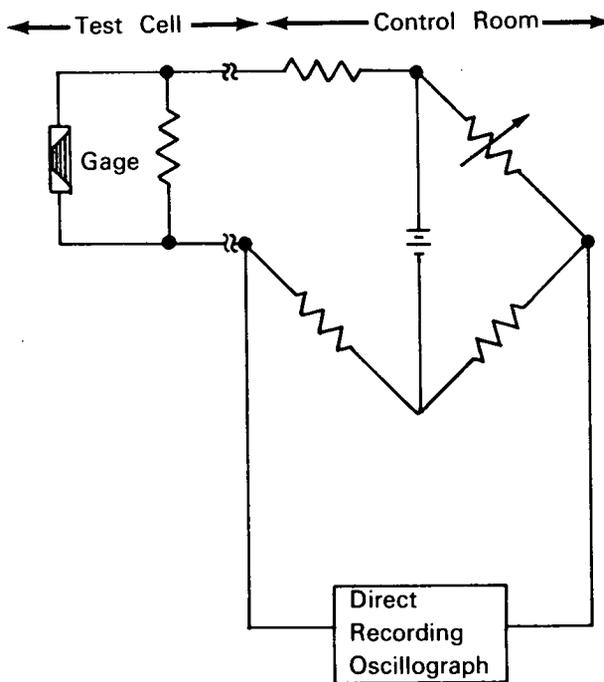


NASA TECH BRIEF



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Crack Growth Measured on Flat and Curved Surfaces at Cryogenic Temperatures



The problem:

Determination of the fracture toughness of a material requires knowledge of the crack length at the onset of rapid fracture or unstable crack growth. Cinematography, electrical potential measurement, and displacement (compliance) gaging have been used but become difficult or impractical when the test specimen is immersed in a cryogenic liquid or when a curved surface is involved, such as that of a cylindrical pressure vessel.

The solution:

A multiple element continuity gage for measuring plane stress crack growth plus surface crack growth under plane strain conditions.

How it's done:

The multiple element foil gage resembles a conventional foil gage but consists of 20 elements of high resistivity alloy foil physically and electrically in parallel. The gage is mounted on the test specimen at

(continued overleaf)

the crack tip with the elements perpendicular to the expected direction of crack propagation, with the leading edge of the shortest filament at the tip of the crack. If the crack growth is expected to exceed the gage width, additional gages may be placed in tandem with the first.

The continuity gage is designed to be used with a 1.5-ohm shunt resistor. As the crack grows, the elements are broken, from the shortest to the longest in turn, and the resistance of the assembly increases in a finite and relatively linear stepwise manner. A resistance of 119 ohms is added in series to make the assembly compatible with existing 120-ohm bridge circuitry used for recording strain gage data. Bridge output is fed to a direct recording oscillograph along with an applied load signal.

Notes:

1. This gage has performed satisfactorily at -320° and -423° F with 301 stainless steel, 5 aluminum-2.5tin-titanium, and 2014-T6 aluminum sheet specimens and pressure vessels.
2. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B67-10384

Patent status:

No patent action is contemplated by NASA.
Source: Timothy L. Sullivan and Thomas W. Orange
(LEW-389)