

### Special Purpose Sensors - Crack Detection Patterns

CD-Series Crack Detection Gages are designed to provide a convenient, economical method of indicating the presence of a crack, or indicating when a crack has progressed to a predetermined location on a test part or structure. By employing several CD gages, it is also possible to monitor the rate of crack growth; however, Crack Propagation Gages would normally be selected for that purpose.

In some applications, thin copper wires bonded to the test structure are used to provide a low-cost method of detecting crack initiation or propagation. Because of the behavior of copper wire, however, this method suffers from two limitations: (a) the crack tip may progress considerably beyond the wire without breaking the strand, and (b) in areas of high cyclic strains, the wire may fail in fatigue without crack initiation in the specimen. CD-Series Crack Detection Gages are designed to overcome both of these limitations.

CD-Series gages consist of a single strand of high-endurance alloy. A crack propagating beneath the gage will induce local fracture of the sensing strand and open the electrical circuit. When the CD gage is installed at critical locations on a test part or structure and used as a sensing element in a control system, the signal can serve to alter a test sequence or to alert an operator to incipient component failure.

#### CONSTRUCTION

Two gage constructions are currently available:

The **CD-02** is made of beryllium copper alloy laminated to polyimide, and offers a low-resistance sensing element. Select the CD-02 type for maximum conformability to irregular surfaces and ease of soldering, when greatest fatigue life is not required.

The **CD-23** type is constructed of isoelastic alloy laminated to a glass-fiber-reinforced backing for applications where the highest endurance is required. The superior fatigue life of the isoelastic alloy allows the CD-23 to be used in high cyclic

strain fields without premature failure, while maintaining high sensitivity to crack formation under the gage. This gage is less conformable than the CD-02 and requires use of SS-Flux for tinning of solder tabs for leadwire attachment.

Crack Detection Gages are available with various strand lengths; from 0.4 in (10 mm) for applications where space is limited, to 2.0 in (50 mm) for use where the direction of crack propagation, or the point of crack initiation, is uncertain.

Resistance of the CD Series is nominally  $0.05\Omega/\text{mm}$  of active strand length for beryllium copper and  $1\Omega/\text{mm}$  for isoelastic gages.

The normal operating temperature range is  $-320^{\circ}$  to  $+250^{\circ}\text{F}$  ( $-195^{\circ}$  to  $+120^{\circ}\text{C}$ ).

#### ADHESIVES

Conventional strain gage adhesives are suitable for bonding CD-Series gages. M-Bond 600, 610, or 43-B are preferred for excellent performance over the widest operating temperature range. However, M-Bond AE-10 and AE-15 are also suitable where in-service temperatures will not exceed  $+200^{\circ}\text{F}$  ( $+95^{\circ}\text{C}$ ). M-Bond 200 is satisfactory for fast installation, but should not be used for long-term testing.

#### PROTECTIVE COATINGS

Corrosion, which can cause premature filament failure, is greatly accelerated in the presence of high cyclic strain fields. For long-term use, it is essential to protect the crack detection gage from atmospheric corrosion and other contamination.

M-Bond 43-B is an excellent protective coating when the bonding adhesive, leadwire insulation and solder can tolerate the cure temperature. If lower cure temperatures are necessary, M-Bond AE-10 and AE-15 are recommended. When in-service environmental conditions are not extreme, a softer coating may prove perfectly adequate. Either 3140 RTV or M-Coat D would be a good choice in these instances.

For repetitive use on identical structural shapes, special patterns may be designed to fit the expected crack formation area. Contact our Applications Engineering Department for details.

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### CD-SERIES GAGE DESIGNATION SYSTEM

CD - 23 - 15 A

**GEOMETRY** (tabs as shown)

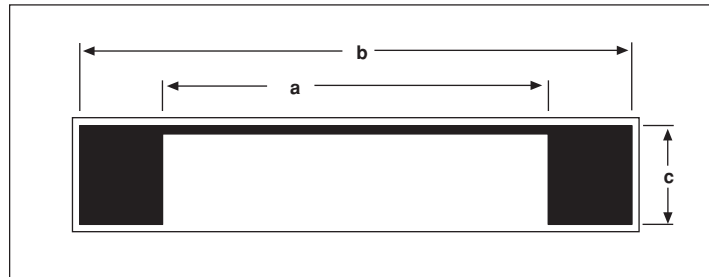
**LENGTH OF ACTIVE LINE IN MILLIMETRES**

**MATERIAL AND CONSTRUCTION:**

02 = 0.0005 in (0.013 mm) beryllium copper laminated to  
0.001 in (0.025 mm) polyimide backing

23 = 0.00025 in (0.006 mm) isoelastic alloy laminated to  
0.0008 in (0.020 mm) glass-fiber-reinforced backing

**CRACK DETECTION GAGE** (single strand)



GAGE DESIGNATION	DIMENSIONS				
	a	b	c	MATRIX	
				Length	Width
CD-02-10A	0.40	0.56	0.10	0.60	0.13
CD-23-10A	10.2	14.2	2.5	15.2	3.2
CD-02-15A	0.60	0.76	0.10	0.80	0.13
CD-23-15A	15.2	19.3	2.5	20.3	3.2
CD-02-20A	0.80	0.96	0.10	1.00	0.13
CD-23-20A	20.3	24.4	2.5	25.4	3.2
CD-02-25A	1.00	1.16	0.10	1.20	0.13
CD-23-25A	25.4	29.5	2.5	30.5	3.2
CD-02-50A	2.00	2.16	0.10	2.22	0.13
CD-23-50A	50.8	54.9	2.5	56.4	3.2