

**New York City College of Technology**

**Electrical and Telecommunication Engineering Technology Department**

**Assignment # 3**

**Course:** EET 3120 Sensors and Instruments

**Submitted to:** Prof. Viviana Vladutsecu

**Date:** March 29, 2015

**Submitted by:** Damian Robinson

1. **How can we convert inch of water into Pascal?**

When pressure is exerted on a fluid that is 1 inch in height, with fluid density of 1.004514556 gram per cubic centimeter with gravitational acceleration exactly 9.81 m/ sec2.

Example: Conversion of 1 inch of water to Pascal

**Density** = 1.00454556g/cm3 = 1000kg/m3

**Area** = 1 m²

**Height** = 1 inch = 0.0254m

**1 inch water mass:** m = density \* Volume = 1000 \* 1 \* 0.0254 = 25.4kg

**Force:** F = mass \* acceleration (g) = 25.4 \* 9.80665 = 249.08891 N

1 inch water Pressure = $\frac{Force}{Area}$ = $\frac{249.0889}{1}$ = 249.08891pa

1. **inch of water =** 249.08891 Pascal
2. A metallic wire embedded in a strain gage in 4.2cm long with a diameter of 0.07mm. The gage is mounted on the upper surface of a cantilever beam to sense strain. Before strain is applied, the initial resistance of the wire is 64Ω. Strain is applied to beam, stretching the wire 0.1mm, and changing its electrical resistivity by 2 x 10^-8Ωm. if Poisson’s ratio for the wire is 0.342, find the change in resistance in the wire due to the strain to the nearest hundredth ohm.

**Given:**

Length = 4.2cm = 0.042m

Diameter = 0.07mm Radius = D/2 = 0.035mm = 0.000035m

Resistance = 64Ω.

∆L = 0.1mm = 0.0001m d$ρ$ = 2 Resistivity = 2\* 10-8Ωm

$v$ = 0.342

dR =?

**SOLUTION** **Formula:** $\frac{dR}{R}=\left(1+2v\right)ϵL+\frac{dρ}{ρ}$

**-** $A=πr^{2}$= 3.14 \* (0.000035)2 = 3.8465 \* 10-9 m^2

 $R=ρ\frac{L}{A} ρ=\frac{RA}{L}=\frac{64\*3.85\*10\^-9}{0.042}=5.867\*10\^-6Ωm$

 $ϵL=\frac{∆L}{L}=\frac{0.0001}{0.042}=0.00238$

$\frac{dR}{R}=\left(1+2v\right)ϵL+\frac{dρ}{ρ}$ = (1+ 2\*0.342)0.00238 + 2 \* 10-8Ωm/$5.867\* 10^{-6}$

**dR= 0.4747Ω**

1. A metallic strain gage has a resistance of 350 Ω at zero strain. It is mounted on a 1-m-long column. The column is strained axially by 1 cm. Determine a typical resistance (in Ω) of such a gage under its strained condition.

**Given:**

Ge = 2 (Engineering factor of most metallic strain gage)

R = 350Ω L = 1m ∆L = 1cm = 0.01m

**Solution:**

$Ge=\frac{∆R/R}{∆L/L}$ ,

$∆R=Ge\*R\frac{∆L}{L}$ = 2 \* 350 \* $\frac{0.01m}{1m}$ = 7Ω

**Total Resistance** = 350 + 7 = 357Ω

1. A resistive accelerometer is fabricated with an internal mass of 1 g and 2-mm-long strain gages, each having a spring constant of 300 N/m. When the gages are strained by 2 % in a direction parallel to the strain gages, determine (a) the acceleration $\frac{}{}$(in m/s2) in the direction parallel to the strain gages and (b) the acceleration (in m/s 2) in the direction perpendicular to the strain gages.

**Given:**

m = 1g = 0.001kg **∆**L **=** 2mm = 0.002m K = 300N/m

**Solution:**

$∆L=\left(\frac{m}{k}\right)a, $$a=∆L\*\frac{k}{m}$

1. ∆L = 0.002 \* $\frac{2}{100}$ = 0.00004m (Parallel to strain gages)

$a=∆L\*\frac{k}{m}$ = 0.00004 \* $\frac{300}{0.001}$ = 12 m/s2

1. ∆L = 0.002 \* $\frac{98}{100}$ = 0.00196m (Perpendicular to the strain gages)

$a=∆L\*\frac{k}{m}$ = 0.00196 \* $\frac{300}{0.001}$ = 588 m/s2