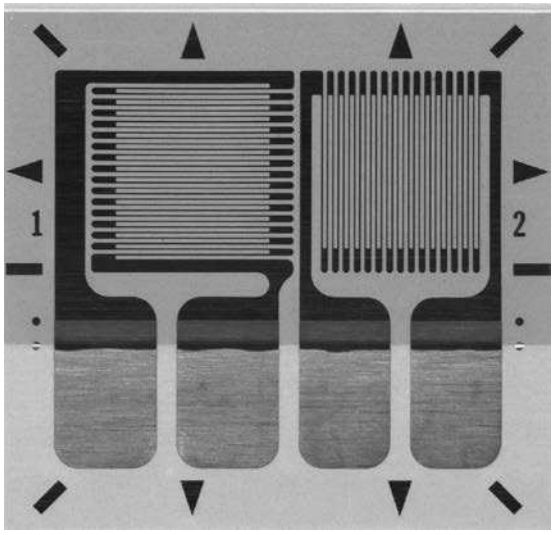
General Purpose Strain Gages—Tee Rosette

GAGE PATTERN DATA



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GAGE DESIGNATION See Notes 1 and 4	RESISTANCE (OHMS) See Note 2	OPTIONS AVAILABLE See Note 3
CEA-XX-125UT-120	120 ± 0.4%	**P2,** SP35
CEA-XX-125UT-350	350 ± 0.4%	**P2,** SP35
CEA-XX-125UTA-350	350 ± 0.2%	**P2,** SP35

DESCRIPTION

Two-element 90° tee rosette for general-purpose use. Exposed solder tab area 0.10 x 0.07 in (2.5 x 1.8 mm).

GAGE DIMENSIONS

Legend
ES = Each Section
S = Section (S1 = Section 1)
CP = Complete Pattern
M = Matrix

inch
millimeter

Gage Length	Overall Length	Grid Width	Overall Width	Matrix Length	Matrix Width
0.125 ES	0.325 CP	0.165 ES	0.365 CP	0.42	0.45
3.18 ES	8.26 CP	4.19 ES	9.27 CP	10.7	11.4

GAGE SERIES DATA — See Gage Series datasheet for complete specifications

Series	Description	Strain Range	Temperature Range
CEA	Universal general-purpose strain gages.	±5%	–100° to +350°F (–75° to +175°C)

Note 1: Insert desired S-T-C number in spaces marked XX.

Note 2: Tolerance is increased when Option W, E, SE, LE, P, or SP35 is specified.

Note 3: Products with designations and options shown in **bold** are not RoHS compliant.

Note 4: Pattern names ending with “A” are built with Advanced Sensors Technology.

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LTR	REVISION	ERN	INITIAL	DATE
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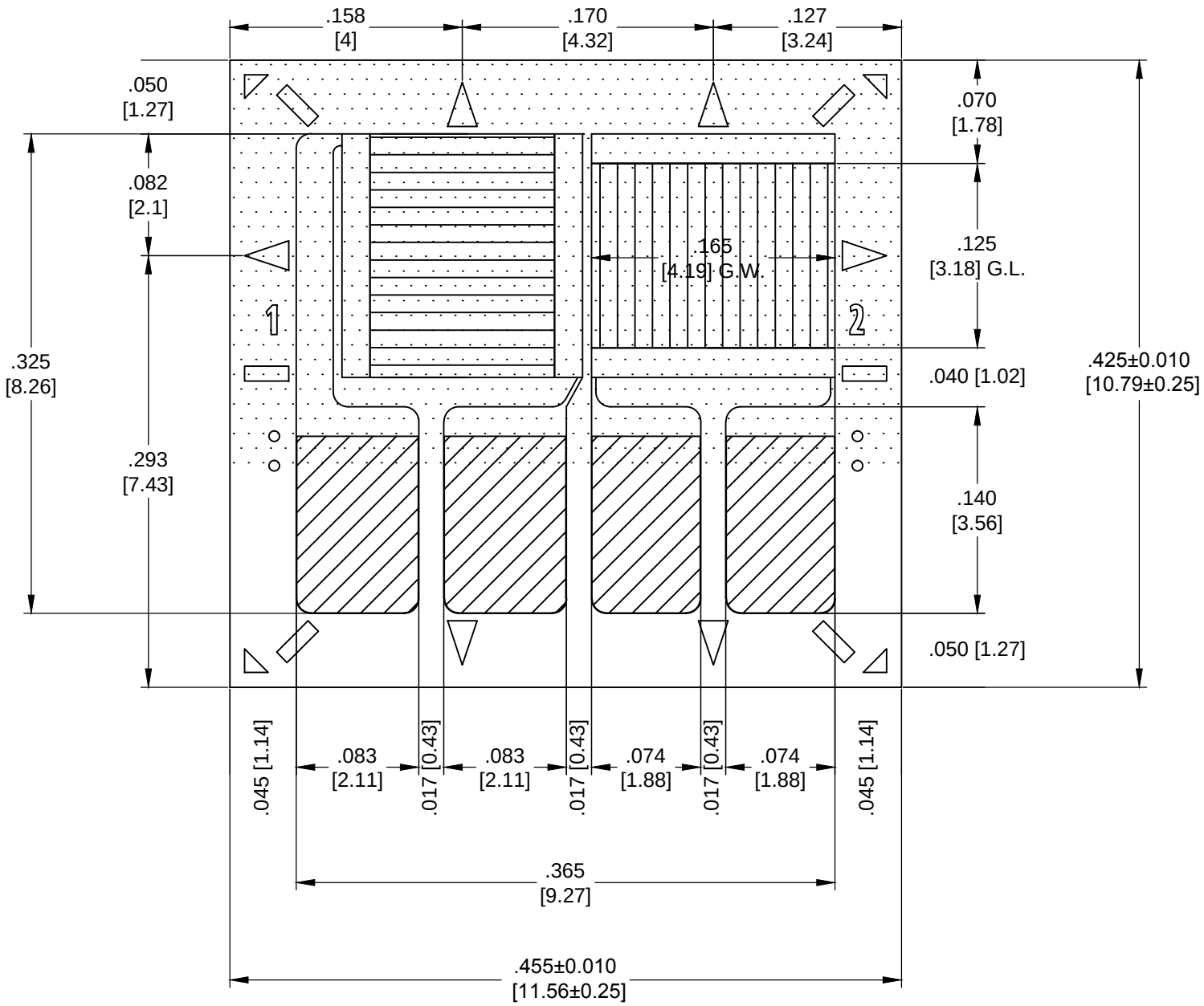

DIMENSIONS TOLERANCE IS ±.0025 [±0.06]

Micro-Measurements
Raleigh, North Carolina USA

125UTA PATTERN LAYOUT

CONSTRUCTION:	OPTIONS:
CEA	
RESISTANCE:	REFERENCE:
350±0.2%	

DRAWN BY:	DATE:	SCALE:	ALL DIMENSIONS ARE IN INCHES [mm].
OS	2018-06-20	N.T.S.	
PROJ. ENG.	DATE:	DWG. #	REVISION:
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MICRO MEASUREMENTS
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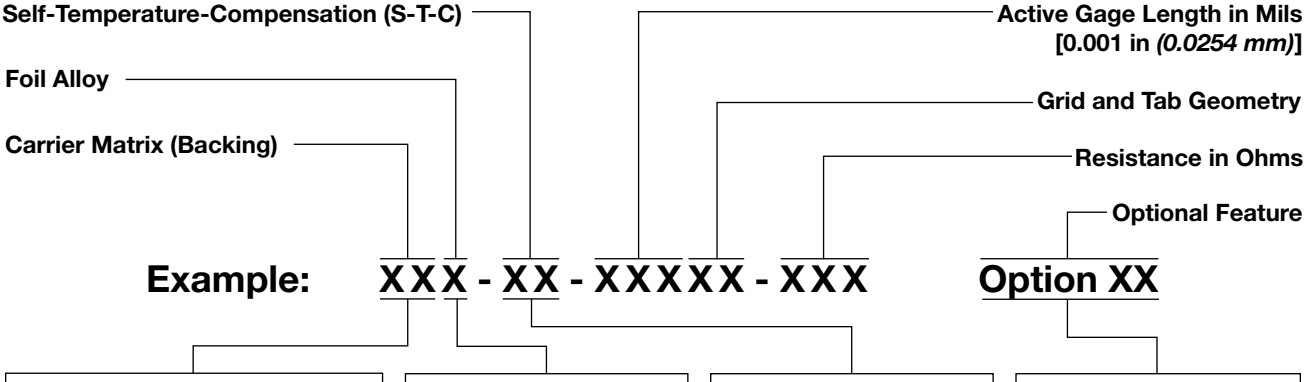
Stress Analysis Strain Gages

The Strain Gage Designation System described below applies to Micro-Measurements General-Use Strain Gages.



E: Open-faced cast polyimide backing.

CE: Thin, flexible gages with a cast polyimide backing and encapsulation featuring large, rugged, copper-coated solder tabs. This construction provides optimum capability for direct leadwire attachment.

L2: Thin, laminated, polyimide-film backing featuring encapsulated grids with preattached leadwire ribbons.

C2: Thin, laminated, polyimide-film backing featuring encapsulated grids with leadwire cables.

W: Fully encapsulated, glass-fiber-reinforced epoxy phenolic resin. High endurance leadwires.

N2: The 'N2' matrix provides an open faced gage on a thin, high-performance laminated polyimide film backing.

S2: Gage grid and solder tabs fully encapsulated in a thin, flexible, laminated polyimide film. Provided with large [0.030 in *(0.75 mm)*] solder pads for ease of leadwire attachment.

S: Full encapsulation identical to the W matrix, but with solder dot connections instead of leadwires.

A: Constantan alloy in self-temperature-compensated form.

P: Annealed Constantan.

D: Isoelastic alloy.

K: Nickel-chromium alloy (similar to Karma).

The S-T-C number is the approximate thermal expansion coefficient in ppm/°F of the structural material on which the gage is to be used. The following S-T-C numbers are available:

A: 00, 03, 05, 06, 09, 13, 15, 18, 30, 50

P: 08, 40

K: 00, 03, 05, 06, 09, 13, 15

D: Not available in self-temperature-compensated form. 'DY' is used instead.

W: Integral printed circuit terminal, polyimide encapsulation.

E: Polyimide encapsulation, leaving a portion of solder tab exposed.

SE: Solder dots plus polyimide encapsulation.

L: Preattached, soft, formable copper leads.

LE: Leads plus polyimide encapsulation.

P: Preattached leadwire cables and encapsulation.

P2: Preattached leadwire cables for CEA-Series gages.

Standard Stress Analysis Strain Gages

GAGE SERIES	DESCRIPTION AND PRIMARY APPLIATION	TEMPERATURE RANGE	STRAIN RANGE	FATIGUE LIFE	
				STRAIN LEVEL IN με	NUMBER 0F CYCLES
EA	Constantan foil in combination with a tough, flexible, polyimide backing. Wide range of options available. Primarily intended for general-purpose static and dynamic stress analysis. Not recommended for highest accuracy transducers.	Normal: –100° to +350°F (–75° to +175°C) Special or short term: –320° to +400°F (–195° to +205°C)	±3% for gage lengths under 1/8 in (3.2 mm) ±5% for 1/8 in and over	±1800 ±1500 ±1200	10^5 10^6 10^8
CEA	Universal general-purpose strain gages. Constantan grid completely encapsulated in polyimide, with large, rugged copper-coated tabs. Primarily used for general-purpose static and dynamic stress analysis.	Normal: –100° to +350°F (–75° to +175°C) Stacked rosettes limited to +150°F (+65°C)	±3% for gage lengths under 1/8 in (3.2 mm) ±5% for 1/8 in and over	±1500 ±1500	10^5 10^{6*}
				*Fatigue life improved using low-modulus solder.	
C2A	General-purpose stress analysis strain gages. Supplied with preattached cables for direct connection to instrumentation.	–60° to +180°F (–50° to +80°C)	±3%	±1700 ±1500	10^5 10^6
L2A	General-purpose stress analysis strain gages. Supplied with preattached leadwire ribbons.	–100° to +250°F (–75° to +120°C)	±3%	±1700 ±1500	10^5 10^6
N2A	Open-faced constantan foil gages with a thin, laminated, polyimide-film backing. Primarily recommended for use in precision transducers, the N2A Series is characterized by low and repeatable creep performance. Also recommended for stress analysis applications employing large gage patterns, where the especially flat matrix eases gage installation.	Normal static transducer service: –100° to +200°F (–75° to +95°C)	±3%	±1700 ±1500	10^6 10^7
WA	Fully encapsulated constantan gages with high-endurance leadwires. Useful over wider temperature ranges and in more extreme environments than EA Series. Option W available on some patterns, but restricts fatigue life to some extent.	Normal: –100° to +400°F (–75° to +205°C) Special or short term: –320° to +500°F (–195° to +260°C)	±2%	±2000 ±1800 ±1500	10^5 10^6 10^7
SA	Fully encapsulated constantan gages with solder dots. Same matrix as WA Series. Same uses as WA Series but derated somewhat in maximum temperature and operating environment because of solder dots.	Normal: –100° to +400°F (–75° to +205°C) Special or short-term: –320° to +450°F (–195° to +230°C)	±2%	±1800 ±1500	10^6 10^7
EP	Specially annealed constantan foil with tough, high-elongation polyimide backing. Used primarily for measurements of large post-yield strains. Available with Options E, L, and LE (may restrict elongation capability).	–100° to +400°F (–75° to +205°C)	±10% for gage lengths under 1/8 in (3.2 mm) ±20% for 1/8 in and over	±1000	10^4
				EP gages show zero shift under high-cyclic strains.	
ED	Isoelastic foil in combination with tough, flexible polyimide film. High gage factor and extended fatigue life excellent for dynamic measurements. Not normally used in static measurements due to very high thermal-output characteristics.	Dynamic: –320° to +400°F (–195° to +205°C)	±2% Nonlinear at strain levels over ±0.5%	±2500 ±2200	10^6 10^7

Gage Series Selection Chart

MICRO MEASUREMENTS
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Standard Stress Analysis Strain Gages

GAGE SERIES	DESCRIPTION AND PRIMARY APPLIATION	TEMPERATURE RANGE	STRAIN RANGE	FATIGUE LIFE	
				STRAIN LEVEL IN με	NUMBER 0F CYCLES
WD	Fully encapsulated isoelastic gages with high-endurance leadwires. Used in wide-range dynamic strain measurement applications in severe environments.	Dynamic: –320° to +500°F (–195° to +260°C)	±1.5% Nonlinear at strain levels over ±0.5%	±3000 ±2500 ±2200	10^5 10^7 10^8
SD	Equivalent to WD Series, but with solder dots instead of leadwires.	Dynamic: –320° to +400°F (–195° to +205°C)	±1.5% Nonlinear at strain levels over ±0.5%	±2500 ±2200	10^6 10^7
EK	K-alloy foil in combination with a tough, flexible polyimide backing. Primarily used where a combination of higher grid resistances, stability at elevated temperature, and greatest backing flexibility are required. Supplied with Option DP.	Normal: –320° to +350°F (–195° to +175°C) Special or short term: –452° to +400°F (–269° to +205°C)	±1.5%	±1800	10^7
WK	Fully encapsulated K-alloy gages with high endurance leadwires. Widest temperature range and most extreme environmental capability of any general-purpose gage when self-temperature compensation is required. Option W available on some patterns, but restricts both fatigue life and maximum operating temperature.	Normal: –452° to +550°F (–269° to +290°C) Special or short term: –452° to +750°F (–269° to +400°C)	±1.5%	±2200 ±2000	10^6 10^7
SK	Fully encapsulated K-alloy gages with solder dots. Same uses as WK Series, but derated in maximum temperature and operating environment because of solder dots.	Normal: –452° to +450°F (–269° to +230°C) Special or short term: –452° to +500°F (–269° to +260°C)	±1.5%	±2200 ±2000	10^6 10^7
S2K	K-alloy foil laminated to 0.001 in (0.025 mm) thick, high-performance polyimide backing, with a laminated polyimide overlay fully encapsulating the grid and solder tabs. Provided with large solder dots for ease of leadwire attachment.	Normal: –100° to +250°F (–75° to +120°C) Special or short term: –300° to +300°F (–185° to +150°C)	±1.5%	±1800 ±1500	10^6 10^7

Notes:
The performance data given here are nominal, and apply primarily to gages of 0.125-in (3-mm) gage length or larger.
Refer to Gage Series/Optional Feature data sheet for more detailed description and performance specifications.

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.

Strain Gage Dimensions

Gage length is an important consideration in strain gage selection, and is usually the first parameter to be defined.

Dimensions listed for gage length (as measured inside the grid endloops) and grid width refer to active grid dimensions. Overall length and width refer to the actual foil pattern, not including alignment marks or backing.

The matrix size represents the approximate dimensions of the backing/matrix of the gage as shipped. Matrix dimensions are nominal, with a usual tolerance of ±0.015 in (±0.4 mm). If the gages are encapsulated, the matrix may be smaller by as much as 0.01 in (0.25 mm). Most patterns also include trim marks, and, for use in a restricted area, the backing/matrix may be field-trimmed on all sides to within 0.01 in (0.25 mm) of the foil pattern without affecting gage performance.