

## Solutions of ME 355 Home Work No. 1

### 1. 3A-3 Definitions

Sensitivity: smallest variation the instrument can detect

Resolution: smallest variable displayed by a digital readout

Repeatability: capability of reproducing the same value

Stability: resistance to drift

### 2. 3B-6

Yes. The complaint could be justified. Pneumatic gages are not absolute gages; they must be set up against a standard. If the gage was improperly set, all readings will be off.

### 3. 3B-8

RMS roughness ( $R_q$ ) is always greater than arithmetic average roughness ( $R_a$ ). Thus, the permissible limit should be larger by a factor of 1.1 to 1.4, depending on the method used for finishing the surface. (See p66 Table 3-1)

### 4. 3C-1

- (a) Since the tolerance of the shaft is 0.021 mm, the measurement device should preferably have a precision ten times better, which is 0.002 mm.
- (b) The smallest scale division would be 0.002 mm or, since a half division is easily judged, 0.005 mm.

### 5. 3C-7

CTE for Al =  $23.6 \times 10^{-6} \text{ m/(m}\cdot\text{k)}$  (see p115 table 4-1 )

CTE for steel =  $12.4 \times 10^{-6} \text{ m/(m}\cdot\text{k)}$ , (see [www.matweb.com](http://www.matweb.com), or any other references. CTE of iron in p115 table 4-1 can also be used.)

Al: 200 mm at 70 C;  $\Delta T = 50 \text{ C}$ : expansion =  $200 \times 50 \times 23.6 \times 10^{-6} = 0.236 \text{ mm}$

Steel: 200 mm at 25 C;  $\Delta T = 5 \text{ C}$ : expansion =  $200 \times 5 \times 12.4 \times 10^{-6} = 0.0124 \text{ mm}$

Error =  $0.236 - 0.0124 = 0.2236 \text{ mm}$

### 6. 3C-8

Al: 200 mm at 30 C;  $\Delta T = 10 \text{ C}$ : expansion =  $200 \times 10 \times 23.6 \times 10^{-6} = 0.0472 \text{ mm}$

Steel: 200 mm at 30 C;  $\Delta T = 10 \text{ C}$ : expansion =  $200 \times 10 \times 12.4 \times 10^{-6} = 0.0248 \text{ mm}$

Error =  $0.0472 - 0.0248 = 0.0224 \text{ mm}$