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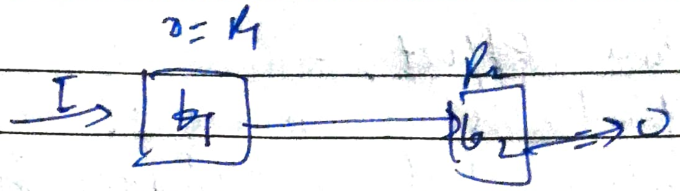
Q1.




Full scale error of Inst 1

$$= \frac{k_1 R_1 \alpha x_1}{100}$$

But if input is not FS,

$$\text{Error} = \frac{k_1 I y_1}{100}.$$

So, we have 4 case here.

Taking $(x_1, x_2)$, $(x_1, y_2)$, $(y_1, x_2)$ & $(y_1, y_2)$.

Case I $(x_1, x_2)$

$$O = k_2\left(k_1 I + \frac{k_1 R_1 x_1}{100}\right) + \frac{k_2 R_2 x_2}{100}.$$

$$O = k_2 k_1 I + \frac{k_1 k_2 R_1 x_1}{100} + \frac{k_2 R_2 x_2}{100}.$$

$$\text{Error} = \frac{k_1 k_2 R_1 x_1}{100} + \frac{k_2 R_2 x_2}{100}.$$

Case II $(x_1, y_2)$

$$0 = b_2\left(b_1 I + \frac{b_1 R_1 x_1}{100}\right) + \frac{b_2 y_2}{100}\left(b_1 I + \frac{b_1 R_1 x_1}{100}\right)$$

$$0 = b_2 b_1 I + \frac{b_1 b_2 R_1 x_1}{100}$$

$$+ \frac{b_2 b_1 y_2 I}{100} + \underbrace{\frac{b_2 b_1 R_1 x_1 y_2}{10000}}_{\text{ignored.}}$$

$$\text{Error} = \frac{b_1 b_2 (R_1 x_1 + y_2 I)}{100}.$$

Case III $(y_1, x_2)$

$$\cancel{0 =} \text{ Error} = \frac{b_1 b_2 I y_1 + b_2 R_2 x_2}{100}.$$

Case IV (.

$$0 = b_2\left(b_1 I + \frac{b_1 I y_1}{100}\right) + \frac{b_2 y_2}{100}\left(b_1 I + \frac{b_1 y_1 I}{100}\right)$$

$$\text{Error} = \frac{b_1 b_2 I y_1}{100} + \frac{b_1 b_2 I y_2}{100}.$$

Q2o) Given :-

Rated Input ($I$) = 2kN

Output Sensitivity wrt Input ($k$) = 2mV/V of excitation

Repeatability error ($E_1$) = ±0.05% of rated O/P (FS)

Reversibility error ($E_2$) = ±0.05% of rated O/P

Non-linearity ($N$) = ±0.25% of rated O/P

Deviation of zero signal ($E_3$) = ±0.05% of rated O/P.

Modifying input sensitivity = ±0.26% of O/P / 5°C

→ Modifying input here is dependent on Temp ⇒ $T = I_m$

in the worst case $T = 50°C$

→ Similarly, interfering input is also temp ⇒ $= I_I$

Sensitivity ($k_I$) = ±0.18% of rated O/P / 5°C

(a) from here net o/p can be divided into sections:-

Nominal Excition $(O_L)$ =

$(kI + a)$

$= (2m\text{V} \times I + a)$ ↳ zero value.

$= 2mI$

Errors $= (\pm 0.05\% \pm 0.5\% \pm 0.05\%) \times (2m\,I)$

$= 1.2 \times 10^{-5} I.$

Non-linearity $= \pm 0.25\% \times 2m\,I$

$= 0.5 \times 10^{-5} I.$

Interfering output $= k_I I_T\, I\, T$

$= \frac{0.18}{10} \times 2m\, I \times T$

$= \frac{0.36}{10} \times 10^{-5}\, T I.$

Till now total output $= (2mI + 1.2 \times 10^{-5} I + 0.36 \times 10^{-5} IT)$

Modifying output =

$(\pm 0.28\%$ of mean o/p$)$

$= \cancel{0.1 \times 10^{-3}}$

$0.28 \times \frac{TI}{10} \times (2m + 1.2 \times 10^{-5} + 3.6 \times 10^{-7} T)$

So, net output =

$$\left(2\times10^{-3} \pm 1.7\times10^{-5} \pm 3.6\times10^{-5}T\right) I$$

$$+ 3.6\times10^{-5}\, IT \left(2\times10^{-3} \pm 1.7\times10^{-5} \pm 3.6\times10^{-5}T\right)$$

(b). $O(I,T) = \left(2\times10^{-1} \pm 1.7\times10^{-3} \pm 3.6\times10^{-3}T\right)\%$ of FS O/P

$\pm \left(3.6\times10^{-2}T\right)\%$ of Measured O/P.

Here ideal output = $2\times10^{-3}$ V/V FS.

then error bound

= 0.2035% of FS/OP)

$\pm$ 1.8%. of Measured O/P

(c). $I = 10V$, Measured O/P = 10 mV.

FS O/P = $kI_{ex}$

= 2mV/V × 10

= 20mV.

From above Equation.

①

d) Temperature Effect :-
As load cells are made of either Stainless steel or tool steel then temperature changes will influence the accuracy.

CREEP Effects :-
This is the change of load cell signal that occurs to under load.

Repeatibility :-
When a load is repeatibility applied to a load cell, the output may vary slightly.