# NASA TECH BRIEF



## Temperature Controlled Strain Gaged Extensometer

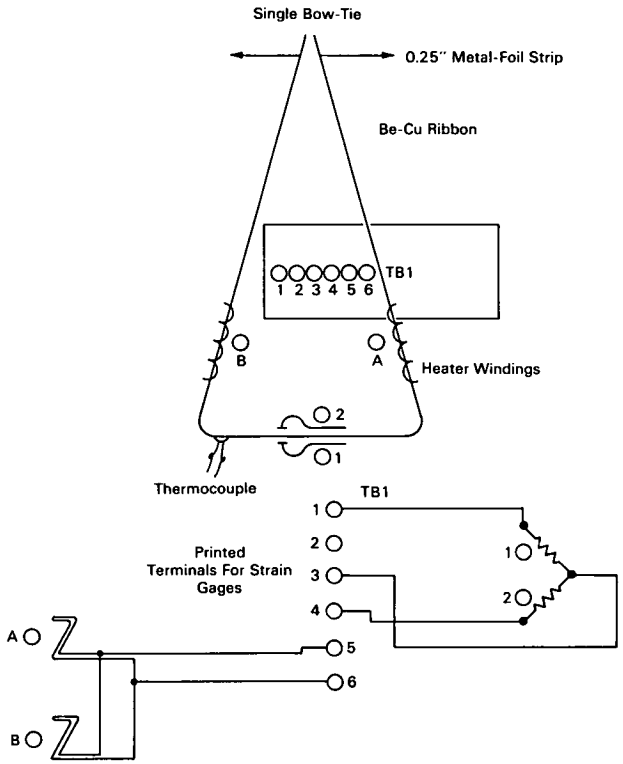


Figure 1

### The problem:

Measuring longitudinal and girth deflections of pressure vessels in excess of one percent strain during pressurization and depressurization with cryogenic fluids at cryogenic temperatures. Conventional strain gages are not satisfactory due to gage variations and adhesive limitations. Adhesives available for use at cryogenic temperatures are not recommended for strains greater than one percent.

### The solution:

A temperature controlled strain-gaged extensometer. This spring type strain-gaged extensometer is made in a "Bow Tie" configuration. A half "Bow Tie" (Figure 1) is used to measure changes from 0.060" to 1.0" and a full "Bow Tie" (Figure 2) is used to measure changes from 0.50" to 3.0".

### How it's done:

This device consists of beryllium-copper strips bent into a configuration that provides two cantilever beams. The strain gages are cemented on the short straight section of the Bow Tie exactly opposite each other. See Figure 1. Metal-foil strip, approximately 0.25-inch wide, was used to link the beam ends to the pressure vessel. For girth (hoop) measurements, the

(continued overleaf)

Double Bow-Tie

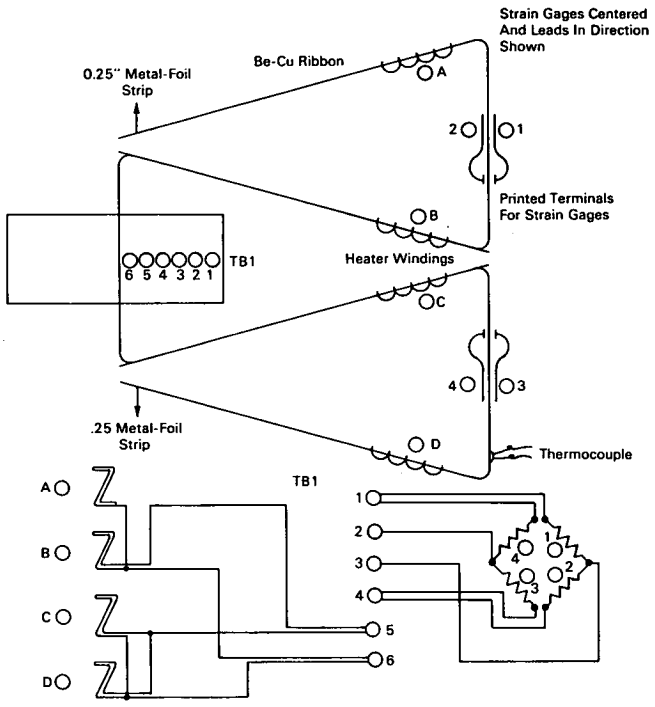


Figure 2

metal-foil strip is placed around the tank equator and secured to opposite ends of the beam. For longitudinal-deflection measurements, the metal-foil strips are affixed to tank bosses, and the cantilever-beam ends of the Bow Tie are connected to the ends of the foil strips at the midsection of the tank.

Heater wire is installed on the Bow Tie and a thermocouple is soldered to the beryllium-copper between the heater and the top strain gage.

Leads are connected from the strain gage terminals to a barrier strip which is clipped to the Bow Tie. The gages are so wired that they electrically add their output and are sensitive to a bending mode only.

The strain gages are connected to a signal conditioning unit which provides excitation voltages and transfers the output voltage to a strip chart millivolt recorder.

During operation, with the tank at cryogenic temperature, the heaters maintain the Bow Tie at a nominal 80°F and this temperature is controlled by using the output millivoltage of the thermocouple soldered to the Bow Tie. The thermocouple is connected to a recorder controller whose setting turns the heater voltage on and off, as required, to keep the Bow Tie at the nominal 80°F. In this way, the strain gages are operated at essentially room ambient temperature and no changes of gage factor occur.

**Note:**

Documentation for this innovation is available from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Price $3.00
Reference: B68-10543

Technical questions may be directed to:

Technology Utilization Officer
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B68-10543

**Patent status:**

No patent action is contemplated by NASA.

Source: G. L. Ramos and S. Seplow
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