Stress Analysis Strain Gages

GAGE SELECTION

Many factors, such as test duration, strain range required, and operating temperature, must be considered in selecting the best strain gage/adhesive combination for a given test profile. These factors and others are addressed in Tech Note TN-505, “Strain Gage Selection—Criteria, Procedures, Recommendations.”

SELF-TEMPERATURE COMPENSATION (S-T-C)

All gages with XX as the second code group in the gage designation are self-temperature-compensated for use on structural materials with specific thermal expansion coefficients. The table below lists S-T-C numbers and test specimen materials to which gages are thermally matched.

When ordering, replace the XX code group with the desired S-T-C number, which is the approximate thermal expansion coefficient of the structural material in ppm/°F. The Gage Designation System lists the available S-T-C numbers for specific grid alloys. The 06 and 13 values, available in A and K alloys, are most common and more likely to be in stock. When not otherwise specified, the 06 compensation is shipped.

S-T-C NO.	EXPANSION COEFFICIENTS**		COMMON MATERIAL
	per °F	per °C	
00	0.8	1.4	Invar, Fe-Ni alloy
	0.3	0.5	Quartz, fused
	0.017	0.03	Titanium Silicate*, polycrystalline
03	3.0	5.4	Alumina, fired
	2.7	4.9	Molybdenum*, pure
	2.4	4.3	Tungsten, pure
	3.1	5.6	Zirconium, pure
05	5.1	9.2	Glass, Soda-Lime-Silica
	5.5	9.9	Stainless Steel, Ferritic (410)
	4.8	8.6	Titanium, pure
	4.9	8.8	Titanium Alloy, 6Al-4V*
06	6.4	11.5	Beryllium, pure
	6.0	10.8	Cast Iron, grey
	7.0	12.6	Inconel, Ni-Cr-Fe alloy
	6.7	12.1	Inconel X, Ni-Cr-Fe alloy
	7.5	13.5	Monel, Ni-Cu alloy
	6.6	11.9	Nickel-A, Cu-Zn-Ni alloy
	6.3	11.3	Steel alloy, 4340
	6.7	12.1	Steel, Carbon, 1008, 1018*
	6.0	10.8	Steel, Stainless, Age Hardenable (17-4PH)
	5.7	10.3	Steel, Stainless, Age Hardenable (17-7PH)
	5.0	9.0	Steel, Stainless, Age Hardenable (PH15-7Mo)
09	9.3	16.7	Beryllium Copper, Cu 75, BE 25
	10.2	18.4	Bronze, Phosphor, Cu 90, Sn 10
	9.2	16.5	Copper, pure
	9.6	17.3	Steel, Stainless, Austenitic (304*)
	8.0	14.4	Steel, Stainless, Austenitic (310)
	8.9	16.0	Steel, Stainless, Austenitic (316)
13	12.9	23.2	Aluminum Alloy, 2024-T4*, 7075 T6
	11.1	20.0	Brass, Cartridge, Cu 70-Zn 30
	13.0	23.4	Tin, pure
15	14.5	26.1	Magnesium Alloy*, AZ-318

* Indicates type of material used in determining thermal output curves supplied with Micro-Measurements strain gages.
** Nominal values at or near room temperature for temperature coefficient of expansion values.

GAGE RESISTANCE

Micro-Measurements strain gages are available in various resistance values that range from 30 to 5000 ohms.

Strain gages with resistances of 120 and 350 ohms are commonly used in experimental stress analysis testing. For the majority of applications, 120-ohm gages are usually suitable; 350-ohm gages would be preferred to reduce heat generation (for the same applied voltage across the gage), to decrease leadwire effects, or to improve signal-to-noise ratios in the gage circuit. Higher resistance gages are typically used in transducer applications and on composite materials.

GAGE FACTOR

Gage Factor (GF) is the measure of sensitivity, or *output*, produced by a resistance strain gage. Gage factor is determined through calibration of the specific gage type, and is the ratio between $\Delta R/R_o$ and $\Delta L/L$ (strain), where R_o is the initial unstrained resistance of the gage. It is affected somewhat by pattern size, geometry, S-T-C number, and temperature. Each gage package is supplied with the GF as well as its tolerance and temperature sensitivity. Nominal gage factors for various alloys are: A = 2.05; K = 2.1; D = 3.2; P = 2.00.

TRANSVERSE SENSITIVITY

All gages are sensitive, to some degree, to strains transverse to the grid direction. The transverse sensitivity factor (K_t) is given with the engineering data supplied with all gage types for which the data is relevant.

STRAIN GAGE ADHESIVE SELECTION

When selecting a strain gage, it is most important to consider the adhesive that will be used to bond the gage, since the adhesive becomes part of the gage system and correspondingly affects the performance of the gage. However, when the interaction of test characteristics becomes too complex for selecting the gage/adhesive combination in a straight forward manner, contact our Applications Engineering Department for recommendations.

CUSTOM GAGES

Unusual applications occasionally require a strain gage which is neither listed in the catalog nor available by adding special optional features. Often a custom product can be designed to fit such needs.

Careful consideration is given to the backing, foil, S-T-C, gage length, pattern, resistance and resistance tolerance, operating temperature range, test duration, maximum strain, cyclic endurance, leads, encapsulation, and trim so that the custom gage is designed to properly meet the user's needs. Examples of custom gages include such features as unusual patterns, special trim dimensions, and nonstandard lead materials or length.

A special part number is normally assigned to each custom gage. Doing so ensures that the correct gage is produced each time it is ordered. A set-up charge and a minimum order will normally apply. For further information contact our Applications Engineering Department.

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