HIGH TEMPERATURE STRAIN GAGES

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HIGH TEMPERATURE STRAIN GAGES

500°F and above - up to 2600°F

TYPES INCLUDE:

- Resistance ($\Delta$OHMS/$\Delta$Strain)
- Capacitive ($\Delta$pf/$\Delta$Strain)
- Fiber Optic ($\Delta$ Light/$\Delta$Strain)
HIGH TEMPERATURE STRAIN GAGES

NICROME

• Dynamic Applications
• Useable to 950°C – Do Not Exceed!
• G.F. Very Stable With Temperature
• G.F. Very Stable With Handling
• Rugged And Durable

MOLECULOY®

• Dynamic Applications
• Useable to 950°C – Longer Life
• G.F. Unstable Unless Stress Relieved
• G.F. Unstable Unless Annealed
HIGH TEMPERATURE STRAIN GAGES

PLATINUM TUNGSTEN

- Dynamic Applications
- Useable To 1200°C
- Double The Gage Factor
- Very High Resistance Change With Temperature
- High Elongation
- Static (special cases) to 480°C

HOSKINS 875 (KATHAL A1)

- Static Applications
- Useable To 950°C
- Must Be Used In Half-Bridge Configurations
OTHER TYPES

EVANOHM
- Dynamic Applications
- Useable to 950°C
- Similar To Moleculoy
- Static to 350°C

CAPACITIVE GAGE
- Static Applications
- High Strain Range
- Very Stable
- Bulky In Nature

FIBER OPTIC
- Working Models Demonstrated
- Easy to install
DESIGN IMPROVEMENTS

LEAD WIRE JOINT DESIGN

STRAIGHT LEADS
- 1 TO 3 Million Cycles To Failure
- ± 700 Micro Strain Range
- Easy To Handle

“Z” LEADS
- + 10 Million Cycles To Failure
- ± 1000 Micro Strain Range
- Handling Is Different

INBOARD LEADS
- Used When Space Dictates
- Similar Life To Straight Leads
DESIGN IMPROVEMENTS (CONT.)

TRUE FREE FILAMENT STRAIN GAGE

• Not Flattened – Round Wire For Best Life And Range

• No Tape – Long Shelf Life

• Easy Installation

• Relatively Expensive
OTHER IMPROVEMENTS (CONT.)

INSTALLMENT TECHNIQUES

• Shading Bars On Tapes

• Vortex Cooler To Improve Installation Stresses

NEW CEMENTS

• Non Carcinogen Cement

• Silicon Carbide Cement – *no longer available*

• Pt Alloy Cements

• Ni Alloy Cements
ATTACHMENT TECHNIQUES

CERAMIC CEMENT

• Many Types Available For Varied Applications
• Oven Curing Of Finish Installation Required

ROKIDE

• Equipment Costs Are High
• Wear Resistance And Durability Can’t Be Beaten
• Line Of Sight Installation
ATTACHMENT TECHNIQUES (CONT.)

SPUTTERING

- Expensive per Gage
- Large Parts Require Special Size Equipment

WELDABLE

- Easy To Install
- Lab Conditions For Installation Can Be 100% Quality Checked
- Many Applications Cannot Be Welded Due To Weld Deterioration Of Material Or Non-Weldability Of Specimen
LEAD WIRES

- Conductor Choice
  - Resistance per Length
  - Delta Ohms Over Temperature Range
  - Temperature Range of Conductor
  - Strength of Material

- Insulator Choice
  - Upper Temperature Range
  - G-Forces, Mechanical Environment
  - Temperature Coefficient Of Resistance
  - OHMS/Lead Length
CAPACITIVE GAGES

- Ultra, Ultra Stable, 20 Years Or Longer
- Very High Temperature, 1500°F, 2000°F
- Cannot Be Used In H₂O Environment, G-Force Or Dynamic Applications
- Special Instrumentation And Cables
- 1/2 Bridges Can Be Made Very Linear With Regard To ΔC/Δµε
- 1/4 Bridges Are Not Linear And Must Be Corrected Electrically
FIBER OPTIC

• Tested to 600°C
• Small Sensor and Fiber Size
• Expensive
• Immune To Electric Noise
• Becoming a Practical Solution in Many Applications
**STATIC MEASUREMENTS**

- Hoskins 875 Alloy In Half-Bridge NASA Langley Design Up To 1500°F. Attention Is Needed For Good Data
- Evanohm (known as Karma) to 350°C
- Platinum Tungsten TC Corrected to 450°C
- Palladium Chrome And Pt Alloys Also Used With Some Success
- Half Or Full Bridge Weldable Configuration Capacitive
- Optical Methods
CURRENT DEVELOPMENTS

- ITO  Refer to Dr. Otto Gregory’s presentations

- COATED NICHROME  Nano-coatings to prevent oxidation