

## Strain Measurements on Concrete

Concrete is a porous material and generally will have a surface that is too rough to form a very thin and void-free adhesive layer between the strain gage and the concrete. For these reasons, concrete must first be sealed with an epoxy such as M-Bond AE-10. Long gage length strain gages are typically required on the surface of concrete in order to correctly strain-average over the aggregate and mortar mixture. Since concrete is a poor conductor of heat, precabled gages or gages with preattached leadwires are highly recommended.



### Step 1 Define the Test Conditions

Conditions to Consider	Your Test Conditions
<b>Static measurement</b> One sample per second or less, steady loading	
<b>Dynamic measurement</b> Cyclical or impact loading, high frequency  Event duration Anticipated frequency	
<b>Installation longevity</b>  Short Term: Hours, days, weeks  Long Term: Months, years	
<b>Environment</b>  Maximum temperature  Minimum temperature  Exposure (outdoors, moisture, chemicals)	



### Step 2 Ensure Appropriate Surface Preparation Materials Are On Hand

Use the recommended **surface preparation materials** for concrete:

GC-6 alcohol  
 GSP-1 gauze sponge  
 400-grit SCP-3 silicon carbide paper  
 CSP-1 cotton-tipped applicator

M-Prep Neutralizer 5A  
 M-Prep Conditioner A  
 PCT-3M gage installation tape  
 PDT-3 drafting tape

Reference **Related Documents**: SEARCH our website using the document number.  
**11129** – Instruction Bulletin B-129; **11091** – Tech Tip TT-611

# Strain Gage Installation Checklist

## Concrete



### Step 3 Select the Strain Sensor

Consult the Micro-Measurements team and/or review our [Tech Note TN-505](#), “Strain Gage Selection – Criteria, Procedures, Recommendations” for detailed information about the strain gage selection process.

#### Step 3A: Select the Gage Series for the Temperature Range

Consider the temperature range that will be encountered during the strain measurements and select a **Gage Series** that meets your requirements.

Gage Series	Temperature Range	Features
CEA	-100°F to +350°F (-75°C to +175°C)	Universal, general-purpose strain gages. Large, easily soldered tabs. Precabled (Option P2) available.
C2A	-60°F to +180°F (-50°C to +80°C)	Precabled, general-purpose strain gages.
EA	-100°F to +350°F (-75°C to +175°C)	Widest range of available patterns, sizes and optional features.
EGP	+25°F to +125°F (-5°C to +50°C)	For direct embedment in concrete
LEA	-40°F to +180°F (-40°C to +83°C)	Sealed weldable strain gage for rebar

#### Step 3B: Choose the STC for Your Material

When temperature changes will occur during the course of strain measurements, **self-temperature-compensation (STC) 06** is often selected for concrete.

#### Step 3C: Consider the Geometry

The strain gages below are popular for strain measurements on concrete. Check **Super Stock** for gages that are available to ship promptly. Our C2A-06-20CLW-350 is an excellent choice for aggregate  $\leq 0.5"$  (13 mm) diameter.

Type	Gage Designation	Geometry/Construction
SUPER STOCK Strain Gages with Long Gage Lengths	<a href="#">C2A-06-20CLW-120</a> <a href="#">C2A-06-20CLW-350</a>	Linear pattern, 2-in long gage length, precabled
	<a href="#">EA-06-40CBY-350</a>	Linear pattern, 4-in long gage length
Concrete Embedment Gages	<a href="#">EGP-5-120</a> <a href="#">EGP-5-350</a>	Linear embedment gage, precabled
Weldable Gages for Rebar	<a href="#">CEA-06-W250A-120</a> <a href="#">CEA-06-W250A-350</a>	Linear pattern
Sealed Weldable Gages for Rebar	<a href="#">LEA-06-W125E-350/10L</a> <a href="#">LEA-06-W125E-350/3R</a>	Linear pattern, precabled



### Step 4 Select the Adhesive

Adhesive	Conditions to Consider
<b>M-Bond 200 Kit</b>	For short-term applications involving bonding a strain gage to a sealed surface
<b>M-Bond AE-10</b>	Room-temperature curing epoxy used as a surface sealer and leveler. The preferred adhesive for bonding strain gages to a sealed surface for long-term structural monitoring

Follow the instructions included with the adhesive for application and cure requirements.

**Application Kits** contain specific adhesives, surface preparation materials, and in some cases wire and coatings necessary for a successful strain gage installation on concrete.

- **BAK-200 Kit**  
Contains M-Bond 200 adhesive and basic materials for surface preparation (does not include GC-6 Alcohol). Excellent for use with pre-cabled gages.
- **GAK-2-AE-10 Kit**  
Contain all materials needed to install strain gages on concrete, including solder and cable.



### Step 5 Select Cable and Solder Terminals

Micro-Measurements offers a variety of **cable types** for gage installation on steel. For ease of installation, consider pre-cabled gages; no additional cable is required unless length needs to be extended.

Cable	Conditions to Consider
<b>Vinyl Insulated</b>	Room temperature testing
<b>Teflon Insulated</b>	Wide temperature range testing, high moisture or water immersion, and chemical resistance

Solder Terminals	Conditions to Consider
<b>Bondable Terminals</b>	Bonded to the test structure, these can be used as transition or anchor point for cable.



### Step 6 Select a Solder

Micro-Measurements has a wide selection of **solder** for strain gage applications. Solder melt point should be at least 50°F (10°C) above the maximum operating temperature. Solder is not needed when using pre-cabled gages.



### Step 7 Select a Protective Coating

Consider the environmental conditions that the coating will need to resist and any application issues, such as:

Environmental Conditions	Application Issues
<ul style="list-style-type: none"> <li>• Temperature range</li> <li>• Humidity</li> <li>• Chemical exposure</li> <li>• Localized reinforcement concerns</li> </ul>	<ul style="list-style-type: none"> <li>• Vertical surface</li> <li>• Horizontal surface</li> <li>• Component sensitivity</li> </ul>

For a wide range of applications on concrete, **M-Coat JA** is often selected. A single tube can coat up to three strain gage installations. M-Coat JA has a pot life of about 2 hours after mixing.

- **M-Coat JA Kit**, one tube
- **M-Coat JA-3 Kit**, three tube

For harsh environments and extreme temperatures, refer to the **Protective Coating Selection Guide** to select the proper coating.

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### Step 8 Select the Measurement Instrumentation

Micro-Measurements offers a wide variety of **instrumentation** specifically designed and optimized for strain measurement. Simple Strain Indicators are available for high-accuracy static measurements. Signal Conditioning Amplifiers accept direct strain gage input and provide a conditioned signal output in the  $\pm 10$  V range. Data Systems accept direct strain gage input and provide reduced data, already in engineering units of strain and/or stress.



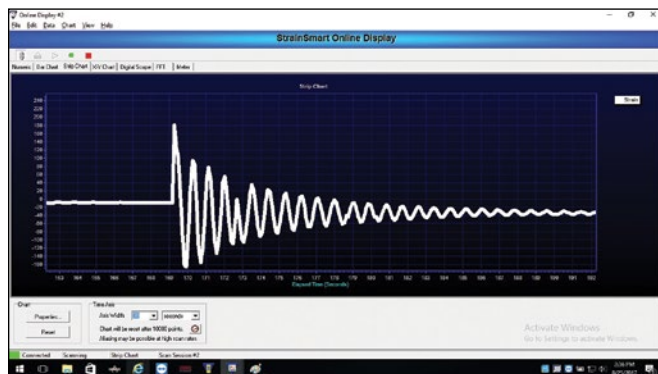
P3  
Strain Indicator



StudentDAQ



D4 Data Acquisition  
Conditioner



StrainSmart® Data Acquisition Software



System 8000 Data Acquisition



System 9000 Data Acquisition



Pacific Instruments  
Series 6000 Data Acquisition System