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ENGINEERING NOTE

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MAGNET COIL

TITLE
POLE BASE TO MAGNET LEG ATTACHMENT BOLTS

CALCULATIONS ARE SHOWN FOR THE POLE BASE TO MAGNET LEG ATTACHMENT BOLTS.

THE 1 3/4 - 5 UNC BOLTS HAVE TO BE TORQUED TO 1200 FT-LB TO GIVE SUFFICIENT PRE LOAD SO THAT THE POLE BASE WILL NOT LIFT OF THE MAGNET LEGS WHEN THE TPC IS PRESSURIZED TO 150 psig

REFERENCE DRAWINGS

DESCRIPTION	DRAWING No.
MAGNET LEG ASSY	19C2346
POLE BASE AND POLE TIP ASSY SOUTH	19C2866
" " " " " NORTH	19C2776
POLE BASE PART 1 SOUTH	19C1546
" " NORTH	19C0696

CALCULATIONS

WHEN TPC IS PRESSURIZED TO 150 PSIG THE TOTAL FORCE ACTING ON THE POLE TIP ASSY

$$W = P\frac{\pi D^2}{4} = \frac{150\ \text{psi}\ \pi\ (90^2)}{4} = 954{,}300\ \text{LB}$$

WHERE 90 IN IS THE O.D. OF THE SEAL RING GROOVE

COMBINING DIRECT TENSION & BENDING

BOLT STRESS = 21.04 + 1.5 = 22.5 KSI

BOLT YIELD = = 153 KSI

F.S = 6.8

O.K.

REQUIRED PRELOAD SO POLE BASE WILL NOT LIFT OF LEGS WHEN TPC IS PRESSURIZED

FROM SHIGLEY "MECHANICAL ENGINEERING DESIGN" 3RD ED McGRAW HILL PP 241

PRELOAD $F_i \geq \frac{K_m}{K_b + K_m} P$

P = EXTERNAL FORCE ON BOLT

K_m = POLE BASE STIFFNES

$= \frac{AE}{\ell} = \frac{\pi D^2 E}{4\ell}$

K_b = BOLT STIFFNESS

$= \frac{\pi d^2 E}{4\ell}$

$D = 3d$

$K_m = \frac{\pi\left[(3\times1.75)^2 - 1.75^2\right]}{4(11.38)} 30\times10^6 = 5.07\times10^7 \frac{LB}{IN}$

$K_b = \frac{\pi (1.75)^2}{4} \frac{30\times10^6}{11.38} = 6.3\times10^6 \frac{LB}{IN}$

$P = \frac{954\,K}{24 \text{ BOLTS}} = 39.8\,K$

$\frac{K_m}{K_b + K_m} P = \frac{5.07\times10^7}{(6.3\times10^6 + 5.07\times10^7)} 39.8\,K = .89(39.8) = 35.4\,K$

USE 40K FOR PRELOAD

RESULTANT BOLT LOAD $= \frac{K_b P}{K_b + K_m} + F_i$

$= \frac{6.3\times10^6 \quad 39.8^K}{(6.3\times10^6 + 5.07\times10^7)} + 40^K = \underline{44.4^K}$

TORQUE REQUIRED TO GET 40K PRELOAD

$T = .2DP$

$T = .2(1.75)\,40000\,LB = 14{,}000\ IN\text{-}LB$

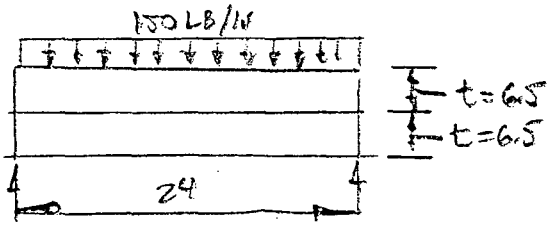
OR $\boxed{1200\ FT\text{-}LB}$

IF BOLTS ARE NOT TORQUED THEY WILL ELONGATE AND THE POLE BASE WILL SEPARATE FROM THE MAGNET LEGS

CHECK ELONGATION $\quad \Delta L = \epsilon L = \frac{\sigma}{E} L = \frac{21{,}040\ psi}{30\times10^6\ psi} \times 11.38\ IN = .008\ IN$

THERE ARE SHIMS AROUND EACH BOLT HOLE. THE SHIM THICKNESSES ARE DIFFERENT WITH MAX BEING ABOUT .125 IN

CHECK DEFLECTION OF POLE BASE WHEN MAGNET IS TURNED ON. MAGNET FORCE $\cong$ 150 psi



FOR $t = 6.5\ IN$

$I = \frac{bh^3}{12} = \frac{1(6.5)^3}{12}$

$= 22.9\ IN^4$

$\Delta max = \frac{5wL^4}{384EI}$

$= \frac{5(150\ LB/IN)(24\ IN)^4}{384\,(30\times10^6\ \frac{LB}{IN^2})\,22.9\ IN^4} = \underline{.00094\ IN}$

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