



9 Strain Gage Bonding Procedure

Surface Treatment of Measuring Site

To bond a strain gage with an adhesive, it is required to treat the bonding surface so that the adhesive may effectively bond the strain gage to the surface. While some details are different depending on the materials of measuring objects, generally the surface is treated as follows.

- (1) Using a grinder or sand blast, remove rust, paint and plating from the measuring site. If the bonding surface is extremely irregular, it should be finished to a smooth surface.

Usually, the treating area should be, at least, 2 times larger than the gage base. If dampproof treatment is to be done after bonding the gage, the surface of the area required for dampproof treatment is also treated at this stage.

Precautions

1. When using a tool, take sufficient safety measures such as protective glasses.
2. Grind the bonding surface to a necessary minimum and not too much.
3. Take care of heating of the material under surface treatment.
4. When the purpose of measurement is to measure strain on the painting or plating layer, do not remove it by taking the procedure described at the left.

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- (2) Like drawing a circle with sandpaper as shown in Fig. 9.1, polish the measuring site to make it smooth. For gradings of sandpaper, refer to Table 9.1.

Precautions

1. Take care not to grind the surface too much, especially for light alloys and thin sheets.
2. Foil, thin film, glass or precisely fabricated surface may not be polished with sandpaper.

- (3) Using industrial tissue paper dipped in a solvent such as acetone, wipe off dirt adhered on the surface. Use the most suitable solvent for the type of dirt. In some cases, repetitive washing with multiple types of solvents ensures a better effect.

At the final stage, the surface should be wiped by moving the tissue paper toward one direction. Reciprocated or circular wiping may return dirt to the cleaned surface, and thus such wiping should be avoided.

Wiping in a single direction should be repeated until the tissue paper has no dirt adhered.

Precautions

1. When using an organic solvent, take the safety and hygiene into sufficient consideration by well ventilating the place.
2. A quickly-evaporating solvent used in high temperature and high humidity environment as in the rainy season may decrease the surface temperature by absorbing temperature from the wiping surface, thereby causing dew condensation. Since dew condensation results in poor bonding, wipe the surface once more with a dry tissue paper.

- (4) To bond the strain gage to the correct position, mark off the bonding site. In the standard method, a center line is marked in longitudinal and transverse directions using a sharpened lead pencil of 4 to 6H and a ruler. That is, a cross is drawn as shown in Fig. 9.3.

Precautions

1. The ruler should be cleaned beforehand with a solvent or the like.
2. There is a method of using a mark-off pin. But use of a mark-off pin should be avoided for thin sheets or if the subject material receives stress at a high level from the pin.
3. Avoid using any oil based ink or color pencil for marking-off.

Fig. 9.1 How to polish with sandpaper

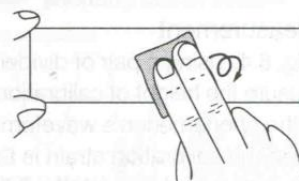


Table 9.1 Materials of Measuring Objects vs. Gradings of Sandpaper

Materials of measuring objects	Gradings of sandpaper
Steel (common steel, stainless steel)	#300
Nonferrous metals (copper alloy, aluminum alloy)	#600
Plastics, composite materials	#800-1000

Fig. 9.2 How to wipe the bonding surface

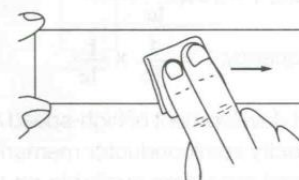
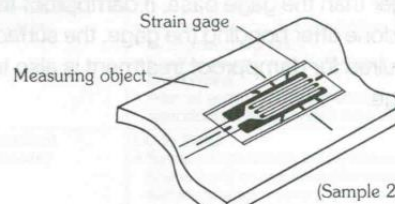
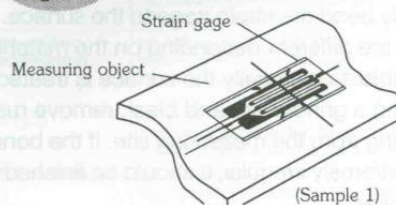


Fig. 9.3 How to mark off



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Bonding General-Purpose Strain Gage

Especially for field measurement, a general-purpose strain gage such as KFG is bonded with an instantaneous adhesive such as CC-33A in most cases, since an instantaneous adhesive ensures easy bonding.

While in the past the polyester adhesive PC-12 had widely been used for general-purpose polyester base gages, the merits of the polyester adhesive are becoming insignificant except for application to concrete.

If long-term reliability over six months or heat resistance against 100°C or higher is required, it is recommended to bond even a general-purpose gage with the epoxy adhesive EP-34B.

Bonding General-Purpose Strain Gage with Instantaneous Adhesive CC-33A

Described here is the procedure to bond a KFG gage with the CC-33A adhesive.

- (1) With a tool such as grinder or sand blast, remove rust, paint and plating from the measuring site.
- (2) With sandpaper of #320 or so, polish the bonding surface to make it smooth.
- (3) With tissue paper dipped in a solvent, wipe the surface in a single direction.
- (4) With a lead pencil, mark off the bonding site.
- (5) With a pin provided inside the cap of CC-33A container, make a hole in the nozzle. (See Fig. 9.4.) Be sure to observe precaution 1 in the next page.
- (6) Apply a drop of adhesive to the gage base (back of the gage). (See Fig. 9.5.)
- (7) Aligning center marks on the gage with the cross marked off on the measuring site, put the gage on the measuring site and covering there with a polyethylene sheet, press the gage over the sheet with a fingertip to closely contact the gage with the measuring object. (See Fig. 9.6.) An optimum pressure is approximately 100 to 300kPa (1 to 3kgf/cm²).
- (8) While the time required for close contact through fingertip pressure depends on temperature and humidity conditions, usually it is 15 to 60 seconds. (See Fig. 9.7 and Table 9.2.)
- (9) After completing application of fingertip pressure, leave the gage in the air for 30 minutes, and it will be ready for measurement. If highly stable measurement is desired, leave the gage as it is for, at least, one hour, or for 24 hours if possible. The bonding strength of CC-33A is maximum in approximately 24 hours.

Fig. 9.4 Making a hole in the nozzle

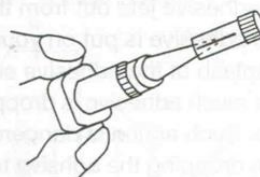


Fig. 9.5 Dropping adhesive to the gage base

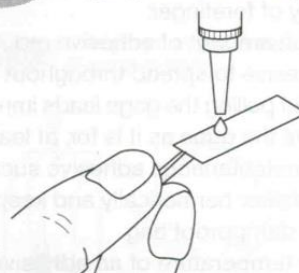


Fig. 9.6 Pressing over polyethylene sheet

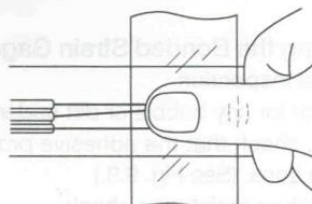


Fig. 9.7 Pressing time required to cure CC-33A

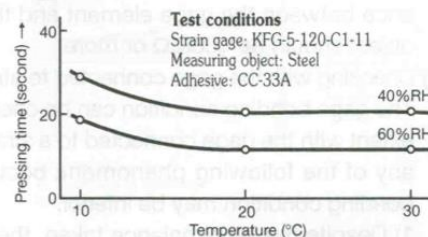


Table 9.2 Time Required to Cure CC-33A through Fingertip Pressure

Materials of measuring objects	Pressing time required (seconds)
Steel	15 to 30
Stainless steel	20 to 30
Aluminum	20 to 30
Acrylic resin	15 to 30
Glass	5 to 15

Test conditions Strain gage: KFG-5-120-C1-11
Temperature: 20°C
Humidity: 40%RH

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Precautions

1. Take sufficient care that the CC-33A may not be put on your skin or may not enter your eye. The adhesive jets out from the container by disorderly pulling off the pin from the nozzle. If the adhesive is put on your skin, wash your skin in tepid soapsuds. If a splash of the adhesive enters your eye, immediately wash your face and visit a doctor.
2. If too much adhesive is dropped on the gage base, never spatter the adhesive by swinging the gage. Such action is dangerous from the viewpoint of safety and health preservation.
3. Upon dropping the adhesive to the gage base, immediately put the gage on the measuring site.
4. As shown in Fig. 9.7, press the gage over the polyethylene sheet in such a manner that the gage base may not protrude beyond the finger. Usually, press the gage with a thumb or the belly of forefinger.
5. Much amount of adhesive requires much time for curing. Too less amount does not allow the adhesive to spread throughout the gage base, thereby resulting in poor bonding.
6. Avoid pulling the gage leads immediately after bonding to check the bonding condition. Usually, leave the gage as it is for, at least, 10 minutes after bonding.
7. An instantaneous adhesive such as CC-33A is apt to deteriorate. Thus, after using it, seal the container hermetically and keep it in a refrigerator (5 to 10°C is most appropriate) by putting it in a dampproof bag.
8. The temperature of an adhesive put out from a refrigerator is low. Before use, keep the cold adhesive at the room temperature as it is for 30 minutes or so and wipe off waterdrops adhered around the container.

Checking the Bonded Strain Gage

(1) Visual inspection

Check for any bubble or dirt under the gage base. Also, check that the adhesive protrudes around the gage base. (See Fig. 9.9.)

(2) Insulation resistance check

Use an electronic ohmmeter providing an application voltage of 50V or less.

For stable measurement, usually the insulation resistance between the gage element and the measuring object should be 100M Ω or more.

(3) Checking with the gage connected to strain amplifier

The gage bonding condition can be checked to some extent with the gage connected to a strain amplifier. If any of the following phenomena occurs, the gage bonding condition may be inferior.

- 1) Despite the initial balance taken, the zero point is hard to be stabilized and considerably fluctuates.
- 2) Pressing the gage element with a rubber eraser considerably varies the reading.
- 3) If applied load is removed, the strain amplifier does not read zero.

Fig. 9.8 Adhesive applied condition

