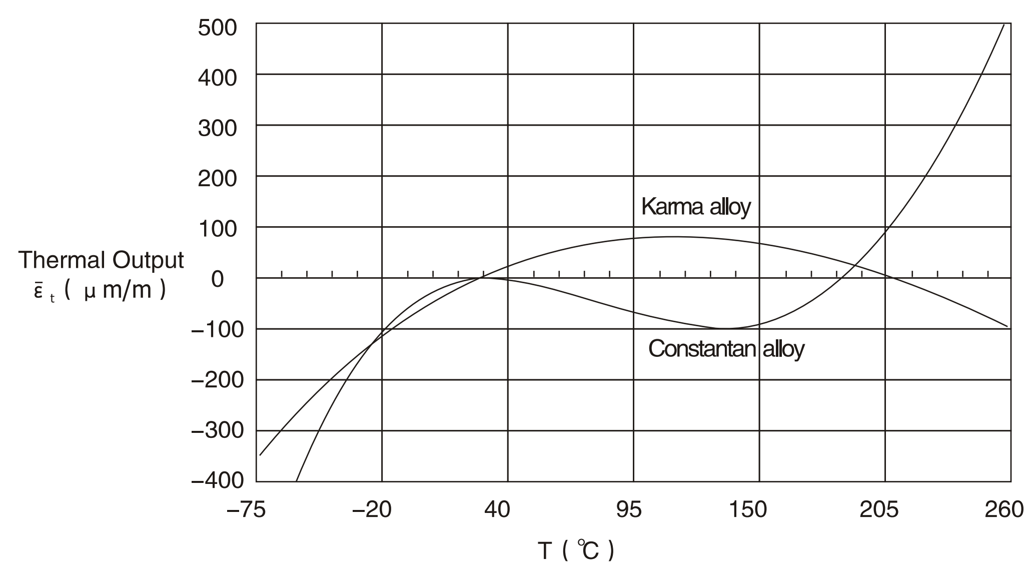



Picture 1 Thermal Output Curve Common Strain Gages

By adjusting the alloy elements' ratio of the strain gages grid material or changing foil's cold rolled reduction and proper heat treatment, the crystal configuration of the sensitive grid would be recombined and its temperature coefficient of the resistance would be changed. Therefore, to make strain gages' thermal output close to zero and to realize the self-temperature compensation for spring element or tested object materials, to meet the requirement of the high precision strain analysis and transducer production. Picture 2 is the typical thermal output curve of the Constantan, Karma self-temperature compensation strain gages. In the range of +20~~+250℃, their thermal output value is very small.




Picture 2 Typical Thermal Output Curves of the Constantan and Kama Self-Temperature Compensation Strain Gages

**Selection Methods**：

(1)At present, ZEMIC offers self–temperature compensation strain gages with codes of: 9、11、16、23、27. Among them, “9” is used for alloy titanium materials (the typical value of the linear coefficient expansion is $8.8\times10^{-6}$/℃)； “11” used for alloy steel, Marten site stainless steel and deposit scleroses stainless steel materials ( the typical value is $11.3\times10^{-6}$/℃); “16” used for austenitic stainless steel and Cu–based material ( the typical value is $16\times10^{-6}$/℃); “23” used for alloy aluminum materials (the typical value is $23.2\times10^{-6}$/℃); “27” used for alloy magnesium materials (the typical value is $26.1\times10^{-6}$/℃).

(2) When the self–temperature compensation gages matched with the material of tested object, it is not necessary to compensate thermal output within the range of compensation temperature.

(3) In case that the material of the tested object required by self–temperature compensation gages did not match the material of the tested object that is used, we should utilize two or four gages to form a half bridge or full bridge to minimize the temperature effect.

(4) Measure with Quarter Bridge, we should install a strain gage on” compensated object” which is he same material as the tested object. The strain gage should be from the same lot as the one installed on the tested object. The two gages should be under the same temperature environment and located next to each other in the Wheatstone bridge.

## 2. Self–Creep Compensation Strain Gages

**Introduction:**

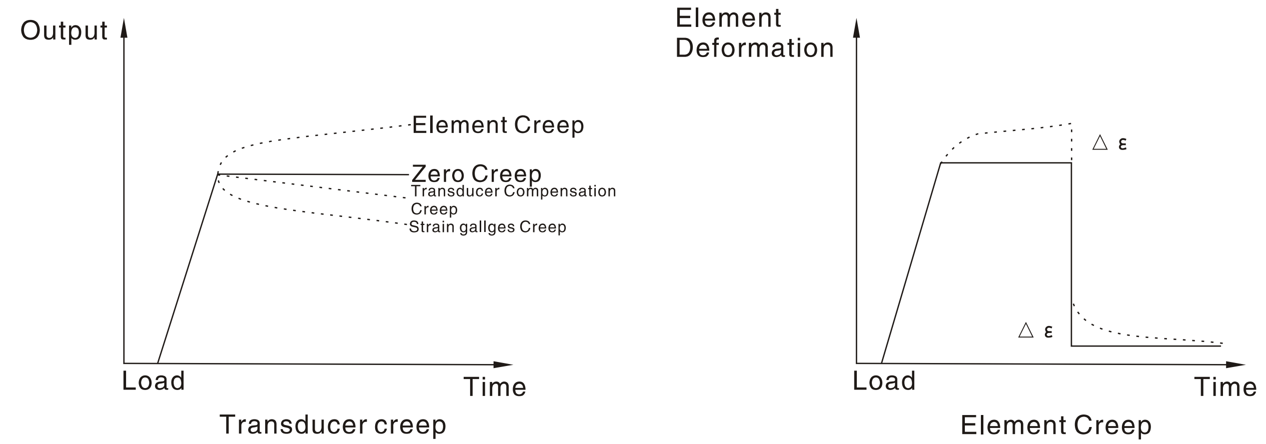
The creep characteristics exist in spring element because of an elasticity of its materials, which makes the transducer output increasing with the addition of time (positive creep), and depends on several variables such as the spring element material, structure, strain field, span, heat treatment and test temperature, etc. The backing of gages and the bonding adhesive have high viscoelasticity that results in the output decreasing with the addition of time; but grid material of gages has an anelasticity which makes the output increasing with the addition of time. The result of accumulation is that the strain gages have positive or negative creep under fixed load; its direction and value could be adjusted by modifying the design of grid structure, backing material ratio and key technology parameter. For example, changing the dimension of the end grid and fixing the other parameters, we can get the curve of creep characteristic as shown in picture 4. After selecting materials of spring element, if gage creep is equal to spring element creep in value but the direction is opposite, then we can compensate the creep of spring element. In the same way, during making transducers, the creep error caused by other factors could be adjusted by this way, and the combined creep value could be limited in minimum range (as shown in picture 3). ZEMIC offers many models of gages which standard creep grads to be selected by transducer manufacturers. (The N※, T※ in strain gages designation refer to creep code, different codes represent different creep value. The rule is: the creep difference between any two–neighbor codes is 0.01–0.015%FS/ 30min)

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

+ ←———— Creep ————→ –








Picture 3 Sketch Map for Creep

**Selection Methods:**

(1) For first time using, please select one or two models of gages which have great different creep values (different creep codes) and bond them onto the spring element. The matched creep codes will be determined according to actual test value of comprehensive creep and direction.

(2) For transducers having the same spring materials and structure, the smaller the capacity are, the more positive creep would be, therefore a more negative creep code should be selected.

(3) Different element material exhibits different creep characteristic. Therefore, different creep code should be selected for steel and aluminum transducers with the same capacity and structure.

(4) Transducer creep depends on many variables such as spring elements, strain gages, adhesive as well as the sealing form, protective coating, technique parameters, etc. The direction and magnitude of such error can be predicted, and shall be considered when selecting creep code.

## 3. Self–Elastic Modulus Compensation Strain Gages

**Introduction:**

With raise of the ambient temperature, the elastic modulus materials will go down. According to the Hooke's theory, as environmental temperature increased the deformation of this structure will be bigger even if the load is not changed. Therefore, the tested strain will be increased along with it. At that time, if the gage factor can be reduced properly with temperature, the output of gages will not be changed as temperature changes. Therefore, the compensation of elastic modulus will be realized. Such kind of strain gages is also called self–elastic modulus compensation strain gages.

The self–elastic modulus compensation strain gages perform the function of common gages and elastic modulus compensation resistor. It also can provide good correction of the sensitivity error of transducer that caused by material of elastic modulus changes with temperature. If self–elastic modulus compensation strain gages are matched with spring materials, the temperature drift of transducer sensitivity will be less than 0.002%FS/℃. CoMPared to common used methods, the self–elastic modulus compensation strain gages take the advantages of high accuracy in compensation, good stability, higher sensitivity, easier usage, lower cost and so on. However, the thermal output of strain gages only with self–elastic modulus compensation is a little bit larger, so zero temperature drift of transducers will be larger, which limited to further improve the precision of transducers. After many years research, we have developed and produced strain gages with self–temperature compensation and self–elastic modulus compensation that solved these problems especially for strain gages with half and full bridge. They have become very popular because of their good temperature capability.

**Selection Method:**

(1) In order to get satisfied compensation result, the elastic modulus compensation gages must be matched with transducer spring materials. Generally, we should choose proper strain gages by testing at least five transducers.

(2)The gages have no functions of self–temperature compensation for most materials; their thermal output is larger than that of ordinary self–temperature compensation gages, therefore they are recommended to use for transducers with smaller temperature grads. It is better to adopt half–bridge or full–bridge gages to gain less zero–temperature drift.

(3)Soldering of elastic modulus compensation gages is more difficult than that of common gages. A special flux can be available from our factory. Carefully solder and clean them completely.

## Strain gage specifications

<table>
<tr><th>Series</th><th>Nominal resistance (Ω)</th><th>Resistance tolerance to average resistance</th><th>Gage factor</th><th>Dispersion of gages factor</th><th>Strain limit</th><th>Fatigue life</th><th>STC code</th><th>Working temperature range (℃)</th></tr>
<tr><td>BF Series</td><td rowspan="6">350<br>650<br>1000</td><td rowspan="6">≤±0.1%</td><td rowspan="3">2.00~2.20</td><td rowspan="7">≤±1%</td><td rowspan="6">2.0%</td><td rowspan="7">$10^7$</td><td rowspan="7">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">-30~+80</td></tr>
<tr><td>ZAM Series</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>
</table>



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**ZF Series**

Fully encapsulated Karma foil gages with modified phenol backing. Offer both self–temperature (or elastic modulus) and creep compensations simultaneously. With high accuracy and excellent stability over a wide temperature range, especially suitable for accuracy class 0.02 transducers, especially suitable for DC/AC electronic weighing instruments.

**BA Series**

Fully encapsulated Constantan foil gages with polyamide backing with self–temperature compensations. With high elongation, excellent heat resistance and wide temperature range. Primarily intend for both precision stress analysis and normal accuracy transducers with temperature up to 150℃.

**BAM Series**

Fully encapsulated Constantan foil gages with thin polyamide film balking backing with self–temperature and creep compensations simultaneously. With high elongation, excellent heat resistance, wide temperature range, low hydroscopicity , and good feature in creep and zero–return. Primarily intend for high accuracy transducers at class 3 or better class.

**BHB Series**

Fully encapsulated Constantan foil gages with glass fiber reinforced epoxy backing. Offer both self–temperature and creep compensations simultaneously. With high accuracy and excellent stability over a wide temperature range and moisture resistant capability, low hydroscopicity , good feature in creep and zero–return, and suitable for transducers at accuracy class3 or higher class.

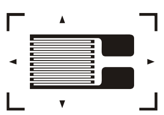
**ZAM Series**

Fully encapsulate Kama foil gages with thin polyamide film backing. Offer both self–temperature and creep compensations simultaneously. With high accuracy and excellent stability over a wide temperature range and moisture resistant capability, low hydroscopicity, good feature in creep and zero–return, and suitable for transducers at accuracy class3 or higher class.

**BB (BAB) 250℃ Series**

Kama foil gages imported Glass Fiber Reinforced Polyimide backing. Offer excellent heat resistance, good insulation, thin backing film, high stability and are suitable for both high precision stress analysis and accuracy transducers with temperature up to 250℃.

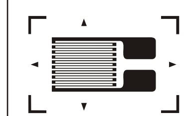
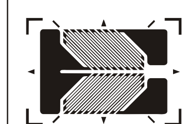
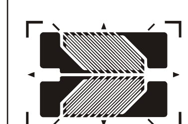
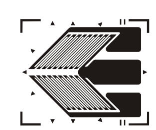
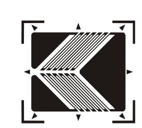
# BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)100–4AA(※※)N※ | 4.0×1.9 | 8.0×3.6 | T0 | |
| | BF(BAM、BHB、BA)120–2AA(※※)N※ | 1.8×1.8 | 5.2×3.2 | T0 | |
| | BF(BAM、BHB、BA)120–3AA(※※)N※ | 2.8×2.0 | 6.4×3.5 | T0、N0、N1、N3、N4、N6、N8 | |
| | BF(BAM、BHB、BA)120–4AA(※※)N※ | 4.0×3.3 | 7.9×4.6 | N6 | |
| | BF(BAM、BHB、BA)120–5AA(※※)N※ | 5.0×2.0 | 10.1×4.0 | N0 | |
| | BF(BAM、BHB、BA)120–6AA(※※)N※ | 5.9×2.7 | 9.8×4.3 | N5 | |
| | BF(BAM、BHB、BA)175–1AA(※※)N※ | 1.5×2.6 | 4.6×3.6 | N0、N6、N8 | |
| | BF(BAM、BHB、BA)175–2AA(※※)N※ | 2.1×1.9 | 6.0×3.5 | N6 | |
| | BF(BAM、BHB、BA)175–3AA(※※)N※ | 3.0×2.4 | 6.8×3.5 | N8、N0 | |
| | BF(BAM、BHB、BA)200–4AA(※※)N※ | 4.0×2.2 | 8.0×3.6 | T0 | |
| | BF(BAM、BHB、BA)200–6AA(※※)N※ | 6.0×2.2 | 10.4×4.5 | N0、T0 | |
| | BF(BAM、BHB、BA)240–3AA(※※)N※ | 3.2×3.1 | 7.4×4.4 | N8 | |
| | BF(BAM、BHB、BA)300–2AA–W(※※)N※ | 2.0×2.0 | 3.8×2.8 | T8 | |
| | BF(BAM、BHB、BA)300–3AA–A(※※)N※ | 3.0×1.9 | 5.5×2.5 | T4 | |
| | BF(BAM、BHB、BA)350–10AA(※※)N※ | 9.4×4.1 | 15.4×6.1 | N9 | |
| | BF(BAM、BHB、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(BAM、BHB、BA)350–1.5AA(※※)N※ | 1.5×4.0 | 4.9×4.8 | N3、N6、T1、T2、T3、T4、T5、T6、T8 | |
| | BF(BAM、BHB、BA)350–2AA–A(※※)N※ | 2.4×3.0 | 4.9×4.0 | N1、N4、N6、T4、T0 | |
| | BF(BAM、BHB、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(BAM、BHB、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(BAM、BHB、BA)350–3AA–A(※※)N※ | 3.2×1.6 | 6.9×3.1 | N0、N6、N8 | |
| | BF(BAM、BHB、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(BAM、BHB、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(BAM、BHB、BA)350–4AA(※※)N※ | 3.8×2.2 | 8.2×4.2 | N0、N2、N6、N9、T6 | |
| | BF(BAM、BHB、BA)350–5AA(※※)N※ | 5.0×2.9 | 9.3×4.5 | N0、N1、N2、N3、N4、N6、N8、T0、T2 | |
| | BF(BAM、BHB、BA)350–6AA(※※)N※ | 6.1×3.1 | 10.4×5.4 | N0、N6、T0 | |
| | BF(BAM、BHB、BA)500–4AA(※※)N※ | 4.0×3.3 | 7.9×4.6 | T0、N4、N6 | |
| | BF(BAM、BHB、BA)650–4AA–A(※※)N※ | 4.0×3.2 | 7.8×4.2 | N6 | |

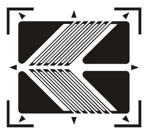
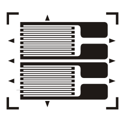
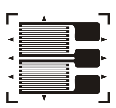
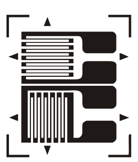




BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)650–4AA(※※)N※ | 4.0×4.4 | 8.6×6.0 | N6 | |
| | BF(BAM、BHB、BA)650–5AA(※※)N※ | 5.0×3.9 | 9.0×5.6 | N6 | |
| | BF(BAM、BHB、BA)650–6AA(※※)N※ | 6.0×4.2 | 10.0×5.2 | N6 | |
| | BF(BAM、BHB、BA)700–3AA(※※)N※ | 3.2×3.1 | 7.4×4.4 | N2、N4、N6、T0、N6 | |
| | BF(BAM、BHB、BA)840–4AA(※※)N※ | 4.0×3.6 | 7.9×4.6 | N6 | |
| | BF(BAM、BHB、BA)1000–2AA(※※)N※ | 2.2×4.6 | 5.8×5.8 | N0、N2、N6、T0、T1、T2、T4、T5、T6、T8 | |
| | BF(BAM、BHB、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(BAM、BHB、BA)1000–4AA(※※)N※ | 4.0×4.2 | 7.7×5.4 | N8 | |
| | BF(BAM、BHB、BA)1000–6AA(※※)N※ | 6.0×4.0 | 9.9×5.4 | N6 | |
| | BF(BAM、BHB、BA)1000–10AA(※※)N※ | 10.0×4.2 | 14.8×6.0 | N0 | |
|  | BF(BAM、BHB、BA)350–2HA(※※)N※ | 2.0×4.4 | 9.0×5.6 | N2、N4、N5、N6、T0、T4 | |
| | BF(BAM、BHB、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(BAM、BHB、BA)350–4HA(※※)N※ | 3.8×4.2 | 9.0×7.8 | N4、N6、T0、T4 | |
| | BF(BAM、BHB、BA)350–6HA(※※)N※ | 5.7×6.1 | 10.9×10.5 | N4 | |
| | BF(BAM、BHB、BA)1000–3HA(※※)N※ | 3.0×5.5 | 9.9×6.2 | N4、N8、T2、T6、T8 | |
| | BF(BAM、BHB、BA)1000–4HA(※※)N※ | 4.0×5.6 | 9.9×7.5 | T0 | |
|  | BF(BAM、BHB、BA)350–2HA–A(※※)N※ | 2.0×4.4 | 9.0×5.6 | N2、N4、N6、T0、T4、T8 | |
| | BF(BAM、BHB、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(BAM、BHB、BA)350–4HA–A(※※)N※ | 3.8×4.2 | 9.0×7.8 | N4 | |
| | BF(BAM、BHB、BA)350–6HA–A(※※)N※ | 5.7×6.1 | 10.9×10.5 | N8 | |
| | BF(BAM、BHB、BA)1000–3HA–A(※※)N※ | 3.0×5.5 | 9.9×6.2 | N2、N4、T2 | |
|  | BF(BAM、BHB、BA)350–2HA–B(※※)N※ | 2.0×2.5 | 7.2×6.3 | N6、N8 | |
| | BF(BAM、BHB、BA)350–3HA–B(※※)N※ | 3.1×4.0 | 9.5×7.8 | N4、N6、N8、T0、T4 | |
| | BF(BAM、BHB、BA)350–5HA–B(※※)N※ | 4.8×4.1 | 10.7×9.3 | N4 | |
| | BF(BAM、BHB、BA)1000–5HA–B(※※)N※ | 4.8×6.5 | 15.7×9.6 | N4 | |
|  | BF(BAM、BHB、BA)350–2HA–C(※※)N※ | 2.0×2.5 | 7.2×6.3 | N0、N2、N4、N6、N8、T2、T4、T8 | |
| | BF(BAM、BHB、BA)350–3HA–C(※※)N※ | 3.1×4.0 | 9.5×7.8 | N2、N4、N6、N8、N9、T0、T4、T6、T8、T9 | |
| | BF(BAM、BHB、BA)1000–3HA–C(※※)N※ | 3.1×5.4 | 10.7×7.8 | N4、N8、T0、T4 | |
|  | BF(BAM、BHB、BA)350–2HA–D(※※)N※ | 2.1×4.3 | 8.9×5.7 | N8 | |
| | BF(BAM、BHB、BA)350–3HA–D(※※)N※ | 2.9×4.0 | 8.8×6.8 | N4 、N8、T0、T1、T4 | |
| | BF(BAM、BHB、BA)350–4HA–D(※※)N※ | 4.2×2.8 | 8.3×8.3 | N4、N8 | |
| | BF(BAM、BHB、BA)350–6HA–D(※※)N※ | 5.9×3.7 | 10.5×11.1 | N8 | |

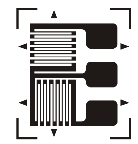
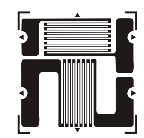
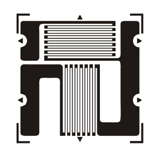
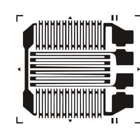
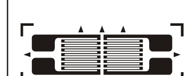
# BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)350–2HA–E(※※)N※ | 2.0×4.3 | 8.9×5.7 | N8 | |
| | BF(BAM、BHB、BA)350–3HA–E(※※)N※ | 3.0×3.9 | 8.8×6.8 | N4、N8 | |
| | BF(BAM、BHB、BA)350–4HA–E(※※)N※ | 4.2×2.8 | 8.3×8.3 | N4、N8 | |
| | BF(BAM、BHB、BA)350–6HA–E(※※)N※ | 5.9×3.7 | 10.5×11.4 | N8 | |
|  | BF(BAM、BHB、BA)60–3AB(※※)N※ | 3.0×3.0 | 8.2×5.1 | T0 | |
| | BF(BAM、BHB、BA)120–6AB(※※)N※ | 5.8×5.8 | 9.7×7.4 | N8 | |
| | BF(BAM、BHB、BA)175–2AB(※※)N※ | 2.0×2.0 | 6.7×3.7 | N8、T0 | |
| | BF(BAM、BHB、BA)175–3AB(※※)N※ | 3.0×3.0 | 8.2×5.1 | N8 | |
| | BF(BAM、BHB、BA)280–3AB(※※)N※ | 3.0×3.0 | 8.2×5.1 | N0 | |
| | BF(BAM、BHB、BA)350–2AB(※※)N※ | 2.0×2.0 | 6.7×3.7 | N0、N4、N8、T3 | |
| | BF(BAM、BHB、BA)350–3AB(※※)N※ | 3.0×3.0 | 8.2×5.1 | N0、N1、N2、N4、N5、N6、N8、T0、T6 | |
| | BF(BAM、BHB、BA)350–4AB(※※)N※ | 4.0×4.0 | 9.1×5.8 | N8 | |
| | BF(BAM、BHB、BA)350–6AB(※※)N※ | 5.9×5.9 | 12.0×8.3 | N5 | |
| | BF(BAM、BHB、BA)350–8AB(※※)N※ | 7.9×7.9 | 13.3×10.0 | N8 | |
| | BF(BAM、BHB、BA)500–4AB(※※)N※ | 4.0×4.0 | 9.1×5.8 | N8 | |
|  | BF(BAM、BHB、BA)350–2FB(※※)N※ | 2.1×2.8 | 6.4×7.6 | N6、T0 | |
| | BF(BAM、BHB、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(BAM、BHB、BA)350–4FB(※※)N※ | 4.0×2.4 | 7.8×6.2 | N6、T0 | |
| | BF(BAM、BHB、BA)350–6FB(※※)N※ | 5.9×2.8 | 9.8×7.3 | N6 | |
| | BF(BAM、BHB、BA)1000–3FB(※※)N※ | 3.0×5.3 | 12.1×6.7 | T0 | |
|  | BF(BAM、BHB、BA)350–3FB–A(※※)N※ | 3.2×2.5 | 6.8×6.4 | N2 | |
|  | BF(BAM、BHB、BA)100–4BB(※※)N※ | 4.0×4.4 | 10.3×7.5 | T0 | |
| | BF(BAM、BHB、BA)120–2BB(※※)N※ | 1.8×2.4 | 6.3×5.5 | N2 | |
| | BF(BAM、BHB、BA)120–3BB(※※)N※ | 2.8×3.3 | 8.5×6.5 | N6 | |
| | BF(BAM、BHB、BA)120–4BB(※※)N※ | 4.0×4.4 | 10.3×7.5 | T0 | |
| | BF(BAM、BHB、BA)240–4BB(※※)N※ | 4.0×4.4 | 10.3×7.5 | T0 | |
| | BF(BAM、BHB、BA)350–1BB(※※)N※ | 2.4×2.1 | 5.5×5.5 | N0 | |
| | BF(BAM、BHB、BA)350–2BB(※※)N※ | 2.0×2.6 | 7.2×6.0 | N8 | |
| | BF(BAM、BHB、BA)350–3BB(※※)N※ | 3.0×3.3 | 8.6×6.6 | N2、N8、T4 | |
| | BF(BAM、BHB、BA)350–4BB(※※)N※ | 4.0×4.1 | 9.7×7.7 | T0 | |
| | BF(BAM、BHB、BA)350–6BB(※※)N※ | 6.0×6.0 | 13.8×9.7 | T0 | |
| | BF(BAM、BHB、BA)600–4BB(※※)N※ | 3.9×4.1 | 9.7×7.7 | N6、N0 | |
| | BF(BAM、BHB、BA)650–4BB(※※)N※ | 4.0×4.4 | 10.3×7.9 | N6 | |

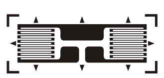
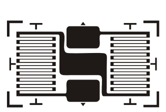
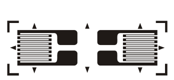




# BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)120–2BB–A(※※)N※ | 1.8×2.2 | 6.3×5.4 | T0 | |
| | BF(BAM、BHB、BA)120–3BB–A(※※)N※ | 2.8×3.3 | 8.5×6.5 | N6 | |
| | BF(BAM、BHB、BA)120–4BB–A(※※)N※ | 4.0×4.4 | 10.3×7.5 | T0 | |
| | BF(BAM、BHB、BA)350–2BB–A(※※)N※ | 2.0×2.7 | 6.9×6.0 | T4、N0 | |
| | BF(BAM、BHB、BA)350–3BB–A(※※)N※ | 3.0×3.4 | 9.8×6.8 | N2 | |
| | BF(BAM、BHB、BA)350–4BB–A(※※)N※ | 4.0×4.1 | 9.7×7.7 | T0、N6 | |
| | BF(BAM、BHB、BA)350–6BB–A(※※)N※ | 5.9×6.3 | 14.3×9.6 | T0、N6 | |
| | BF(BAM、BHB、BA)800–2BB–A(※※)N※ | 2.0×3.5 | 5.8×5.8 | T0 | |
| | BF(BAM、BHB、BA)1000–4BB–A(※※)N※ | 3.6×4.0 | 9.4×7.0 | T0 | |
|  | BF(BAM、BHB、BA)160–5BB(※※)N※ | 4.9×3.0 | 9.6×9.8 | N4 | |
| | BF(BAM、BHB、BA)600–5BB(※※)N※ | 4.9×3.2 | 9.6×9.8 | T0 | |
|  | BF(BAM、BHB、BA)600–5BB–A(※※)N※ | 4.9×3.2 | 9.6×9.8 | N0、N1、N4、N6、N8、T0 | |
| | BF(BAM、BHB、BA)700–5BB–A(※※)N※ | 4.9×3.2 | 9.6×9.8 | N0、N4、N6、N8、T0、T2 | |
| | BF(BAM、BHB、BA)1000–5BB–A(※※)N※ | 4.9×3.2 | 9.6×9.8 | N6 | |
|  | BF(BAM、BHB、BA)160–5BB–C(※※) | 5.2×2.6 | 9.4×8.1 | | |
| | BF(BAM、BHB、BA)350–5BB–C(※※) | 5.2×2.6 | 9.4×8.1 | | |
| | BF(BAM、BHB、BA)700–5BB–C(※※) | 5.2×2.6 | 9.4×8.1 | | |
|  | BF(BAM、BHB、BA)350–2GB(※※)N※ | 2.1×3.0 | 10.8×4.4 | T0、N6 | 2.7 |
| | BF(BAM、BHB、BA)350–3GB(※※)N※ | 3.1×2.8 | 12.4×4.4 | N4、N6 | 3.8 |
| | BF(BAM、BHB、BA)350–4GB(※※)N※ | 4.0×3.8 | 15.3×5.8 | T0 | 5.0 |

# BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)350–1GB–AL0(※※)N※ | 1.5×2.5 | 13.8×3.8 | T0 | 10.5 |
| | BF(BAM、BHB、BA)350–1.5GB–AL68(※※)N※ | 1.5×3.1 | 9.8×4.3 | N6 | 6.8 |
| | BF(BAM、BHB、BA)350–2GB–AL0(※※)N※ | 2.0×3.1 | 14.4×4.4 | N1、N3、N4、N6、 | 10.5 |
| | BF (BAM、BHB、BA) 350–2GB–AL5.5(※※)N※ | 2.0×2.8 | 8.9×3.8 | N8、T0、T2、T6、T8 | 5.5 |
| | BF (BAM、BHB、BA) 350–2GB–AL6(※※)N※ | 2.0×2.8 | 9.4×3.8 | N6 | 6.0 |
| | BF(BAM、BHB、BA)350–2GB–AL7(※※)N※ | 2.0×3.1 | 10.8×4.4 | N0、N2、N6、T0、T4、T6 | 7.0 |
| | BF(BAM、BHB、BA)350–3GB–AL0(※※)N※ | 3.0×2.9 | 15.4×4.2 | N0、N2、N6、T0、T5 | 10.5 |
| | BF(BAM、BHB、BA)350–3GB–AL12(※※)N※ | 3.0×2.9 | 16.9×4.2 | N2、N6、T0 | 12.0 |
| | BF(BAM、BHB、BA)350–3GB–AL13(※※)N※ | 3.2×4.2 | 19.0×5.6 | T0 | 13.2 |
| | BF(BAM、BHB、BA)350–3GB–AL15(※※)N※ | 3.0×2.7 | 20.0×4.1 | N2、N4、N8、T0、T2、T4 | 15.0 |
| | BF(BAM、BHB、BA)750–3GB–AL0(※※)N※ | 3.0×3.5 | 15.2×4.3 | N8 | 10.5 |
| | BF(BAM、BHB、BA)750–3GB–AL12(※※)N※ | 3.0×3.5 | 16.7×4.3 | T0 | 12.0 |
| | BF(BAM、BHB、BA)750–3GB–AL14(※※)N※ | 3.0×3.5 | 18.7×4.2 | N0 | 14.0 |
|  | BF(BAM、BHB、BA)500–2GB–BL8(※※)N※ | 2.1×5.3 | 11.3×6.3 | N0 | 8.0 |
| | BF(BAM、BHB、BA)500–3GB–BL7(※※)N※ | 3.0×4.1 | 12.0×5.5 | T0 | 7.1 |
| | BF(BAM、BHB、BA)500–4GB–BL7(※※)N※ | 3.4×4.1 | 13.0×5.5 | N6 | 7.2 |
| | BF(BAM、BHB、BA)750–2GB–BL12.8(※※)N※ | 2.5×5.2 | 16.9×6.0 | N0 | 12.8 |
| | BF(BAM、BHB、BA)1000–2GB–BL6(※※)N※ | 2.5×5.0 | 10.1×6.0 | N6 | 6.0 |
| | BF(BAM、BHB、BA)1000–3GB–BL7(※※)N※ | 3.0×5.5 | 11.7×6.5 | N8、T4 | 7.0 |
|  | BF (BAM、BHB、BA)350–2GB–CL0(※※)N※ | 2.5×3.3 | 14.7×4.5 | N6、N8、T0、T8 | 10.5 |
| | BF (BAM、BHB、BA)350–2GB–CL8(※※)N※ | 2.5×3.3 | 12.9×4.5 | T2、T4 | 8.0 |
| | BF(BAM、BHB、BA)350–3GB–CL15(※※)N※ | 3.0×2.8 | 20.0×4.1 | N2、T1、T2、T4 | 15.0 |



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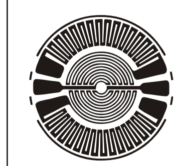
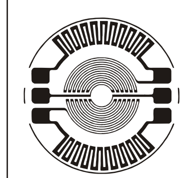
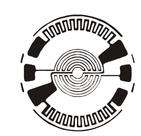
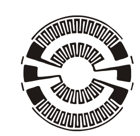
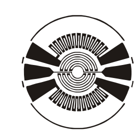
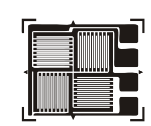
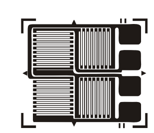
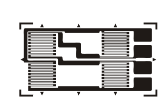
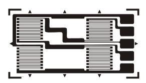
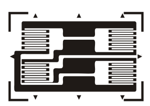
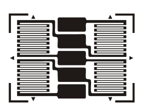
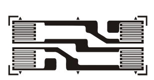
# BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)120–（10）KA(※※) | Φ8.9 | Φ10.0 | | |
| | BF(BAM、BHB、BA)350–（10）KA(※※) | Φ9.0 | Φ10.0 | T0、T2、T6 | |
| | BF(BAM、BHB、BA)350–（13）KA(※※) | Φ12.0 | Φ13.0 | | |
|  | BF(BAM、BHB、BA)350–（8）KA(※※) | Φ7.4 | Φ8.0 | | |
| | BF(BAM、BHB、BA)350–（9）KA(※※) | Φ9.4 | Φ10.0 | | |
| | BF(BAM、BHB、BA)350–（12）KA(※※) | Φ11.4 | Φ12.0 | | |
| | BF(BAM、BHB、BA)350–（14）KA(※※) | Φ12.8 | Φ14.0 | T0、N3、N6 | |
| | BF(BAM、BHB、BA)350–（15）KA(※※) | Φ14.0 | Φ15.0 | | |
| | BF(BAM、BHB、BA)350–（20）KA(※※) | Φ18.6 | Φ20.0 | | |
|  | BF(BAM、BHB、BA)350–（8.5）KA–B(※※) | Φ8.1 | Φ9.0 | | |
| | BF(BAM、BHB、BA)350–（18）KA–B(※※) | Φ16.6 | Φ18.0 | | |
|  | BF(BAM、BHB、BA)350–（20）KA–C(※※) | Φ19.0 | Φ20.0 | | |
| | BF(BAM、BHB、BA)350–（22）KA–C(※※) | Φ19.8 | Φ22.2 | N4、T0 | |
|  | BF(BAM、BHB、BA)120–(10–B13)KA(※※) | Φ9.0 | Φ13.0 | | |
| | BF(BAM、BHB、BA)350–(7–B10)KA(※※) | Φ6.4 | Φ9.9 | | |
|  | BF(BAM、BHB、BA)350–2EB(※※)N※ | 2.3×2.7 | 8.6×7.2 | N2 | |
|  | BF(BAM、BHB、BA)350–2EB–B(※※)N※ | 2.3×2.8 | 8.6×7.4 | N2 | |
|  | BF(BAM、BHB、BA)350–2FG–L8.8(※※)N※ | 2.0×2.7 | 14.5×6.5 | N6 | 8.8 |
| | BF(BAM、BHB、BA)350–2FG–L0(※※)N※ | 2.0×2.7 | 16.2×6.5 | N2、T2 | 10.5 |

## BF, BAM, BHB, BA series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BF(BAM、BHB、BA)350-2FG-AL6(※※)N※ | 2.0×2.2 | 12.0×7.1 | N2、T0、T4、T8 | 6.0 |
| | BF(BAM、BHB、BA)350-3FG-AL6(※※)N※ | 3.0×2.1 | 13.0×6.8 | T4 | 6.0 |
| | BF(BAM、BHB、BA)350-3FG-AL0(※※)N※ | 3.1×3.0 | 17.9×8.4 | N2、T2、T6 | 10.5 |
| | BF(BAM、BHB、BA)350-3FG-AL14(※※)N※ | 3.0×2.1 | 20.5×6.8 | N6、T1、T6、T0 | 14.0 |
|  | BF(BAM、BHB、BA)350-1FG-BL0(※※)N※ | 1.5×2.7 | 13.7×6.9 | T4、T6 | 10.5 |
| | BF(BAM、BHB、BA)350-2FG-BL10(※※)N※ | 2.6×2.7 | 14.8×8.0 | N8 | 10.0 |
| | BF(BAM、BHB、BA)350-3FG-BL0(※※)N※ | 3.1×2.8 | 15.5×6.8 | T2 | 10.5 |
|  | BF(BAM、BHB、BA)350-2FG-CL6(※※)N※ | 2.1×2.9 | 9.8×6.9 | T0、T2、T4 | 6.0 |
| | BF(BAM、BHB、BA)350-3FG-CL0(※※)N※ | 3.1×2.8 | 15.3×7.0 | N2、N6、T0、T4 | 10.5 |
|  | BF(BAM、BHB、BA)350-1FG-DL0(※※)N※ | 1.5×2.5 | 13.9×6.6 | T0、T0、T8 | 10.5 |
| | BF(BAM、BHB、BA)350-3FG-DL15(※※)N※ | 2.8×2.3 | 19.0×6.0 | T0 | 15.0 |

**Note:**

1.N※ or T ※stands for creep code. Different creep codes have different creep value.

2.L※ stands for grid interval codes. For example, L0 refers to 10.5mm grid interval; L6 refers to 6.0mm grid interval.

3.In the above list, BF (BAM, BHB, BA) 350-3AA (※※) represents four series of strain gages, which are BF350-3AA (※※), BAM350-3AA (※※), BHB350-3AA (※※) and BA350-3AA (※※) respectively. Please specify the appropriate models on your purchase order.

4.For the encapsulated gages with grid pattern HA-D and HA-E, we only offer the gages with lead wires.

5.For strain gages with KA patterns:

When standard value=120Ω, resistance range: standard value+2.0/-1.0Ω, resistance difference of the grids≤0.4Ω.

When standard value=350Ω, resistance range: standard value+2.0/-2.0Ω, resistance difference of the grids≤0.8Ω.

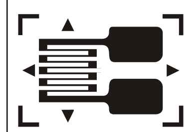
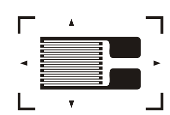
6. for stain gages with FG, EB patterns, when standard value=350Ω, resistance range: 350±50Ω, zero balance≤0.5m V/V.

7. Except for the models listed in above table, we also can produce high precision transducers that use strain gauges with any shape and size according to samples or drawings supplied by customers.

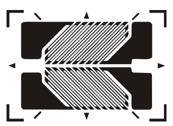
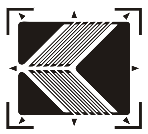
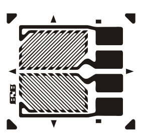
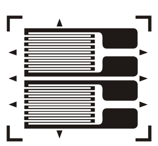




## ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)175-1AA(※※)N※ | 1.0×1.8 | 4.5×3.0 | T8 | |
| | ZF(ZAM)300-1AA(※※)N※ | 1.1×1.2 | 3.6×2.2 | T8 | |
| | ZF(ZAM)200-1AA-W(※※)N※ | 1.0×0.5 | 2.8×1.8 | T8 | |
| | ZF(ZAM)250-1AA-W(※※)N※ | 1.1×1.0 | 2.9×2.0 | T8 | |
| | ZF(ZAM)300-2AA-W(※※)N※ | 2.0×1.0 | 3.8×2.0 | T8 | |
| | ZF(ZAM)300-2AA-A-W(※※)N※ | 2.0×2.0 | 3.8×2.8 | T8 | |
| | ZF(ZAM)350-1AA-W(※※)N※ | 1.1×1.0 | 2.9×2.0 | T8 | |
| | ZF(ZAM)350-2AA-W(※※)N※ | 2.0×1.0 | 3.8×2.0 | T8 | |
|  | ZF(ZAM)300-3AA-A(※※)N※ | 2.9×1.9 | 5.5×2.5 | T4 | |
| | ZF(ZAM)350-2AA(※※)N※ | 1.9×2.8 | 5.7×4.0 | N0、N1、N3、N4、N6、N8、T0、T4、T6 | |
| | ZF(ZAM)350-3AA(※※)N※ | 3.1×2.6 | 7.0×3.8 | N1、N2、N3、N4、N5、N6、N0、T0、T2、T4 | |
| | ZF(ZAM)350-4AA(※※)N※ | 4.0×2.5 | 8.0×3.9 | N6 | |
| | ZF(ZAM)350-5AA(※※)N※ | 5.0×2.3 | 9.0×3.7 | N6 | |
| | ZF(ZAM)350-7AA(※※)N※ | 7.0×2.6 | 10.8×4.0 | N4 | |
| | ZF(ZAM)1000-1.2AA(※※)N※ | 1.2×3.6 | 4.5×4.5 | T8 | |
| | ZF(ZAM)1000-1.5AA-A(※※)N※ | 1.5×2.5 | 4.5×3.1 | T4、T8 | |
| | ZF(ZAM)1000-1.5AA(※※)N※ | 1.5×4.0 | 4.9×4.8 | N3、N6、T1、T2、T3、T4、T5、T6、T8 | |
| | ZF(ZAM)1000-2AA-T(※※)N※ | 2.1×3.3 | 5.8×4.5 | N0、T4、T8 | |
| | ZF(ZAM)1000-2AA(※※)N※ | 2.5×3.3 | 6.4×4.5 | N0、N2、N5、N6、T0、T1、T2、T3、T4、T6 | |
| | ZF(ZAM)1000-3AA-B(※※)N※ | 3.0×3.1 | 14.3×4.5 | N0、N1、N2、N3、N5、N6、N7、T2、T3、T4、T8 | |
| | ZF(ZAM)1000-3AA(※※)N※ | 3.2×3.2 | 7.4×4.5 | N0、N1、N2、N3、N4、N6、N8、T0、T2、T3、T4、T5、T6、T8 | |
| | ZF(ZAM)1000-4AA(※※)N※ | 3.8×2.2 | 8.2×4.2 | N0、N2、N6、N9、T6 | |
| | ZF(ZAM)1000-5AA(※※)N※ | 5.0×2.9 | 9.3×4.5 | N0、N1、N2、N3、N4、N6、N8、T0、T2 | |
| | ZF(ZAM)1500-3AA(※※)N※ | 3.2×3.2 | 7.4×4.5 | N6、N4 | |
| | ZF(ZAM)2000-2AA-A(※※)N※ | 2.1×4.2 | 5.4×5.2 | T1、T6 | |
| | ZF(ZAM)2000-3AA(※※)N※ | 3.2×4.0 | 7.4×5.3 | N0、T4 | |
| | ZF(ZAM)2000-4AA(※※)N※ | 4.0×4.4 | 8.6×6.0 | N6 | |
| | ZF(ZAM)2500-3AA(※※)N※ | 3.2×3.2 | 7.4×4.5 | N2、N6、N8、T0、T1、T2、T3、T4、T5、T6、T7、T8 | |
| | ZF(ZAM)2500-6AA(※※)N※ | 6.0×6.4 | 11.0×8.0 | N0 | |
| | ZF(ZAM)3000-5AA(※※)N※ | 5.2×4.0 | 8.7×5.2 | N6 | |
| | ZF(ZAM)3000-6AA(※※)N※ | 6.1×3.9 | 9.8×5.2 | T0、T4 | |
| | ZF(ZAM)5000-3AA(※※)N※ | 3.2×4.6 | 6.7×5.8 | N6 | |

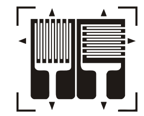
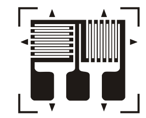
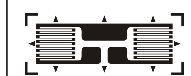
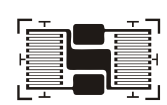
# ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)350-2HA(※※)N※ | 1.9×2.2 | 6.0×4.9 | T0 | |
| | ZF(ZAM)350-3HA(※※)N※ | 3.0×4.4 | 9.4×6.5 | N1、N4、N8 | |
| | ZF(ZAM)350-4HA(※※)N※ | 3.7×2.0 | 7.9×7.9 | N3 | |
| | ZF(ZAM)700-4HA(※※)N※ | 3.8×4.2 | 9.0×7.8 | N5 | |
| | ZF(ZAM)1000-3HA(※※)N※ | 3.0×4.5 | 9.4×6.5 | N0、N1、N2、N3、N4、N5、N6、N7、N8、N9、T0、T2、T3、T4、T8 | |
| | ZF(ZAM)1000-4HA(※※)N※ | 3.8×4.2 | 9.0×7.8 | N4、N6、T0、T4 | |
| | ZF(ZAM)2000-3HA(※※)N※ | 3.0×5.5 | 9.9×6.2 | N4、N8、T2、T6、T8 | |
|  | ZF(ZAM)350-3HA-A(※※)N※ | 3.0×4.4 | 9.4×6.5 | N4、N6、N8、T0 | |
| | ZF(ZAM)650-3HA-A(※※)N※ | 2.9×4.0 | 8.5×6.3 | T0 | |
| | ZF(ZAM)1000-3HA-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 | |
| | ZF(ZAM)1000-4HA-A(※※)N※ | 3.8×4.2 | 9.0×7.8 | N4 | |
|  | ZF(ZAM)200-05HA-W(※※)N※ | 0.5×1.4 | 3.8×2.0 | T4 | |
| | ZF(ZAM)250-1HA-W(※※)N※ | 1.0×1.3 | 3.8×2.8 | T4 | |
| | ZF(ZAM)300-2HA-W(※※)N※ | 2.0×1.2 | 4.0×4.0 | T8 | |
| | ZF(ZAM)350-1HA-W(※※)N※ | 1.0×1.3 | 3.8×2.8 | T4 | |
| | ZF(ZAM)350-2HA-W(※※)N※ | 2.0×1.2 | 4.0×4.0 | T8 | |
| | ZF(ZAM)350-4HA-D(※※)N※ | 3.9×2.3 | 8.3×8.3 | N8 | |
| | ZF(ZAM)650-4HA-D(※※)N※ | 3.8×2.5 | 7.5×7.5 | N1、N8、T0 | |
| | ZF(ZAM)700-4HA-D(※※)N※ | 3.8×2.5 | 7.5×7.5 | N1、N8、T0 | |
|  | ZF(ZAM)700-4HA-E(※※)N※ | 3.8×2.5 | 7.5×7.5 | N1、N8、T0 | |
|  | ZF(ZAM)1000-2HA-T(※※)N※ | 2.7×3.5 | 7.1×6.4 | T0 | |
|  | ZF(ZAM)350-3AB(※※)N※ | 3.0×3.0 | 8.0×5.2 | N8 | |
| | ZF(ZAM)1000-3AB(※※)N※ | 3.0×3.0 | 8.2×5.1 | N0、N1、N2、N4、N5 N6、N8、T0、T6 | |
| | ZF(ZAM)1000-4AB(※※)N※ | 4.0×4.0 | 9.1×5.8 | N8 | |
|  | ZF(ZAM)350-3FB(※※)N※ | 3.0×2.6 | 7.4×7.2 | N6 | |
| | ZF(ZAM)350-4FB(※※)N※ | 4.0×2.4 | 7.8×6.2 | N6、N2 | |
| | ZF(ZAM)1000-2FB(※※)N※ | 2.1×2.8 | 6.4×7.6 | N6、T0 | |
| | ZF(ZAM)1000-3FB(※※)N※ | 3.2×2.8 | 7.4×7.4 | N0、N1、N2、N3、N4、N5、N6、N8、T0、T2、T4、T8 | |
| | ZF(ZAM)1000-4FB(※※)N※ | 4.0×2.4 | 7.8×6.2 | N6、T0 | |
| | ZF(ZAM)1000-6FB(※※)N※ | 6.0×2.4 | 9.5×6.8 | N2 | |

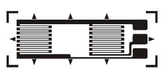
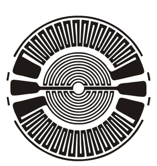




# ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)1000-2BB(※※)N※ | 2.0×2.6 | 7.2×6.0 | N8 | |
| | ZF(ZAM)1000-3BB(※※)N※ | 3.0×3.4 | 8.6×6.6 | T4 | |
| | ZF(ZAM)1000-6BB(※※)N※ | 6.0×6.0 | 13.8×9.7 | T0 | |
|  | ZF(ZAM)350-2BB-A(※※)N※ | 1.5×2.0 | 5.9×4.5 | T0 | |
| | ZF(ZAM)800-2BB-A(※※)N※ | 1.7×3.2 | 5.4×5.4 | T0 | |
| | ZF(ZAM)1000-2BB-A(※※)N※ | 2.0×2.7 | 6.9×6.0 | T4、N0 | |
| | ZF(ZAM)1000-2BB-A(※※)-KR | 2.6×2.2 | 5.4×5.4 | N4 | |
| | ZF(ZAM)1000-3BB-A(※※)N※ | 3.0×3.4 | 9.8×6.8 | N2 | |
|  | ZF(ZAM)350-1GB-AL68(※※)N※ | 1.5×3.2 | 9.8×4.3 | N0、N6、T0、T4 | 6.8 |
| | ZF(ZAM)350-2GB-AL7(※※)N※ | 2.0×2.7 | 10.8×3.9 | N2、N4、N6、T0 | 7.0 |
| | ZF(ZAM)350-1GB-AL8(※※)N※ | 1.5×3.5 | 11.0×4.3 | N2 | 8.0 |
| | ZF(ZAM)350-2GB-AL0(※※)N※ | 2.0×2.7 | 14.4×3.9 | N0、N2、N4、N6、T0、T2、T8 | 10.5 |
| | ZF(ZAM)350-2GB-AL12(※※)N※ | 2.0×2.7 | 15.8×3.9 | N0、N4 | 12.0 |
| | ZF(ZAM)350-2GB-AL15(※※)N※ | 2.0×2.7 | 18.8×3.9 | N2、T4 | 15.0 |
| | ZF(ZAM)750-2GB-AL12(※※)N※ | 2.0×3.3 | 15.8×4.5 | N0、T6、T8 | 12.0 |
| | ZF(ZAM)1000-1.5GB-AL5.5(※※)N※ | 1.5×2.5 | 9.1×4.3 | N6 | 5.5 |
| | ZF(ZAM)1000-1.5GB-AL9(※※)N※ | 1.5×4.0 | 12.0×5.2 | T2、T3、T8 | 9.0 |
| | ZF(ZAM)1000-1.6GB-AL0(※※)N※ | 1.6×3.9 | 13.7×5.1 | T1、T4 | 10.5 |
| | ZF(ZAM)1000-2GB-AL5(※※)N※ | 2.0×3.3 | 8.9×4.5 | N2 | 5.3 |
| | ZF(ZAM)1000-2GB-AL5.5(※※)N※ | 2.0×2.8 | 8.9×3.8 | N6 | 5.5 |
| | ZF(ZAM)1000-2GB-AL6(※※)N※ | 2.0×2.8 | 9.4×3.8 | N0、N2、N6、T0、T4、T6 | 6.0 |
| | ZF(ZAM)1000-2GB-AL7(※※)N※ | 2.0×3.1 | 10.8×4.4 | N0、N2、N4、N6、T0、T5 | 7.0 |
| | ZF(ZAM)1000-2GB-AL0(※※)N※ | 2.5×3.3 | 14.7×4.5 | N0、N2、N3、N4、N5、N6、N8、T1、T6 | 10.5 |
| | ZF(ZAM)1000-3GB-AL7(※※)N※ | 3.0×3.2 | 11.6×4.4 | N2 | 7.0 |
| | ZF(ZAM)1000-3GB-AL0(※※)N※ | 3.0×3.2 | 15.4×4.4 | N6、T0、T2、T4、T6、T8 | 10.5 |
| | ZF(ZAM)1000-3GB-AL14(※※)N※ | 2.9×3.0 | 18.7×4.2 | N0、N1 | 14.0 |
| | ZF(ZAM)1100-2GB-AL6(※※)N※ | 2.0×3.0 | 9.4×4.0 | N2 | 6.0 |
| | ZF(ZAM)2000-2GB-AL0(※※)N※ | 2.5×4.0 | 14.7×5.0 | T0、T4 | 10.5 |
|  | ZF(ZAM)500-2GB-BL6(※※)N※ | 2.1×5.0 | 9.8×6.0 | N4 | 6.0 |
| | ZF(ZAM)1000-1GB-BL6(※※)N※ | 1.5×4.8 | 9.1×6.5 | T6 | 6.0 |
| | ZF(ZAM)1000-2GB-BL6(※※)N※ | 2.1×4.1 | 9.7×5.5 | N0、N2、N6、T0、T1、T2、T3、T4、T5、T6 | 6.0 |
| | ZF(ZAM)1000-2GB-BL7(※※)N※ | 2.1×4.1 | 10.7×5.5 | N6、T1、T3、T5、T8 | 7.0 |
| | ZF(ZAM)1000-2GB-BL0(※※)N※ | 2.1×4.1 | 14.2×5.5 | T1、T3、T5 | 10.5 |
| | ZF(ZAM)1000-3GB-BL6(※※)T※ | 3.0×3.6 | 10.7×4.8 | T0、T2 | 6.0 |
| | ZF(ZAM)2000-2GB-BL6(※※)N※ | 2.1×4.2 | 9.7×5.5 | T6 | 6.0 |
| | ZF(ZAM)2000-2GB-BL7(※※)N※ | 2.1×5.4 | 10.8×6.4 | N6、T0 | 7.0 |

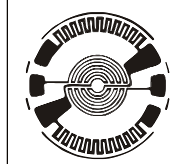
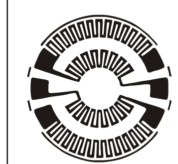
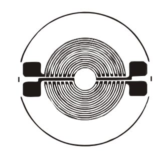
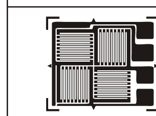
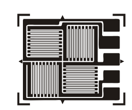
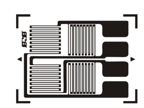
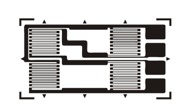
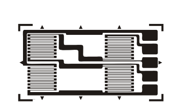
## ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)1000-2GB-CL8(※※)N※ | 2.5×3.3 | 12.9×4.5 | N2、T1、T2、T4 | 8.0 |
| | ZF(ZAM)1000-2GB-CL0(※※)N ※ | 2.5×3.3 | 14.7×4.5 | T2、T4 | 10.5 |
|  | ZF(ZAM)350-3GB-L12(※※)N※ | 3.0×3.3 | 20.3×4.2 | N6 | 12.0 |
| | ZF(ZAM)500-3GB-L0(※※)N※ | 3.0×4.8 | 18.8×5.3 | N6 | 10.5 |
| | ZF(ZAM)500-3GB-L12(※※)N※ | 3.0×4.8 | 16.8×5.3 | N6 | 12.0 |
| | ZF(ZAM)1000-2GB-L6(※※)N※ | 2.1×3.4 | 11.7×5.2 | T4 | 6.0 |
| | ZF(ZAM)1000-3GB-L6(※※)N※ | 3.0×3.8 | 13.2×4.8 | T8 | 6.0 |
| | ZF(ZAM)1000-3GB-L0(※※)N※ | 3.0×3.8 | 17.2×4.9 | N2、T2、T8 | 10.5 |
| | ZF(ZAM)1000-3GB-L12(※※)N※ | 3.1×3.9 | 18.5×4.9 | N2 | 12.0 |
| | ZF(ZAM)1000-4GB-L12(※※)N※ | 4.0×2.5 | 19.5×4.5 | N8 | 12.0 |
| | ZF(ZAM)2000-3GB-L0(※※)N※ | 3.0×2.8 | 17.8×4.4 | T8 | 10.5 |
|  | ZF(ZAM)350-(14)KA(※※) | Φ12.8 | Φ14.0 | | |
| | ZF(ZAM)350-(20)KA(※※) | Φ19.0 | Φ20.0 | | |
| | ZF(ZAM)1000-(14)KA(※※) | Φ12.8 | Φ14.0 | N6、N3、T0 | |
| | ZF(ZAM)1000-(15)KA(※※) | Φ14.0 | Φ15.0 | | |
| | ZF(ZAM)1000-(20)KA(※※) | Φ18.6 | Φ20.0 | | |
| | ZF(ZAM)2000-(14)KA(※※) | Φ13.2 | Φ14.0 | T0、T4 | |
| | ZF(ZAM)2000-(15)KA(※※) | Φ14.2 | Φ15.0 | | |
| | ZF(ZAM)3000-(14)KA(※※) | Φ13.2 | Φ14.0 | | |
|  | ZF(ZAM)350-(6.5)KA(※※) | Φ5.3 | Φ6.5 | | |
| | ZF(ZAM)350-(9)KA(※※) | Φ9.4 | Φ10.0 | | |
| | ZF(ZAM)350-(25)KA(※※) | Φ23.4 | Φ25.0 | | |
| | ZF(ZAM)1000-(10)KA(※※) | Φ9.0 | Φ10.0 | T0、T2、T6 | |
| | ZF(ZAM)1000-(13)KA(※※) | Φ12.0 | Φ13.0 | | |
| | ZF(ZAM)1500-(10)KA(※※) | Φ9.0 | Φ10.0 | | |
| | ZF(ZAM)1500-(11)KA(※※) | Φ10.0 | Φ10.8 | | |
| | ZF(ZAM)2000-(17)KA(※※) | Φ16.0 | Φ17.0 | | |
| | ZF(ZAM)2000-(18)KA(※※) | Φ17.0 | Φ18.0 | | |
| | ZF(ZAM)2500-(20)KA(※※) | Φ19.0 | Φ20.0 | | |
|  | ZF(ZAM)350-(6-B10)KA(※※) | Φ6.4 | Φ10.0 | | |
| | ZF(ZAM)420-(7-B10)KA(※※) | Φ6.4 | Φ9.9 | | |
| | ZF(ZAM)1200-(7-B10)KA(※※) | Φ6.4 | Φ9.9 | | |
| | ZF(ZAM)1000-(10-B13)KA(※※) | Φ9.0 | Φ13.0 | | |
| | ZF(ZAM)1000-(7-B10)KA(※※) | Φ6.4 | Φ9.9 | | |
| | ZF(ZAM)1000-(7-B9)KA(※※) | Φ6.4 | Φ8.7 | | |
| | ZF(ZAM)1650-(10-B13)KA(※※) | Φ9.4 | Φ13.0 | | |
| | ZF(ZAM)2000-(10-B13)KA(※※) | Φ9.4 | Φ13.0 | | |

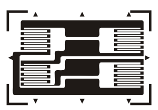
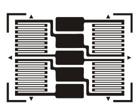


中航电测 ZEMIC
Measuring Excellence Worldwide

## ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)350-(6)KA-B(※※) | Φ5.3 | Φ6.0 | | |
| | ZF(ZAM)350-(8-B10)KA-B(※※) | Φ8.0 | Φ10.0 | | |
| | ZF(ZAM)500-(6)KA-B(※※) | Φ5.3 | Φ6.0 | | |
| | ZF(ZAM)550-(6)KA-B(※※) | Φ5.3 | Φ6.0 | | |
| | ZF(ZAM)550-(6-B10)KA-B(※※) | Φ5.3 | Φ9.8 | | |
| | ZF(ZAM)700-(6)KA-B(※※) | Φ5.4 | Φ6.0 | | |
| | ZF(ZAM)1000-(10)KA-B(※※) | Φ9.0 | Φ10.0 | | |
| | ZF(ZAM)2000-(12)KA-B(※※) | Φ11.2 | Φ12.0 | | |
|  | ZF(ZAM)350-(8)KA-C(※※) | Φ8.2 | Φ8.0 | | |
| | ZF(ZAM)350-(10)KA-C(※※) | Φ9.2 | Φ10.0 | | |
| | ZF(ZAM)350-(20)KA-C(※※) | Φ19.0 | Φ20.0 | | |
| | ZF(ZAM)350-(22)KA-C(※※) | Φ20.0 | Φ22.0 | | |
| | ZF(ZAM)750-(20)KA-C(※※) | Φ19.0 | Φ20.0 | | |
| | ZF(ZAM)1000-(20)KA-C(※※) | Φ19.0 | Φ20.0 | | |
| | ZF(ZAM)1500-(13-B16)KA-C(※※) | Φ13.2 | Φ16.0 | | |
| | ZF(ZAM)2000-(13-B16)KA-C(※※) | Φ13.3 | Φ16.0 | | |
|  | ZF(ZAM)1000-(11)KB(※※) | Φ6.7 | Φ11.0 | T0、T2 | |
|  | ZF(ZAM)350-2EB(※※)N※ | 1.8×2.2 | 7.4×8.5 | N2 | |
| | ZF(ZAM)1000-2EB(※※)N※ | 2.3×2.7 | 8.6×7.2 | N2 | |
| | ZF(ZAM)1000-3EB(※※)N※ | 2.7×3.2 | 9.8×8.4 | N2 | |
|  | ZF(ZAM)350-2EB-A(※※)N※ | 1.8×2.3 | 7.4×8.4 | N2 | |
| | ZF(ZAM)1000-2EB-A(※※)N※ | 2.3×2.7 | 8.6×7.5 | N2 | |
|  | ZF(ZAM)1000-2EB-BT(※※)N※ | 1.8×1.8 | 7.9×5.2 | T6 | |
| | ZF(ZAM)1200-2EB-BT(※※)N※ | 1.8×1.8 | 7.9×5.2 | T6 | |
|  | ZF(ZAM)350-1FG-L0(※※)N※ | 1.5×2.0 | 16.0×6.2 | T0 | 10.5 |
| | ZF(ZAM)350-2FG-L7(※※)N※ | 2.0×1.9 | 13.4×6.4 | T1 | 7.0 |
| | ZF(ZAM)350-2FG-L8(※※)N※ | 2.0×1.9 | 14.3×6.4 | T0 | 8.0 |
| | ZF(ZAM)1000-3FG-L0(※※)N※ | 3.0×2.5 | 17.4×6.4 | N6、T8 | 10.5 |
| | ZF(ZAM)1000-3FG-L12(※※)N※ | 3.1×2.3 | 18.6×6.8 | N0、T8 | 12.0 |
|  | ZF(ZAM)350-2FG-AL6(※※)N※ | 2.0×2.2 | 11.9×7.1 | T0、N4、N6、N8、T4 | 6.0 |
| | ZF(ZAM)350-3FG-AL0(※※)N※ | 3.0×2.0 | 17.2×6.6 | N6 | 10.5 |
| | ZF(ZAM)1000-2FG-AL0(※※)N※ | 2.1×2.6 | 16.9×7.4 | T1、T6、T8 | 10.5 |
| | ZF(ZAM)1000-3FG-AL0(※※)N※ | 3.1×3.2 | 17.9×8.4 | N2、N6、T0、T2、T4、T6 | 10.5 |
| | ZF(ZAM)1000-3FG-AL14(※※)N※ | 3.0×2.1 | 20.5×6.8 | N6、T1、T6、T0 | 14.0 |
| | ZF(ZAM)1000-3FG-AL12(※※)N ※ | 3.1×2.9 | 19.4×8.4 | T8 | 12.0 |

## ZF、ZAM series strain gages

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | ZF(ZAM)350-1FG-BL6(※※)N※ | 1.5×2.2 | 9.3×6.1 | T0、N4 | 6.0 |
| | ZF(ZAM)350-1FG-BL0(※※)N※ | 1.5×2.5 | 13.9×6.4 | N0、T0、T8 | 10.5 |
| | ZF(ZAM)400-1FG-BL68(※※)N※ | 1.5×2.4 | 9.8×6.1 | T8 | 6.8 |
| | ZF(ZAM)500-2FG-BL6(※※)N※ | 2.1×2.2 | 9.7×5.8 | T8 | 6.0 |
| | ZF(ZAM)1000-1.5FG-BL0(※※)T※ | 3.0×2.8 | 13.8×6.9 | T8 | 10.5 |
| | ZF(ZAM)1000-2FG-BL6(※※)N※ | 2.1×2.7 | 9.8×6.9 | N4、N8、T0、T4、T8 | 6.0 |
| | ZF(ZAM)1000-2FG-BL0(※※)N※ | 2.1×2.8 | 14.4×6.9 | N2、N6 | 10.5 |
| | ZF(ZAM)1000-3FG-BL0(※※)T※ | 3.1×2.8 | 15.5×6.8 | T2 | 10.5 |
| | ZF(ZAM)1100-2FG-BL0(※※)N※ | 2.1×2.8 | 14.4×6.9 | N2、T8 | 10.5 |
| | ZF(ZAM)1100-2FG-BL6(※※)N※ | 2.1×2.8 | 9.8×6.8 | N2 | 6.0 |
| | ZF(ZAM)1200-3FG-BL7(※※)N※ | 3.0×2.6 | 12.0×6.8 | T0 | 7.0 |
| | ZF(ZAM)2000-2FG-BL0(※※)N※ | 2.0×3.3 | 14.3×7.8 | T8 | 10.5 |
|  | ZF(ZAM)350-1FG-CL6(※※)N※ | 1.5×2.2 | 9.2×6.0 | T0 | 6.0 |
| | ZF(ZAM)350-1FG-CL68(※※)N※ | 1.5×2.4 | 9.8×6.2 | N2 | 6.8 |
| | ZF(ZAM)350-1FG-CL0(※※)N※ | 1.5×2.2 | 13.9×6.4 | T2 | 10.5 |
| | ZF(ZAM)1000-2FG-CL6(※※)N※ | 2.1×2.9 | 9.8×6.9 | T0、T2、T4 | 6.0 |
| | ZF(ZAM)1000-3FG-CL0(※※)N※ | 3.1×2.8 | 15.3×7.0 | N2、N6、T0、T4 | 10.5 |
| | ZF(ZAM)1100-2FG-CL6(※※)N※ | 2.1×2.8 | 9.6×6.8 | N2 | 6.0 |

**Note:**

1.N※ or T ※stands for creep code. Different creep codes have different creep value.

2.L※ stands for grid interval codes. For example, L0 refers to 10.5mm grid interval; L6 refers to 6.0mm grid interval.

3.In the above list, ZF (ZAM) 350-3AA (※※) represents two series of strain gages, which are ZF350-3AA (※※) and ZAM350-3AA (※※) respectively. Please specify the appropriate models on your purchase order.

4.For the encapsulated gages with grid pattern HA-D and HA-E, we only offer the gages with lead wires.

5.For strain gages with KA patterns:

When standard value=350Ω, resistance range: standard value+2.0/-2.0Ω, resistance difference of the grids≤0.8Ω.

When standard value=1000Ω, resistance range: standard value+100.0/-50.0Ω, resistance difference of the grids≤1.0Ω.

When standard value≥1500Ω, resistance range: standard value ±10%, resistance difference of the grids≤standard value 1%.

6.for stain gages with FG, EB patterns:

When standard value=350Ω, resistance range: 350±50Ω, zero balance=0.5m V/V.

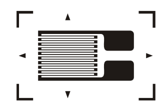
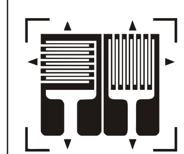
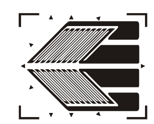
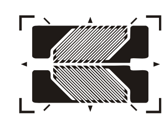
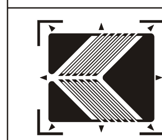
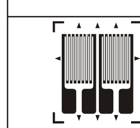
When standard value=1000Ω, resistance range: 1000±10%, zero balance=1.0m V/V.

7.Except for the models listed in above table, we also can produce high precision transducers that use strain gauges with any shape and size according to samples or drawings supplied by customers.





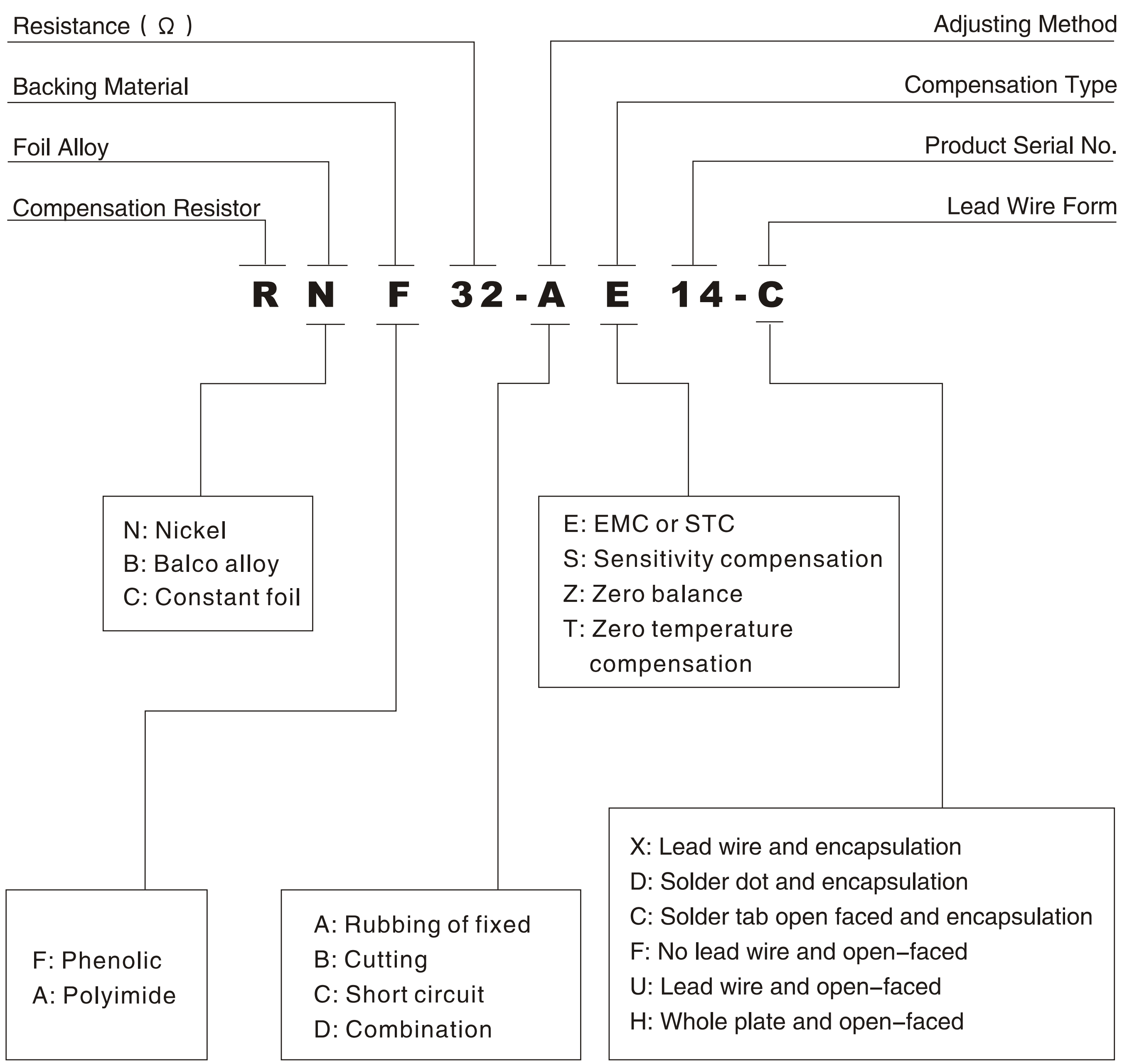
## BB (BAB) 250℃ Series

| Strain gage type | Strain gage model | Grid dimension L×W(mm) | Backing dimension L×W(mm) | Creep code | Grid distance (mm) |
|---|---|---|---|---|---|
|  | BB(BAB)120-2AA250(※※) | 2.1×2.3 | 5.8×3.8 | | |
| | BB(BAB)120-3AA250(※※) | 2.8×2.0 | 6.4×3.5 | | |
| | BB(BAB)120-4AA250(※※) | 8.0×4.0 | 3.9×2.7 | | |
| | BB(BAB)120-10AA250(※※) | 10.0×3.0 | 15.0×5.0 | | |
| | BB(BAB)350-4AA250(※※) | 8.0×4.9 | 4.0×3.7 | | |
| | BB(BAB)350-5AA250(※※) | 9.4×5.7 | 5.0×4.1 | | |
| | BB(BAB)1000-3AA250(※※) | 3.2×3.2 | 7.4×4.5 | | |
| | BB(BAB)2000-4AA250(※※) | 4.0×4.4 | 8.6×6.0 | | |
|  | BB(BAB)120-3BB250(※※) | 2.8×3.3 | 8.5×6.5 | | |
| | BB(BAB)120-4BB250(※※) | 4.0×4.4 | 10.3×7.5 | | |
| | BB(BAB)350-2BB250(※※) | 1.9×2.5 | 6.4×5.5 | | |
| | BB(BAB)350-3BB250(※※) | 3.0×3.4 | 8.8×6.8 | | |
| | BB(BAB)350-4BB250(※※) | 4.0×4.3 | 10.0×7.8 | | |
|  | BB(BAB)350-3HA-C250(※※) | 3.0×3.8 | 9.5×7.8 | | |
|  | BB(BAB)350-4HA-A250(※※) | 4.0×3.6 | 8.8×7.8 | | |
| | BB(BAB)1000-3HA-A250(※※) | 3.0×4.5 | 9.4×6.5 | | |
|  | BB(BAB)250-1HA-W250(※※) | 1.0×1.3 | 3.8×2.8 | | |
| | BB(BAB)300-2HA-W250(※※) | 2.0×1.2 | 4.0×4.0 | | |
| | BB(BAB)350-4HA-D250(※※) | 3.9×2.3 | 8.3×8.3 | | |
|  | BB(BAB)350-4HA-E250(※※) | 3.9×2.3 | 8.3×8.3 | | |
|  | BB(BAB)350-(10)KA250(※※) | Φ8.8 | Φ10.0 | | |
| | BB(BAB)350-(15)KA250(※※) | Φ14.0 | Φ15.0 | | |
| | BB(BAB)350-(20)KA250(※※) | Φ18.6 | Φ20.0 | | |
| | BB(BAB)1000-(10)KA250(※※) | Φ9.0 | Φ10.0 | | |
| | BB(BAB)1000-(20)KA250(※※) | Φ18.6 | Φ20.0 | | |
|  | BB(BAB)1000-6FB250(※※) | 6.0×2.4 | 9.5×6.8 | | |

# Compensation Resistor Designation and Selection

High accuracy transducers not only need to choose high accuracy strain gages but also need to proceed with series compensation and adjustment. R series compensation resistor is a kind of bonded adjustable compensation resistor. It can be used to improve traducers' output sensitivity, sensitivity temperature change, zero output, zero output temperature shifts, etc. technical parameter; furthermore, it has several advantages such as easy bond, convenient adjustment, temperature performance in accordance with the spring element material and high compensation accuracy, etc.

## Designation system for compensation resistors








**How to choose compensation resistors**

During the production of high accuracy transducers, a series of compensation should be done in order to improve the specifications of transducers. Mainly to compensate sensitivity temperature coefficient, sensitivity, zero balance and zero temperature shifts, following is an introduction to each compensation methods and choice of compensation resistors:

(1) Sensitivity temperature compensation (i.e. elastic modulus compensation): usually adopts RNF, RBF series fixed (or combined) compensation resistor. When the transducers environmental temperature changed, the elastic modulus of the spring element and the strain gages' factor will also be changed correspondingly, and the sensitivity of the transducer is changed accordingly that caused the measuring errors. Therefore, high accuracy transducers need to compensate this error. The method is as follows: To connect the compensation resistor in series into the supply excitation circuit, using the characteristic that the resistance will be changed by temperature and the direction is just opposite to the transducer sensitivity changes, to counteract the drift caused by temperature changes, thereby to reach the compensation purpose. The compensation resistance value can be calculated by the formula bellow:

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

$R_m$ refers to the resistance value of compensation resistor, $S_1$、$S_2$ refer to temperature $T_1$ and $T_2$ transducer sensitivity respectively, $R_{in}$ refers to the bridge input resistance when temperature value is $T_1$; $\alpha_c$ refers to the resistance temperature coefficient of the compensation resistor (Resistance temperature coefficient of the RNF series compensation resistor is $5.5\times10^{-3}$/℃, resistance temperature coefficient of the RBF series compensation resistor is $4.3\times10^{-3}$/℃). Sensitivity S=Eo / V( Eo refers to the bridge output voltage, V refers to the supply excitation voltage). Generally, for steel transducers you can choose RNF series 20Ω compensation resistance, for aluminum transducers you can choose RNF series 32Ω compensation resistance. The specific compensation resistance value should be confirmed through the test, and to adjust according to the transducers' accuracy.

(2) Sensitivity compensation: You can adopt RCF series compensation resistor or thinner wires with lower resistance temperature coefficient. Because the spring element material, machining difference and gage factor combine together (≤1% ), transducers sensitivity decentralization would be larger. In order to increase the interchange of transducers, during transducers manufacturing, generally to design the sensitivity a little bit higher than the standard value intentionally, then during machining to adjust it into the standard value according to the test result. The specific method is: To connect the compensation resistor with smaller resistance temperature coefficient into the excitation circuit, to lower down the real excitation voltage of the transducers, so as to decrease transducer's sensitivity. The compensation resistance value can be calculated by the formula bellow:

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

Rc refers to resistance value of the compensation resistor, $S_1$、$S_2$ refers to the real sensitivity before connection and standard sensitivity after adjustment respectively, R refers to input resistance of the bridge.

(3) Zero balance compensation: Usually to connect a RCF compensation resistance or managing varnish wrapped wire with lower resistance temperature coefficient into one of the arms in the bridge, to make the transducer's strain gage bridge output close to zero without load, so as to decrease the

measuring error and easy for zero adjustment of the indicator. Usually we use frictional structure, cutter structure and short connection compensation resistors that can adjust bridge zero neatly and easily. Resistance value of frictional compensation resistor could be adjusted through polishing grids with abrasive; Resistance value of cutter compensation resistor could be adjusted through cutting the connection grid; Resistance value of short connection compensation resistor could be adjusted by short connecting the grids. For instance, (Resistor Ra in Fig.5), suppose that strain gages $R_1$、$R_3$ get compression strain(negative strain), $R_2$、$R_4$ get tensile strain (positive strain). If zero output is positive, a–b terminal resistance should be increased (i.e. increase resistance value by polishing), meanwhile check zero output until output becomes zero. If zero output is negative, then we should increase the resistance value of a–c terminal (i.e. increase the resistance value by polishing), meanwhile check zero output until output becomes zero. We recommend adopting frictional RCF5–AZ04 compensation resistor to adjust zero, fig. 5, Ra is the zero balance compensation resistance.

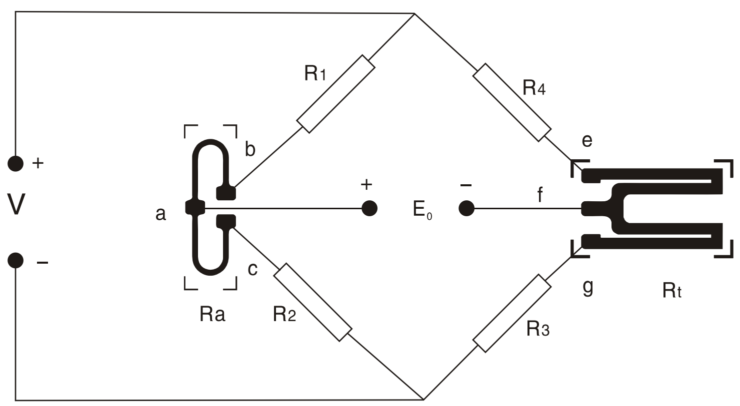



Fig.5 Zero balance compensation

(4) Zero temperature compensation: Usually to decrease the temperature effect on zero output through connecting RNF compensation resistor or varnish wrapped pure copper wire, or varnish wrapped nickel wire with larger resistance temperature coefficient to one of the arms in the bridge. Transducers output is almost zero with no loads, when transducers temperature changes, one side, spring element, bonding adhesive and strain gages will expand or shrink for different extent to cause strain gage resistance changes. Another side, sensitivity grid material resistance temperature coefficient will also cause the strain gage resistance changes. All of these factors will affect transducer's zero output, even to adopt self–temperature compensation strain gages and full bridge connection, due to dispersion of the strain gage temperature performance, the output zero will also be changed more or less, so it needs to be compensated. The specific method is: first to test transducers temperature performance, after you get the rule of the compensation resistance and zero temperature drift, then to adjust the corresponding bridge arm compensation resistance value according to the transducer temperature zero drift value. The compensation resistance value can be calculated by the formula bellow:

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



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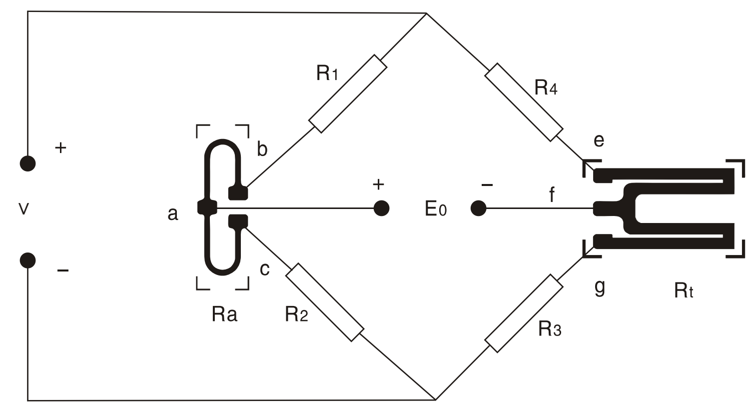
$R_t$ refers to resistance value of compensation resistor; R refers to bridge resistance; $U_{in}$ refers to the excitation voltage; $\alpha_c$ refers to resistance temperature coefficient of the compensation resistor; $U_2$, $U_1$ refer to zero output voltage at temperature $T_2$, $T_1$. The compensation of zero temperature we often use the compensated wire or compensated resistance with the structure of frictional type, cutter type and short connection type.

The theory of zero temperature compensation is similar with the zero balance compensation, but it needs to be accomplished during the simulated temperature field. For example (Resistor $R_t$ in picture 6), suppose gages $R_1$、$R_3$ get compression strain(negative strain), $R_2$、$R_4$ get tensile strain (positive strain). If the zero temperature output is positive (take example of positive temperature, the difference of zero output between positive temperature and normal temperature is called the zero temperature output), so we should increase the resistance in f–g terminal as we calculated. (We can polish it to increase the resistance value), then we can test the temperature zero output and adjust it until the temperature zero output is the same with the start value. If the temperature zero output is negative, we can increase the resistance in e–f terminal (we can polish it to increase the resistance value), then we can test the temperature zero output and adjust it until the temperature zero output is the same with the start value. We recommend the frictional type RNF1–AT02 to adjust the temperature zero output, as shown in picture 10. In the picture, Rt means the compensation resistors of temperature zero.




Picture 6 Zero temperature compensation

## Transducer Wiring Compensation Skeleton Drawing

$R_1 \sim R_4$ ------ Strain gages

$R_t$ ------- Zero temperature compensation resistors

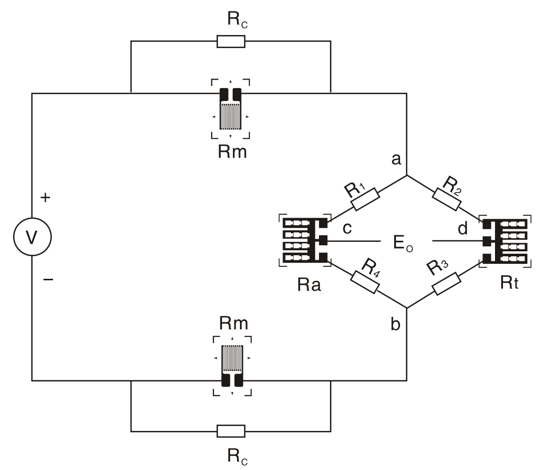
$R_a$ ------- Adjustable resistor for zero output

$R_m$ ------- Sensitivity temperature compensation resistors (or elastic modulus compensation resistors)

$R_l$ ------- Linearity compensation resistors

V ------- Excitation voltage

$E_0$ ------- Bridge output ( or measure output )



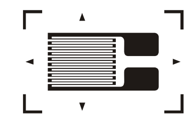
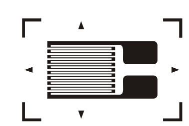

Picture 7 Compensation circuit of transducers

## Compensation Resistor Specification

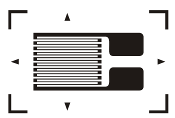
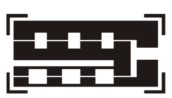
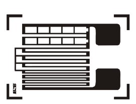
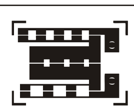
| Specification | RNF series | RBF series | RCF series |
|---|---|---|---|
| Resistance tolerance to average resistance(23 ℃) | ≤ ±0.5% | | |
| Resistance temperature coefficient | $5.5\times10^{-3}$/℃ | $4.3\times10^{-3}$/℃ | |
| Temperature range（℃） | -30～+60 | | |
| Adhesive | H-600,H-610,X-602 | | |
| Wiring | X(may omit)、C、D、F、H、U | | |



## RBF、RNF、RCF series compensation resistor

| Strain gage type | Strain gage model | Nominal resistance（Ω） | | Backing dimension L×W(mm) |
|---|---|---|---|---|
| | | Initial | Adjusted | |
|  | 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 |
| | 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 | 5.0 | | 5.7×4.4 |
| | RNF9-AE05 | 9.0 | | 6.2×3.9 |
| | RNF13-AE45 | 13.0 | | 6.2×4.0 |
| | RNF15-AE16 | 15.0 | | 5.6×3.8 |
| | RNF16-AE57 | 16.0 | | 7.6×4.3 |
| | RNF18-AE06 | 18.0 | | 5.8×3.8 |
| | RNF18-AE73 | 18.0 | | 5.8×3.8 |
| | RNF20-AE07 | 20.0 | | 5.9×3.8 |
| | RNF22-AE07 | 22.0 | | 5.9×3.8 |
| | RNF24-AE66 | 24.0 | | 5.9×3.8 |
| | RNF26-AE08 | 26.0 | | 6.0×3.8 |

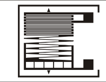
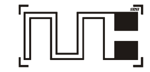
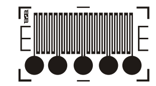
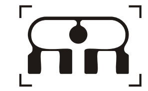
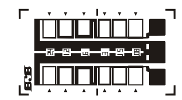
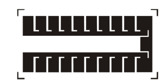
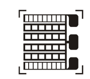
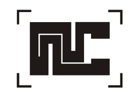
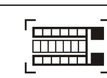
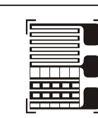
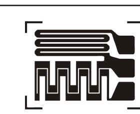
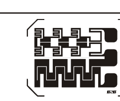
## RBF、RNF、RCF series compensation resistor

| Strain gage type | Strain gage model | Nominal resistance ( Ω ) | | Backing dimension L×W(mm) |
|---|---|---|---|---|
| | | Initial | Adjusted | |
|  | RNF28–AE09 | 28.0 | | 6.1×4.0 |
| | RNF30–AE09 | 30.0 | | 6.1×4.0 |
| | RNF32–AE14 | 32.0 | | 6.8×4.4 |
| | RNF35.5–AE10 | 35.5 | | 6.5×4.2 |
| | RNF40–AE11 | 40.0 | | 6.8×4.0 |
| | RNF42–AE11 | 42.0 | | 6.8×4.0 |
| | RNF50–AE22 | 50.0 | | 7.1×4.2 |
| | RNF54–AE28 | 54.0 | | 7.1×4.4 |
| | RNF55–AE62 | 55.0 | | 7.2×3.0 |
| | RNF60–AE23 | 60.0 | | 7.1×4.6 |
| | RNF64–AE31 | 64.0 | | 7.1×4.6 |
| | RNF65.4–AE25 | 65.4 | | 7.1×4.6 |
| | RNF70–AE25 | 70.0 | | 7.1×4.6 |
| | RNF73–AE25 | 73.0 | | 7.1×4.6 |
| | RNF76–AE13 | 76.0 | | 7.6×4.8 |
| | RNF81–AE13 | 81.0 | | 7.6×4.8 |
| | RNF112–AE59 | 112.0 | | 8.0×8.0 |
| | RNF120–AE61 | 120.0 | | 6.5×3.9 |
| | RNF300–AE64 | 300.0 | | 8.6×5.3 |
|  | 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 |
|  | RNF035–AT03 | 0.65 | | 10.6×5.5 |
|  | RNF1–AT02 | 0.9 | | 8.5×5.4 |
| | RCF2–AZ01 | 2.0 | | |
|  | RNF3–AT03 | 0.9 | | 11.5×5.0 |
| | RCF5–AZ04 | 5.0 | | |
|  | 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 |





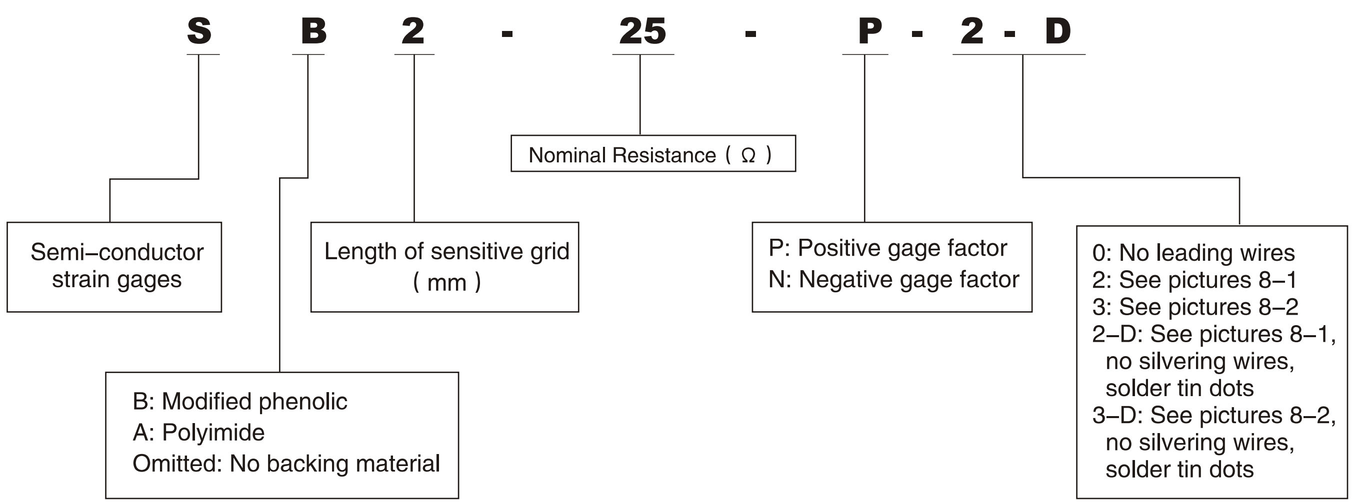
## RBF、RNF、RCF series compensation resistor

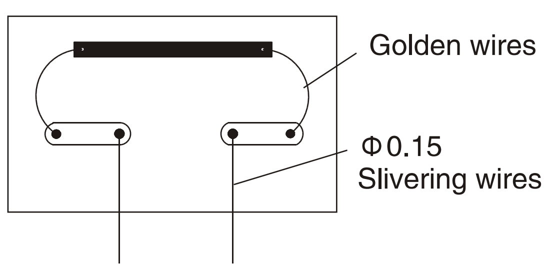
| Strain gage type | Strain gage model | Nominal resistance ( Ω ) | | Backing dimension L×W(mm) |
|---|---|---|---|---|
| | | Initial | Adjusted | |
|  | RNF9–BE37 | 9.5 | 33.0 | 7.9×7.8 |
| | RNF15–BE32 | 15.0 | 25.5 | 8.2×7.3 |
|  | RNF10–CT41 | 13.0 | 2.0 | 6.4×3.2 |
| | RCF70–CS41 | 75.0 | 6.3 | |
|  | RNF20–AE15 | 20.0 | 20.0 | 10.4×6.0 |
|  | RBF4–AT69 | 3.4 | | 10.0×6.5 |
|  | RCF01–BZ62 | 17.5 | 29.0 | 14.3×7.8 |
|  | RCF02–CS46 | 5.3 | 1.0 | 20.0×10.0 |
|  | RCF1–AZ63 | 1.0 | | 4.8×1.6 |
|  | 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–AS55 | 2.6 | | 11.2×5.2 |
|  | RCF2–BS19 | 2.0 | 22.0 | 6.6×3.6 |
| | RNF05–BT20 | 0.3 | 3.3 | |
|  | RCF5–BS56 | 55 | 74 | 9.4×7.8 |
|  | RCF10–BS3 | 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 Gages

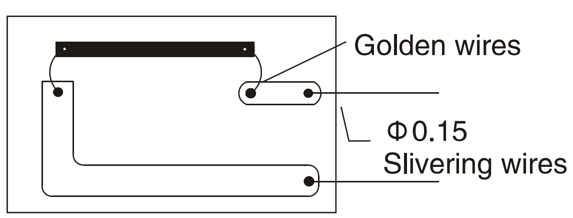
Semi–conductor strain gages adopt silicon, germanium, antimony steel, gallium phosphide and so on for manufacture material, with large sensitivity factor (large than tinsel strain gage and foil strain gages dozen times, therefore have large signal for output); small transverse effect factor; small mechanical hysteresis; small size, easy to use manufacture tiny transducers.

## Designation System for Semi–conductors




Picture 8–1




Picture 8–2

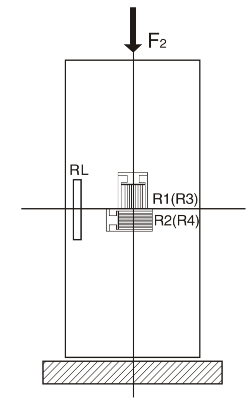
Picture 8 : Pictorial illustration for typical semi–conductor

**Linear Compensation Principle**

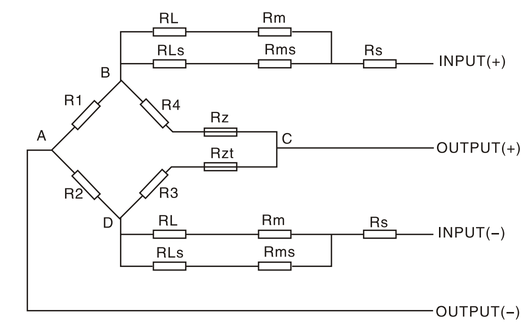
Due to the unbalance of transverse (Poisson Strain) and axial strain of the column or similar structure transducers element, caused the non–linearity error of the bridge output, and because of the non–linearity between load and strain, material non–linearity, transverse load non–linear error, severely affect the accuracy of column and similar structure transducers, therefore we must correct it to meet the requirement of producing high precision transducers.

Non–linear compensation could practice compensation through changing the actual supply voltage of the bridge to compensate transducer linear accuracy. Generally, in the strain area of the column spring element, on the side of strain gage we just bond two pieces of semi–conductor gages symmetrically along with the axle, as for linear compensation resistance RL. Picture 9 shows the bonding area of compensation resistance; connect two pieces of resistance with value of RL/2 symmetrically to the supply bridge. Picture 10 shows the linear compensation bridge and complete bridge circuit.

As we all know, non–linear error for column and similar structure is a digressive parabola. Namely, as the increase of load, output will present digressive trend. After linear compensation, digressive output and increased supply voltage will compensate to each other, therefore the real output will be a straight line.




Picture9 Compensation resistance bonding sketch




Picture10 Linear compensation bridge and complete bridge circuit sketch

## Semi–conductor strain gauges

| Model | Backing dimension ( mm ) | Grid dimension (mm) | Resistance value ( Ω ) | Sensitive coefficient K | Resistance temperature coefficient ( 1/℃ ) | Sensitive temperature coefficient ( 1/℃ ) | Ultimate working temperature ( ℃ ) | Ultimate working current ( mA ) | Ultimate strain ( μ ε ) |
|---|---|---|---|---|---|---|---|---|---|
| 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 adopt imported copper foil, with polyimide or glass fiber reinforced epoxy colophony backing. It has better electronic performance and bigger flexibility that is easy for installation. Before soldering, polishing is required to erase the protective film. It is the same way as strain gages installation.

***DTA Series***

Polyimide backing and pure copper foil making it has good flexibility, insulation and humidity and heat resistance, high security and reliability. It can be used in relatively curviness conditions.

***DTB Series***

Glass fiber reinforced epoxy backing and pure copper foil, with high intensity and good bonding performance.

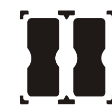
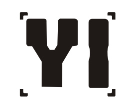
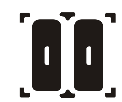
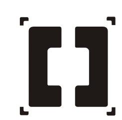
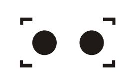
***DHA Series***

Adopt special polyimide backing and pure copper foil, with good heat resistance. It can use in mid–temperature environment.





## Terminal Tabs

| Strain gage type | Strain gage model | Grid size length(L)×width(W)(mm) | Backing dimension L×W(mm) |
|---|---|---|---|
|  | DTA(DTB、DHA)0–G1 | 2.2×0.5 | 4.5×3.2 |
| | DTA(DTB、DHA)1–G1 | 3.0×1.2 | 4.0×4.2 |
| | DTA(DTB、DHA)2–G1 | 3.2×1.2 | 5.0×4.0 |
| | DTA(DTB、DHA)3–G1 | 5.0×2.0 | 6.0×6.0 |
| | DTA(DTB、DHA)6–G1 | 6.4×2.6 | 8.0×8.0 |
| | DTA(DTB、DHA)10–G1 | 10.0×4.0 | 12.0×12.0 |
|  | DTA(DTB、DHA)3–G2 | 5.0×1.4 | 7.0×6.0 |
| | DTA(DTB、DHA)4–G2 | 4.0×1.5 | 7.5×4.4 |
| | DTA(DTB、DHA)5–G2 | 5.0×1.0 | 6.0×5.0 |
| | DTA(DTB、DHA)6–G2 | 7.0×1.6 | 8.0×8.0 |
| | DTA(DTB、DHA)7–G2 | 7.0×1.5 | 9.6×8.0 |
| | DTA(DTB、DHA)10–G2 | 9.7×3.0 | 13.0×12.0 |
|  | DTA(DTB、DHA)3–G3 | 5.0×2.0 | 6.0×6.0 |
| | DTA(DTB、DHA)6–G3 | 6.4×2.6 | 8.0×8.0 |
| | DTA(DTB、DHA)10–G3 | 10.0×3.0 | 12.0×12.0 |
|  | DTA(DTB、DHA)3–G4 | 5.0×1.4 | 7.0×6.0 |
| | DTA(DTB、DHA)6–G4 | 6.5×1.6 | 8.0×8.0 |
| | DTA(DTB、DHA)10–G4 | 10.0×4.0 | 12.0×14.0 |
|  | DTA(DTB、DHA)3–G5 | 5.0×2.0 | 6.0×6.0 |
| | DTA(DTB、DHA)6–G5 | 6.0×2.5 | 8.0×8.0 |
| | DTA(DTB、DHA)10–G5 | 10.0×3.0 | 10.0×12.0 |
|  | DTA(DTB、DHA)3–G6 | Φ1.0 | 5.0×3.0 |
| | DTA(DTB、DHA)6–G6 | Φ2.0 | 8.0×4.0 |
| | DTA(DTB、DHA)10–G6 | Φ4.0 | 12.0×6.0 |

**Note:**

In the above list, DTA (DTB and DHA) 6–G6 represents 3 models, DTA6–G6, DTB6–G6 and DHA6–G6. Please specify the appropriate models on your purchase order.

# High Precision Transducers Gage Bonding Adhesive

ZEMIC provides high quality gage bonding adhesive for load cells manufactures, offering load cells gage binding. At present, ZEMIC mainly provides two common gage bonding adhesive: H-610, H-600. The following is several common gage bonding adhesive and protection adhesive instructions.

## Application for H-610Adhesive

1. Characteristic and Application

H-610 is twin-pack high-performance Epoxy Resin adhesive which is America SEAN company SR-610 patent of introduction, with the advantages of small creep, low hysteresis, good repeatability, wide operation temperature, low viscosity and wide working temperature range, additionally along with the characteristic of no-needing back coating, short term for gage bonding procedure and easy to use.

Operation temperature range: long-term -269℃ ~ +260℃

Short term: -269℃~+370℃

H-610 is suitable for all series of strain gages and compensation resistors gages bonding especially recommending for high precision transducers except for 250℃ medium temperature strain gages, TJ underwater strain gage series and TA strain gage series for great strain analysis.

2. Dispose and Storage

ZEMIC H-610 is composed of A and B components. Ensure to take out of A and B sets from refrigerator before using 1-2 hours; next mix them by pouring part B into part A according to A: B=1: 2 after making a balance between adhesive liquid temperature and external temperature; then screw down cap, sway for 2-5 minutes to mix A and B sets completely and set aside for 1 hour then it can be used directly at the moment of light yellow liquid or yellowish orange. There is 6 months storage life for individual set A and Individual set B under the degree of 24℃; 12 months storage life under the degree of 2℃-6℃. After mixing, enclosed adhesive can be kept for 7-10days in the normal temperature and 1 month in 2℃-6℃.

3. Methods of Application

(1)Test-piece side should be sand blasted or polished and cleaned well with acetone and butanone.

(2)Use anhydrous ethyl alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one lay thin H-610 in the position of test-piece gage bonding, keep air for 2-5 minutes but if the temperature is lower airing time should be reduced or cancelled and bond strain gages after coating.

(4) Gage bonding in the correct position, cover teflon film then squeeze out bubble or spare adhesive along with strain gages axle.

(5) Cover silicon rubber sheet and metal platen in time, inflate 0.1-0.3MPa and keep constant then put oven for welding.

(6) Heat up to 135℃ from room temperature at the speed of 2℃/minute, keep warm for 2 hours, release press after cooling to room temperature in the oven, then once again heat up to 165℃ at the same speed, keep warm for 2 hours then wait until the oven is cooling to room temperature.

(7) H-610 is suitable for the environment where the relative humidity is less than 65%.



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4. Cautions

(1) Take out of H-610 from refrigerator at least 2 hours before using and try to use it after keeping balance between adhesive liquid temperature and external temperature.

(2) When disposing adhesive, B set should be poured into A set completely (if not complete pouring it will cause disproportional mixture and influence adherence force), and make these two sets mix completely to guarantee adhesive homogeneous.

(3) During usage period, adhesive bottle should be far away from heat source (e.g. light) to avoid solvent volatilizing fast in the higher temperature.

(4) Screw bottle cap in time after using to avoid solvent volatilizing and curing agent separating out, otherwise it will cause fine particle in the adhesive and influent future application.

(5) Clean up coating tools after using to avoid outside impurity going into the bottle and polluting adhesive.

(6) When one bottle of adhesive is used up, the adhesive will become thicker; or there will be fine particle due to dust from air; Under these two condition the adhesive can't be suitable for gage bonding for key strain gages but it can be used for compensation resistors or terminals which has no very high quality requirement for gage bonding.

## Application for H-600 Adhesive

1. Characteristic and Application

H-600 is twin-pack high-performance Epoxy Resin adhesive that is used for replacement of H-610. H-600 has the advantage of small creep, low hysteresis, good repeatability, wide operation temperature, low viscosity and wide working temperature range, additionally along with the characteristic of no-needing back coating, short term for gage bonding procedure and easy to use.

Operation temperature range: long-term -269℃ ~ +260℃ Short term: -269℃ ~ +370℃

H-600 is suitable for all series strain gages and compensation resistors gage bonding, specially recommended for high precision transducers except for TJ underwater strain gage series and TA strain gage series for great strain analysis.

2. Dispose and Storage

ZEMIC H-600 is composed of A and B sets. Ensure to take out of A and B sets from refrigerator before using 1-2 hours; next mix them by pouring B set into A set according to A: B=1: 2 after making a balance between adhesive liquid temperature and external temperature; then screw down cap, sway for 2-5 minutes to mix A and B sets completely and set aside for 1 hour then it can be used directly at the moment of light yellow liquid or yellowish orange. There is 6 months storage life for individual set A and Individual set B under the degree of 24℃; 12 months storage life under the degree of 2℃-6℃. After mixing, enclosed adhesive can be kept for 7-10 days in the normal temperature and 1 month in 2℃-6℃.

3. Methods of Application

(1)Test-piece side should be sand blasted or polished and cleaned well with acetone and butanone.

(2)Use anhydrous ethyl alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one thin lay H-600 in the position of test-piece gage bonding, then gage bonding immediately and the time shouldn't exceed 2 minutes.

(4) Gage bonding in the correct position, cover Teflon film then squeeze out air bubbles or spare adhesive along with strain gages axle.

(5) Cover silicon rubber sheet and metal platen in time, inflate 0.1–0.3MPa and keep constant then put oven for welding.

(6) Welding procedure:

Application within 150℃ strain gages series: Heat up to 135℃ from room temperature at the speed of 2℃/minute, keep warm for 2 hours, release press after cooling to room temperature in the oven, then once again heat up to 165℃ at the same speed, keep warm for 2 hours then wait until the oven is cooling to room temperature.

Application within 250℃ strain gages series: Heat up to 150℃ from room temperature at the speed of 2℃/minute, keep warm for 2 hours, release press after cooling to room temperature in the oven, then once again heat up to 175℃ at the same speed, keep warm for 2 hours then wait until the oven is cooling to room temperature

(7) H–600 is suitable for the environment where the relative humidity is less than 65% and if temperature is lower (below40%) gage bonding should be made immediately.

4. Caution

(1) Take out of H–600 from refrigerator at least 2 hours before using and try to use it after keeping balance between adhesive liquid temperature and external temperature.

(2) When disposing adhesive, B set should be poured into A set completely (if not compete pouring it will cause disproportional mixture and influence adherence force), and make these two sets mix completely to guarantee adhesive homogeneous.

(3) In the process of using, adhesive bottle should be far away from heat source (e.g. lights) to avoid solvent volatilizing fast in the higher temperature.

(4) Screw down cap in time after using to avoid solvent volatilizing and curing agent separating out, which will cause fine particle in the adhesive that will influence future application.

(5) Clean up coating tools after using to avoid outside impurity going into the bottle and polluting adhesive.

(6) When one bottle of adhesive is used up, the adhesive will become thicker; or there will be fine particle due to dust from air. Under these two conditions the adhesive can’t be suitable for gage bonding for key strain gages but it can be used for compensation resistors or terminals which have no higher quality requirement for gage bonding.



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**Application for A–713 Adhesive**

1.Characteristic and Application

A–713 is a kind of high temperature adhesive, adopts Aromatic Short chain Imides through multivariate copolymerization, and mixed with modified phenolic resin. Low coefficient of linear expansion, wide range of applying temperature, high strain limit, low creep and hysteresis, and stable performance make it suitable for manufacturing and gage bonding for medium temperature strain gages and strain gages for great strain analysis.

Temperature Range: –60℃ ~+150℃

A–713 is suitable for BA medium temperature strain gage series and TA medium temperature strain gage series for great strain analysis, with max. strain value of 20%.

2. Dispose and Storage

A–713 is offered in one–component. Before using, shake the bottle for 2–3 minutes until there is no bubble. A–713 can be stored in low temperature, to avoid occurring degradation under high temperature and influencing the performance. Tighten the bottle cap to avoid humidity and 12 months storage for A–713 in 2℃–6℃.

3. Methods of Application

(1) Test–piece side should be sand blasted or polished and cleaned well with acetone and butanone.

(2) Use anhydrous ethyl alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one thin lay A–713 in the position of test–piece gage bonding; bake for 30 minutes in a distance of 30mm to bonding areas with infrared lamp or filament lamp.

(4) Coat one thin lay A–713, put the correct position then cover Teflon film and squeeze out air bubbles or spare adhesive along with strain gages axle.

(5) Cover silicon rubber sheet and metal platen in time, inflate 0.1–0.3MPa and keep constant then put oven for curing.

(6) Heat up to 120℃ from room temperature at the speed of 2℃/minute, keep warm for 1 hour then once again heat up to 180℃ at the same speed, keep warm for 3 hours then wait until the oven is cooling to room temperature.

(7) A–713 is suitable for the environment where the relative humidity is less than 65%.

4. Cautions

(1) Shake whole bottle 2–3 minutes before using until there is no bubble.

(2) In the process of using, adhesive bottle should be far away from heat source (e.g. lamps) to avoid solvent volatilizing fast under higher temperature.

(3) Screw down cap in time after using in order to avoid solvent volatilizing and influence coating quality.

(4) Clean up coating tools after using in order to avoid outside impurity going into the bottle and polluting adhesive.

(5) Due to degradation A–713 will become thinner if long time storage.

## Application for F-601 Adhesive

1. Characteristic and Application

F-601 is a kind of high temperature adhesive which is made by phenolic resin and epoxy resin copolymerization and adding filler. Better sealing and bonding ability, small creep, high insulation, excellent performance under low-high temperature, good stability and wide operation temperature range make it suitable for middle-high temperature strain gages bonding. Besides it can be used on structure adhesive in sealing for metal, ceramics and glass especially F-601 has strong sealing and bonding ability for ceramics.

Temperature Range: -60℃ ~+250℃

F-601 is suitable for BA 150℃ system, BB 250℃ series, BAB 250℃ series and other middle-high temperature strain gages.

2. Dispose and Storage

F-601 is offered in one-component with the color of orange. Because F-601 has solid filler it must be stirred even. If F-601 density is stronger butanone can be added. Tighten bottle cap to avoid solvent volatilize to gel. F-601 has 8 months storage in the degree of10℃.

3. Methods of Application

(1)Test-piece side should be sand blasted or polished and cleaned well with acetone and butanone.

(2)Use anhydrous ethyl alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one thin layer F-601, air-dry for 20 minutes, recoat one layer backing adhesive, air-dry for 4 hours then put it in oven. Heat up to 60℃ from room temperature at the speed of 2℃/minute,keep warm for 1 hour then once again heat up to 150℃ at the same speed, keep warm for 1 hour then wait until the oven is cooling to 80℃.

(4)Take out of test piece at 80℃, coat one layer F-601, and wait until half-dry. Put the correct position then cover Teflon film and squeeze out bubble or spare adhesive along with strain gages axle.

(5) Cover silicon rubber sheet and metal platen in time, inflate 0.1-0.3MPa and keep constant then put oven for welding.

(6) Application within 150℃ strain gages systems: Heat up to 100℃ from room temperature at the speed of 2℃/minute, keep warm for 1 hour then once again heat up to 150℃ at the same speed, keep warm for 3 hours and release when the oven is cooling down to room temperature. Then heat up to 170℃ at the same speed, keep warm for 2 hours and wait until oven is cooling down to room temperature.

(7) Application within 250℃ strain gages systems: Heat up to 100℃ from room temperature at the speed of 2℃/minute, keep warm for 1 hour, release press after cooling to room temperature in the oven, next once again heat up to 150℃ at the same speed, keep warm for 2 hours then heat up to 250℃ at the same speed, keep warm for 4 hours and wait until oven is cooling down to room temperature.

(8）F-601 is suitable for the environment where the relative humidity is less than 65%.

4. Cautions

(1) Take out of F-601 from refrigerator at least 2 hours before using and try to use it after keeping balance between adhesive liquid temperature and external temperature.

(2) Ensure the adhesive is homogeneous; otherwise it might influence the bondability of adhesive.

(3) Tighten bottle caps for avoiding volatilization which might cause extra thickness and influence bonding quality.

(4) Clean up coating tools after using in order to avoid outside impurity going into the bottle and polluting adhesive.





## Application for H-611 Adhesive

1. Characteristic and Application

H-611 is a kind of normal temperature curing adhesive which is made of new glycidol epoxy resin, bisphenol A epoxy resin, low polysulfide rubber and modified amine curing agent, with excellent bondability, double components, no solvent, cured under room temperature, lower creep and good insulation.

Temperature Range: -3℃ ~+6℃

H-611 is suitable for most strain gages bonding especially for bonding of compensation resistors and terminals together with stress analysis for normal temperature and normal pressure. It has special significance for bonding of inconvenient or difficult in thermosetting and complicated test-piece.

2. Dispose and Storage

H-611 is offered by A and B sets. Mix them by pouring B set into A set according to A: B= 1: 2 by stirring of toothpick or thin glass rod then it can be used directly but H-611 should be used up within 1 hour. H-611 individual set A or B can be kept for 10 months in room temperature.

3. Methods of Application

(1) Bonding surface should be sand blasted or polished and cleaned well with acetone and butanone.

(2) Use absolute alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one thin layer H-611 on test-piece after heating up to4℃- 6℃ (if no heating for backing the test-piece is in low temperature; the viscidity is thick and difficult for bonding, also curing time will de extended).

(4) Coat one layer H-611 corresponding to the correct position then cover Teflon film and squeeze out bubble or spare adhesive along with strain gages axle.

(5) Test-piece can be tested after 24 hours curing in room temperature or 2 hours curing in 6℃-8℃.

(6）H-611 is suitable for the environment where the relative humidity is less than 65%.

4. Cautions

(1) Take out of H-611 from refrigerator at least 2 hours before using and try to use it after keeping balance between adhesive liquid temperature and external temperature.

(2) When disposing adhesive, B set should be poured into A set completely (if not complete pouring it will cause disproportional mixture and influence adherence force), and make these two sets mix completely to guarantee adhesive homogeneous.

(3) Due to short using term of amine curing agent, it is better to use up the entire mixed adhesive within 1 hour.

(4) During usage period, adhesive bottle should be far away from heat source (e.g. light) to avoid solvent volatilizing fast in the higher temperature.

(5) Bonding tools should be cleaned after usage, for avoiding unnecessary invade of outer substances into adhesive.

### Application for AZ-709 Adhesive

1. Characteristic and Application

AZ-709 is a kind of polyurethanes adhesive, providing good performance for waterproof, anti humidity, anti fungus, and high insulation performance with automatic curing in room temperature.

Temperature Range: -30℃ ~+60℃

AZ-709 is suitable for TJ underwater strain gage series, also suitable for other gages and load cells protection.

2. Dispose and Storage

AZ-709 is offered in I and II components. Customers can dispose them before 2-3 hours. For underwater strain gages the proportion of I: II should be 45:55; for protection it is 48:52. When disposing, firstly, I set should be poured into an empty bottle; secondly, pour II set into I set; thirdly, screw down the cap and shake 2 minutes until two components mix completely; finally, wait for 1 hour and until there is no transparent bubbles or with light-yellow. Individual I or II set can be kept for 12 months under the temperature of 24℃; disposed AZ-709 can be kept for 4-8 hours under the temperature of 24℃; if 2℃-6℃ it will be 2-4 days.

3. Methods of Application(1) Bonding surface should be sand blasted or polished and cleaned well with acetone and butanone.

(2) Use absolute alcohol to clean tools, Teflon film and strain gages which will be bonded.

(3) Coat one thin layer AZ-709 and air-dry for 20 minutes.

(4) Coat one layer AZ-709 corresponding to the correct position then cover Teflon film and squeeze out bubble or spare adhesive along with strain gages axle.

(5) Make air-dry for 4-5 hours, over silicon rubber sheet and metal platen in time, inflate 0.1-0.3MPa and keep constant then put oven for curing.

(6) After 24 hours curing put it in the oven and heat up to 80℃ from room temperature at the speed of 2℃/minute, keep warm for 4 hours then once again heat up to 120℃ at the same speed, keep warm for 2 hours and release when the oven is cooling down to room temperature.

(7) If used for gage or load cells protection, first use solvent to clean protecting areas; coat AZ-709 and with an area larger than protection area, and 24 hours curing in room temperature will be fine.

4. Cautions

(1) Take out of AZ-709 from refrigerator at least 2 hours before using and try to use it after keeping balance between adhesive liquid temperature and external temperature.

(2) When disposing adhesive, I and II sets should be poured into clean bottle completely (if not complete pouring it will cause disproportional mixture and influence adherence force), and make these two sets mix completely to guarantee adhesive homogeneous.

(3) In the process of using, adhesive bottle should be far away from heat source (e.g. lamps) to avoid solvent volatilizing in higher temperature.

(4) Tightening bottle cap in time after using in order to avoid solvent volatilizing and influence coating quality.

(5) Clean up coating tools after using in order to avoid outside substances going into the bottle and polluting adhesive.





### Application for G-D04 Adhesive

1.Key features and application

G-D04 is a kind of room temperature vulcanized silicone rubber products, dealcoholized, one-component and cured under moisture circumstance. High insulation resistors, wide bond area, neutral characteristics, anti corrosion, and transparent make it suitable for applying on electronic components as protection layer, using as castables in electronic components, and also adhesives in other fields. G-D04 has good bondablity for glass, metal, ceramics, and other resin enforced products, mainly used as adhesive and sealing compound.

Temperature Range: -70℃ ~+200℃

G-D04 room temperature vulcanized silicone rubber products are suitable for protection of all the strain gages and compensating resistors, especially for anti-heat and anti-humidity of high precision load cell manufacturing.

2.Dispose and Storage

G-D04 silicon rubber offered in one-component. After operating please tightening bottle cap and sealed storing. Removing crust of the sealing area when using for next time, this is immunizing to the performance of adhesive. In storage often curing on the nozzle also can be found, removing the cured parts and this is also immunizing to adhesive performance. Under room temperature the storage range covers 12 month.

3.Application

(1) Thoroughly clean bonding materials, remove rusty stain, dust and oil.

(2) Open rubber bottle, squeezer enough adhesive onto bonding surface homogeneously, folding on the bonding surface and fix it.

(3) Place bonded components under room temperature and cured. Curing process starts from surface and later gets into inner parts. Within 24 hours the adhesive would cure at some degree (Room temperature should higher than 5℃). If the bonding area is too deep and hard to contact with air, the curing process would take a much longer time. Also if the temperature is too low, a longer curing time is required.

(4) Before next procedure or packaging of bonding components, a longer time for firmed curing and solid is recommended.

(5) Sufficient curing takes 144 hours.

(6)The longer time placing in room temperature, the better bonding performance.

4.Caution

(1) G-D04 curing based on hydrosphere in room temperature. Thus after operating please tightening bottle immediately and sealing stored.

(2) Removing crust of the sealing area when using for next time, this is immunizing to the performance of adhesive.

(3) During operating, if intervals are too often and takes longer time, please tightening bottle immediately after each step.

(4) In storage often curing on the nozzle also can be found, removing the cured parts and this is also immunizing to adhesive performance.

## Application for G-704 Adhesive

1.Key features and application

G-704 is a kind of white liquid adhesive, room temperature vulcanized silicone rubber products, providing good bonding performance, high intensity and solvent-free. High insulation, better sealing and bonding ability, anti corrosion, good aging resistant features, and excellent performance under low-high temperature make it suitable for applying on metal, non-metal, plastics, and other rubber products, mainly used as perfect material in protecting and sealing for strain gages and load cells.

Temperature Range: -50℃ ~ +250℃

G-704 silicone rubber products are suitable for protection of all the strain gages and compensating resistors, especially for anti-heat and anti-humidity of high precision load cell manufacturing.

2.Dispose and Storage

G-704 silicon rubber offered in one-component. After operating please tightening bottle cap and sealed storing. Removing crust of the sealing area when using for next time, this is immunizing to the performance of adhesive. In storage often curing on the nozzle also can be found, removing the cured parts and this is also immunizing to adhesive performance. Under room temperature the storage range covers 12 months.

3.Application

(1) Thoroughly clean bonding materials, remove rusty stain, dust and oil.

(2) Open rubber bottle, squeezer enough adhesive onto bonding surface homogeneously, folding on the bonding surface and fix it.

(3) Place bonded components under room temperature and cured. Curing process starts from surface and later gets into inner parts. Within 24 hours the adhesive would cure at 2-4mm (Room temperature and relative humidity should be 55%). If the bonding area is too deep and hard to contact with air, the curing process would take a much longer time. Also if the temperature is too low, a longer curing time is required.

(4) Before next procedure or packaging of bonding components, a longer time for firmed curing and solid is recommended.

(5) The longer time placing in room temperature, the better bonding performance.

(6) For anti-humidity components, curing could be done in the oven with temperature 50℃ - 150℃, 4-12 hours would have better performance.

4.Caution

(1) G-704 curing based on hydrosphere in room temperature. Thus after operating please tightening bottle immediately and sealing stored.

(2) Removing crust of the sealing area when using for next time, this is immunizing to the performance of adhesive.

(3) During operating, if intervals are too often and takes longer time, please tightening bottle immediately after each step.

(4) In storage often curing on the nozzle also can be found, removing the cured parts and this is also immunizing to adhesive performance.



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## Bonding and Protection of Strain Gages

For gauges installation, the most common method is bonding. The quality of the gage bonding is one of the key factors to decide the strain test success or not. Therefore, when bonding the gages, we should strictly follow with the bonding procedures and processing techniques.

1. Procedures of Bonding and Protection of Strain Gages：

(1) Selecting gages (2) Selecting bonding adhesive (3) Sanding elements (4) Surface cleaning (5) Lining and locating (6) Gages cleaning (7) Painting adhesive (8) Gages bonding (9) Heat curing (10) Checking the quality after curing (11) Soldering lead wire (12) Quality checking (13) Compensating normal temperature performance and temperature performance (14) Quality checking (15) Testing performance (16) Protection.

2. Bonding Workmanship for Gages

Choosing of strain gages are based on usage, major technical parameters and optional table. For load cells in 0.02 and 0.03 accurate class, choosing BF, BB or ZF series strain gages. For load cells in 0.05 accurate class, choosing BE or BA series strain gages. For stress analysis, choosing of strain gages are based on testing conditions and accuracy requirements. After machining the elements or testing beam should undertake stabilizing treatment, to release the residual stress or inside stress and make the performance become more stable. Using different adhesives, there is different workmanship. In addition, we only introduce some common contents.

2.1 Gages choosing

Gages choosing includes two steps, gage checking and surface treatment.

(1) Gages checking, including surface checking and resistance checking

Surface checking is mainly to check if the backing and the encapsulation film are damaged, or any rust on the grid, or the lead wire is broken, or the grid arrangement is in order, or there is any short circuit, gap, broken grid, deformed and so on, or any air bubble, furrow or hole on the backing. The resistance measuring should be accurate to 0.1Ω。

(2) Surface treatment

Before using gages, we should clean it by absorbent cotton with absolute alcohol. Please pay more attention that we should clean the both sides. For the open-faced gages, we should clean it follow the grid direction. After cleaning, we should dry it by infrared light or other dryer.

2.2 Selecting bonding adhesives

Selecting of bonding adhesives should base on the introduction of adhesives. For load cells we strongly recommend H-610 or H-600.

2.3 Sanding the elements.

In order to bond the gages hard, we should do mechanical or chemical treatment on the bonding area (surface). It is about 3~5 times larger than the gages. First, we should clean dirt, rust, oxidation film and plating coat, etc. According to different materials of tested object, we should choose sand papers with grid 220~400# to polish the bonding areas (surface). Polish the cross stripe that form an angle of 45° with the bonding direction.

2.4 Surface cleaning

Clean the polished area by absorbent cotton with acet, absolute ethyl alcohol, trichloroethane, Isopropyl Alcohol or other organic solvent. Then clean the surface with acetone or methyl ethyl ketone, till there is no any dirt on the absorbent cotton. When clean gage surface should always follow one direction, please don’t clean in alternating directions. The cleaned surface should not be polluted again, for instance, mouth blowing or hand touching. When the surface is dry, please bond the gages immediately.

2.5 Lining and locating

In order to ensure the exact gage bonding position, please use ball pen without oil or pin to slightly mark the locating lines.

2.6 Gage cleaning

Get strain gages and put onto the Teflon film, clean two sides of strain gages with absolute alcohol and put the bonding side upper to make it well dried for bonding.

2.7 Painting adhesive

Most bonding adhesives required painting the bottom adhesive, and it should be proper heat cured. The area of the bottom adhesive should be 1.5 times larger than the gages. For the bottom adhesive we often use the same adhesive as for the gages bonding, the thickness should be controlled between 0.01~0.03mm. Moreover, it should be fully cured with the curing parameter. Only when it fulfills bonding and insulation requirement, the thinner the adhesive film (including the bottom adhesive) is, the better the performance could be. Thus can maintain the stronger transferring strain ability, reduce the unevenly of the adhesive film, debase the dispersion of gage factor and creep. Some of the adhesive do not need bottom adhesive such as H-600, H-610 and H-611, etc. Those adhesive have strong stickiness, high insulation, small creep and suitable to produce the transducers and high accuracy stress analysis.

2.8 Bonding gages

Gages bonding is the most important step during the whole process, and absolutely affect the measuring accuracy. Before bonding, clean the required instruments with acetone, for example, tweezers, knife, brush, etc. Wearing the clean spun yarn gloves, using brush to paint the adhesive on the surface of the element, and wait until the adhesive begin to stick, put the gages to the position that have marked. Cover the Teflon film and press with fingers following with the axes direction 1 ~ 2 times to extrude air bubbles and extra adhesive, then discover the film to adjust gage position. Note: For gages with lead wires, the film should be discovered from the gage end without lead wire. The discovering direction should be parallel with the bonding surface to avoid leading the gages up, to avoid extra movements of gages. After bonding and cured, we should check gages carefully. If there is backing damaged, grid deformation, open circuit, short circuit, the bonding position is correct, there are some air bubbles, not bonding it completely, the insulation is not enough, etc. We should remove this in time or move it away and bonding again.

2.9 Heat curing

At present, the most adhesives used that need to be heat cured. Temperature, time and pressure are the main three basic factors for curing. We should assure these three basic factors strictly follow the requirement of cure. Press gages, we often put the Teflon film, silicon rubber, and then use fixture plate. For some complicated parts, we can use special fixture to press gages. Sandbag and enlace are also be adopted. In order to dispel the inner stress effectively, generally after taking out the pressure, increase the temperature up about 30℃ than the temperature during press curing. And keep the temperature 1 ~ 2 hours for stability treatment. As for detailed curing parameter, we can consult Adhesive Manual. For instance, H-610, the bonding technology is: at the beginning, put the pressure of 0.1 ~ 0.3MPa, then increase the temperature up to 135℃ and keep for 2 hours. Then we can decrease to room temperature, take out pressure and increase temperature up to 165℃and keep for 2 hours, finally decrease to room temperature.



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2.10 Checking the quality after curing

After cured, we should check the quality of the bonding gages carefully. We should check: the resistance changes after gage cured; insulation resistance; any residual air bubbles under the gage backing; the bonding position is correct or not; and if there is any short circuit, open circuit or deformation of the grids.

2.11 Soldering lead wire

When wiring on surface of the gages solder terminal, we should slightly wipe the residual adhesive or oxide by using fine sand paper or sand eraser before wiring, and clean it for easy wiring and avoid damaging solder terminal. The soldering temperature can not be too high(for normal temperature gages, the temperature will not be higher than 250℃). The time for soldering cannot be too long, and we should solder quickly to avoid high temperature damaging solder terminal and reducing insulation intension. We should adopt soft wires to avoid it is damaged or broken off when it is getting force for a long time. We should leave enough stress release loop between solder terminal and connection tab to avoid forming inner stress collection on connection wires when tested object or spring element is getting force for long time, environmental temperature changes in a large range. Thus, wires will be broken by force, to cause bridge open or circuit broken. After soldering, we should clean out fluxes without residual to avoid affecting insulation intension or resistance of strain gages. Finally measure the insulation intension again.

2.12 Quality checking

Inspect the strain gauges after wiring; mainly check the residue of soldering tin and flux on the strain gauge surface, the wire tie, and the rosin joint.

2.13 Testing performance

(1) Test load capability

The transducers installation is correct， not loose, load point is correct， not removed, and equipment is loading automatically, measuring equipment adopt automatic scanning form, reduce effect made by hand, good wire connection， without bad connection and empty soldering.

(2) Temperature Capability

Test The temperature instrument in simulated environment required high accuracy and fulfilled test requirement of transducers, without temperature grads and instant change. Choose heat preservation time according to the size of transducers; keep inner temperature equal and invariable of the tested transducer to achieve the required temperature value. Avoid producing temperature grads in spring element. Humid-heat test require temperature and humidity of the surrounding environment achieved the requirement.

(3) Environment requirement

The room environment must achieve the requirement of national standard to reduce the effect for transducers caused by environment.

2.14 Protection

Adopt credible and practical protection to ensure gages working naturally and enhance test accuracy. The essential approach to protect strain gages is to use some materials or medium to divide strain gages and its accessories from abominable environment. During installation and application, first we should operate cautiously and carefully. Please don't use hand to touch directly; secondly, to protect by encapsulation coat. The adhesive used for protection you can choose AZ-709, to protect bare parts, it need to be painted evenly, and then coat silicon adhesive such as G-704 or G-D04.

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**Problems and countermeasures for Strain Gages**

1. Zero Drift

As we know that in strain gages application, the most difficult controlled problem is zero drift that is occurred frequently. In addition, zero drift is affected by many factors, now we will analysis them in detail.

(1) Effect of insulation resistance

Insulation resistance is an important specification of gages. Zero drift is the direct representation of its value. Insulation resistance refers to the resistance that between gages grid and tested objects or elements. If the insulation is decreased, leaking current will occur between grids and elements or tested objects. Thus, it will affect zero stability of gages. This is called zero drift. Why this is caused and how to solve is the matter that we are concerned.

a. If gages after soldering are not cleaned, or not cleared absolutely, this will cause decrease of the insulation intension. The problem is that we use flux for soldering. Moreover, flux is a kind of active material that is good for combination of soldering tin and solder terminal. However, it also is a kind of ion object if it is not cleaned, or not cleared absolutely, the positive ion will move that cause insulation intension decrease.

b. When soldering, if the head of soldering iron is leaking or temperature is too high or soldering time is too long that will cause gages backing is penetrated, then insulation intension will decrease. As to this problem, when we use soldering iron we must check it to assure insulation intension of soldering iron head to avoid penetrate gages or damage human body; soldering temperature can not be higher than 250℃; soldering for short time or many times to avoid backing is penetrated.

c. If gages are moist, it will cause insulation intension decreased. The main reason is protection is not good or environmental humidity is too large during application of gages. This drift is similar with item a. Therefore, when using gages we should control humidity within 60%. On gages application, we should protect gages to avoid moist coming into gages, to affect the stability.

d. As for penetrated gages, that causes insulation intension decrease. This phenomenon is mainly occurred during gages bonding or connection process. For example, if we use hard objects to hold gages or surface of tested objects and spring elements have bur, nick and so on, or soldering iron head is too sharp, which will penetrate gages.

(2) Effect that caused during gages bonding process

This phenomenon also occurred during gages bonding process.

a. There is unfilled phenomenon or hole after bonding that causes gages zero drift. If such phenomenon exists, we will find there are eye-winker and blur under gages backing when checking toward light. At the same time if we use soft objects to press gages we find gages resistance will change, and remove soft objects the resistance will come back. Due to the unfilled phenomenon or hole exist, when gages connect to circuit, part of gages will be hot, thus cause temperature zero drift.

b. On gage bonding ,over-think adhesive， adhesive ridge， or little protruding slope after bonding will cause zero drift. If such phenomenon exists, there will be adhesive layer under backing, and much adhesive left around gages, and adhesive ridge and little protruding slope after cured. The main reason is tested objects or spring elements are not cleaned absolutely and exist grains, or adhesive is not painted evenly, or adhesive is too much.

(3)Effect of gage grids or encapsulation

a. Slipping gages. It represents that there are acerate light point or twisty grids under microscope. The main reason is environmental humidity is too large or clean impregnant with too much water, thus results in gages getting moisture.

b. Encapsulation film is fallen off. It represents that there are part or whole of encapsulation film fallen off. The main reason is not firm enough between encapsulation film and grids after cured to cause uneven heat dispersion.

2. Resistance Changes after Bonding

Usually the resistance after bonding has little changes. However, in some caseas, our clients point out that the resistance value changes too much. The reasons are as follows:

(1) The pressure for curing are too much that causes the resistance change after bonding. Properly decrease pressure according to the requirement. The pressure between 0.15MPa~0.3MPa are recommended.

(2) The pressure when curing are not even that causes grids deformation and gages resistance changes. The main reason is that the fixture is not canonical or wrong pressure process to cause uneven forces on gages.

(3) The curvature radius of the fixture doesn't conform to object or element, to cause gages deformation, protruding slope and resistance changes.

(4) Resistance changes after using for some time. The reason is there are air bubbles under backing, or unfilled phenomenon or hole, or bad soldering, etc.

3. Surface Defect after Bonding

From the above-mentioned content, we get to know that the gage bonding defects are mainly unfilled phenomenon or hole, protruding slope, uneven adhesive layer, thick adhesive layer, adhesive ridge, pit, deformation, etc. Among them, if protruding slope and little pit are not in grid area, gages still can be used. Regarding on these defects, we must check the appearance after gage bonding, filtrate out the defected strain gages to ensure bonding quality. Meanwhile, we should also check gages' resistance and insulation in advance to avoid repeating and unnecessary work in later working process.