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Strain Gauge Installation
Data Acquisition Services
Work Specification Sheet

This document is intended to simplify the specification of strain gauge and data acquisition service requirements. This will aid the selection of strain gauges, adhesive materials and sealants appropriate to the measurement requirement, physical location constraints and conditions. Furthermore, it allows the specification of any data acquisition services and reporting requirements.

March, 2004.

❒ Customer and Site Details

❶ Customer Information

Company: _____ Division: _____

Address: _____

Contact: _____ E-mail: _____

Telephone: _____ Facsimile: _____

❷ Site and Test Information

Address: _____

Building: _____ Telephone: _____

❒ *Special Site Requirements*

Please specify any special requirements for working at this site, such as, site induction course, confined space, outdoor exposure, tool traceability, etc.

Task No.: _____

Test Title: _____

Please specify the objectives of the test.

❒ Strain Gauge Installation

❸ Gauge Selection Schedule (refer page 4 for description and typical values)

Use the following tables to define each unique strain-gauge configuration in your application. The first table (Gauge Selection Schedule) defines the gauge requirements while the second table (Gauge Installation Schedule) defines the protection and cabling requirements for the gauge. The Configuration Number column links configurations in the two tables. Table column descriptions and typical values are given below (page 4); an *example* is provided on the first line.

Config. Number	Type Of Strain	Pattern	Temperature Range (°C)	Material (STC)	Test Life (hours)	Accuracy	Gauge Length (mm)	Mount Radius	Maximum Strain (με)	Test Cycles	Gauge Ohm (Ω)	Bridge Completion	Number
	General	*Uniaxial*	*To 40°C*	*00*	*<10^4*	*Moderate*	*3*	*Flat*	*1000*	*10^2*	*350*	*3-Wire*	*4*
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

❹ Gauge Installation Schedule (refer page 4 for description and typical values)

Use the following table to define the coating/protection and cabling requirements for each configuration. To include any additional information for a particular configuration, attach separate sheets referring to the Configuration Number.

Config. Number	Coating/Protection	Cabling Distance (m) Under…		Comments
		Test Conditions	Room Conditions	
	Laboratory	*N/A*	*5m*	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

❒ *Digitally Photograph Each Gauge Installation (before and after coating)*

Gauge Selection and Installation Schedule Tables Description

Type of Strain: Typical measurement categories include *General*, *High-Elongation* (Post-Yield), *Dynamic* (Cyclic), *Transducer*. Specialist categories include *Crack Detection*, *Crack Propagation*, *Temperature* Measurement and *Composite* Materials.

Pattern: Typical arrangements include *Uniaxial* (measurement of strain in one direction), *Biaxial* (measurement of principal strains where principal axes are known) and *Triaxial* (measurement of principal strains where principal axis are unknown). Specialist categories include *Strip* and *Diaphragm*.

Temperature Range: Enter the temperature range encountered during measurement. For example, typical gauges for general strain analysis operate over -45 to +65°C, -45 to +205°C, -269 to +230°C and to +370°C.

STC	Material Description
00	Invar (Fe-Ni alloy)
	Quartz (fused)
	Titanium Silicate* (polycrystalline)
03	Alumina (fired)
	Tungsten (pure)
	Zirconium (pure)
	Molybdenum* (pure)
05	Glass (Soda, Lime, Silica)
	Steel, Stainless (Age Hardenable, PH15-7Mo)
	Steel, Stainless (Ferritic 410)
	Titanium (pure)
	Titanium Alloy (6Al-4V*)
06	Beryllium (pure)
	Cast Iron (Gray)
	Inconel (Ni-Cr-Fe alloy)
	Inconel X (Ni-Cr-Fe alloy)
	Monel (Ni-Cu alloy ())
	Nickel-A (Cu-Zn-Ni alloy ())
	Steel, Alloy (4340)
	Steel, Stainless (Age Hardenable, 17-4PH)
	Steel, Stainless (Age Hardenable, 17-7PH)
	Steel, Carbon (1008, 1018*)
09	Beryllium Copper (Cu 75, Be 25)
	Bronze, Phosphor (Cu 90, Sn 10)
	Copper (pure)
	Steel, Stainless (Austenitic 310)
	Steel, Stainless (Austenitic 316)
	Steel, Stainless (Austenitic 304*)
13	Brass, Cartridge (Cu 70, Zn 30)
	Tin (pure)
	Aluminum Alloy (2024-T4*, 7075-T6)
15	Magnesium Alloy* (AZ-31B)

Material (STC): Select a self-temperature-compensation (from the table) appropriate to the material being gauged.
Test Life: Enter the gauge test life required (eg. $<10^3$ hours).

Accuracy: While it is not possible to quantify accuracy without consideration of various aspects of the actual test program and the instrumentation used, enter the approximate desired measurement accuracy as *Moderate* (2% to 5%), *High* (1% to 3%) or *Very-High* (<1%).

Gauge Length: Enter the length over which strain is to be measured. While gauge lengths ranging from 0.2 mm to 100 mm are available, lengths of 3mm to 6mm are generally recommended for the common applications. Shorter gauge lengths (3mm) are used where there is little space is available for mounting the gauge, a localised strain gradient needs to be measured or accuracy is not critical. Select a longer (6mm) if heat dissipation is an issue (usually on non-metallic materials), the substrate has non-homogeneous material properties (eg. concrete) or to reduce cost.

Mount Radius: Radius of curvature of the gauge mounting surface; Flat (not applicable), inside diameter (I.D. mm) or outside diameter (O.D. mm).

Maximum Strain: Enter the maximum likely strain, particularly for cyclic loading.

Test Cycles: Enter the number of cycles likely to be experienced by the gauge during its test life.

Gauge Ohm: Enter the required gauge nominal resistance (120Ω, 350Ω, 1000Ω). Typically 350Ω gauges are used, however, 120Ω can be used where fatigue loading is an issue or for compatibility with existing instrumentation.

Bridge Completion: Enter any bridge completion requirements for the gauge. For example, uniaxial gauges (or individual gauge arms of a rosette) can be cabled in a 3-wire (lead-compensating) configuration where bridge completion is supplied by the data acquisition system. Alternatively, gauges can be wired into a bridge comprised of dummy (no-loaded) gauges where bridge completion is required on the gauged article.

Number: Number of gauges/rosettes using this configuration.

Coating: The coating required to protect the gauge from its working environment. For example, *Laboratory* (<60% RH), *Field* (outdoor installations), *High Humidity/Water Splash*, *Water Immersion* for *Short/Long Term* in *Fresh/Salt Water*, *Steam*, *Concrete Surfaces*, *Oils/Petrol* or *High Temperature Air*.

Gauge Installation Quality Assurance

To ensure a high quality strain gauge installation and operation during testing, numerous tests of strain gauge and associated wiring are performed during the installation of each gauge. These include both qualitative and quantitative tests after the strain gauge is bonded to the test specimen, and after leadwires are attached to the gauge and any environmental protection applied (if appropriate). Quantitative tests of the strain gauges and associated wiring include a continuity check, gauge resistance test, resistance to ground test and function test. For further information refer to Fortburn Work Instruction No. 11 (*Typical Strain Gauge/Accelerometer Installation Procedure*).

❺ Additional Transducers Supply

Use the following table to specify any additional transducers (eg. accelerometers, load cells, pressure transducers, LVDT's, RTD's, etc.) required for the test program. An *example* is provided on the first line.

Transducer Type	Range	Number	Comment
Accelerometer	*10g*	*1*	

❒ Supply Data Acquisition System and Services

❻ Input Channel Requirements

❒ *Strain gauge and bridge channels*

Use the following table to enter the number of quarter, half and full bridge channels to be measured.

Number Of Gauges/Bridges		Gauge/arm resistance (Ω)			Excitation Voltage (V) [4]
		120	350	1000	
Quarter Bridge [1]	Uniaxial Gauge				
	2-Arm Rosette				
	3-Arm Rosette				
Half-Bridge [2]	Bridge				
Full-Bridge [3]	4-Wire				
	6-Wire				

[1] For quarter-bridges with 350Ω nominal resistance gauges, the data acquisition system provides bridge completion; other gauge resistance values may require custom bridge completion. Uniaxial gauges, 2-arm rosettes and 3-arm rosettes require 1, 2 and 3 data acquisition system channels, respectively. All quarter-bridge channels are connected in a 3-wire (lead length compensating) configuration. Quarter-bridge channels are individually multi-point shunt calibrated.
[2] Half-bridge channels are individually multi-point shunt calibrated.
[3] For 6-wire full-bridge configurations, excitation voltage is separately measured at the bridge (correcting for lead length excitation attenuation). This configuration requires 2 data acquisition system channels per measurement channel. Where commercial transducers are used, calibration sheets must be supplied unless a full calibration is to be performed as part of data acquisition system setup.
[4] The data acquisition system nominally provides 6V bridge excitation voltage (3V across a gauge or bridge arm). Other excitation voltages (eg. lower voltage for composite materials) can be configured as required. Bridge excitation is automatically recorded during testing.

❒ *Low-level (±100mV) voltage channels (eg. thermocouples, RTD's)*

Number of low-level voltage channels ..... ☐

Please specify transducer types and any special conditions:

❒ *High-level (±10V) voltage channels (eg. monolithic temperature sensors, conditioned transducers, excitation and signal voltages)*

Number of high-level voltage channels..... ☐

Please specify transducer types and any special conditions:

❒ *Digital input channels*

Number of digital input channels..... ☐

❼ Sampling Rate

Sampling Rate (Hz)..... ☐

Notes: Sampling is continuous. The operator can manually flag significant event periods during sampling.

❽ Testing

Typically, tests are conducted and recorded in a similar manner. Immediately prior to any test all data acquisition channels were zeroed to set a nominal 'zero' condition. Data acquisition is then started and runs continuously for the duration of the test. The test sequence is then executed and at each test step the operator can activate the event marker. At the end of a test, acquisition is stopped and recorded data file renamed with the test name.

Please specify the number and duration of tests, or any required variation of this test procedure:

❾ Data Output and Reporting

Following each test, the data acquisition system writes test data in engineering units to tab-delimited text files (suitable for loading into a spreadsheet) in several formats. The formats include date/time-stamped data from every scan, data averaged over a one second period, and data averaged over the event-marked periods flagged by the operator during testing. Calibration data is also written to file and is available. This represents the minimum data output from the data acquisition system.

Where required, additional test and data reporting can be provided. For example, a written report of sensor schedules, calibration procedures and results, and tests conducted and data output can be supplied. Please specify any additional test/data reporting requirements:

❿ Data Post-Processing and Analysis

As described above, the minimum data acquisition system output is test data in engineering units written to tab-delimited text files. Where required, further post-processing and analysis of test data can be provided. Please specify any additional data post-processing and analysis required: