Grid to Tracker Stud Interface
Trade Study

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Rear Insert

**Pro’s**
- No concentricity issues – wide range of float possible
- Serviceable at side flexure locations
- Eliminates grid stresses caused by bushing press fit
- Reduced tolerance requirements

**Con’s**
- Not applicable to corner flexures
- Requires constraint to retain insert in cavity and prevent insert rotation
- Creates four openings on each mid-side location, causing larger pin stresses
Square Nut

**Pro’s**
- No concentricity issues – wide range of float possible
- Serviceable at corner flexure locations
- Eliminates grid stresses caused by bushing press fit
- Reduced tolerance requirements

**Con’s**
- Not serviceable at side flexure locations
- Requires shield from heatpipe bonding epoxy
- Requires constraint to retain insert in cavity and prevent insert rotation
- Creates four openings on each mid-side location, may increase stresses
Helicoil

**Pro’s**
- Simplest design
- Lowest cost design
- Applicable at both side and corner locations
- Eliminates grid stresses from the bushing press fit

**Con’s**
- Helicoils are intended for secondary structure not primary structure
- May spin out during disassembly or during vibration environment
- Not readily repairable
- May not meet concentricity requirements
- Stud would seat on chamfer
Recommendation
Square Nut at Corners & Rear Insert at Sides

Pro’s
• No concentricity issues
• Serviceable at all locations
• Eliminates grid stresses from the bushing press fit
• Same stud design & load path for dula eccentric design

Con’s
• Constraint required to hold insert and square nut in position
• Additional Stress Analysis Required
Cut-Away at Side Locations

- Backside Insert
- Roll pin
- Shown with Helicoil
Shoulder Bolt Bearing Calculation Assumptions

Load distributions considered

Distribution 1 – Uniform through depth – **UNCONSERVATIVE**.
This distribution idealizes the bearing load of the pin on the hole, but is valid for short pins (L/D is a small number). In this case, L/D is 0.89, which is not small.

Distribution 2 – Trapezoidal; Linear varying through depth – **REALISTIC**.
This distribution is probably the most realistic case. However, there is not a clear method of calculating w1 and w2.

Distribution 3 – Triangular; Linear varying through depth – **CONSERVATIVE**.
This distribution represents the critical pin depth where less engagement would result in a trapezoidal distribution and more engagement would result in pin bending, i.e. “Distribution 4.” This distribution is conservative and easy to calculate.

Distribution 4 – Bending; Linear varying through depth – **MOST CONSERVATIVE**.
This distribution is well suited for longer pins where pin bending may become a factor. In this case, it is not necessary to be overly conservative.

**AL6061-T6 Bearing Strength**
(e/D = 1.5): Fby = 53 ksi; Fbu = 69 ksi
(e/D = 2.0): Fby = 61 ksi; Fbu = 90 ksi

Smax = 811 lbf = 3.61kN
M = 0 N-m
L = 0.279 in = 7.09 mm
D = 1/4 in = 6.35 mm

Selected Method

**Shoulder Bolt, A286**
#10-24 UNC, 0.38” depth

**Grid, AL6061-T6**
Shoulder Bolt Bearing Calculation Margins

Bearing Stress in Alum Grid Using Load Distribution 3

Pin engagement into Grid is
L = 7.09 mm (0.279 in)
D = 6.35 mm (1/4 in)

Bearing load using load distribution 3
\[ w_i = \frac{2 \cdot S}{L} = 1.018 \frac{kN}{mm} \]

Bearing Stress calculation
\[ \sigma_{br} = \frac{w_i}{D} = 160 MPa \]

Margins using Shear out-bearing strength from Bruhn (more realistic; based on empirical data)

Calculate Edge distance (e/D)
\[ e = \frac{7.493}{6.35} \text{ mm (0.295 in); D = 6.35 mm (1/4 in)} \]
\[ e/D = 1.18 \]
\[ P_{Bru} = K_{Bru} F_{tu} A_{Br}; P_{Bry} = K_{Bry} F_{ty} A_{Br} \]
\[ K_{Bru} = 1.2; K_{Bry} = 1.1 \]
\[ F_{tu} = 296 MPa; F_{ty} = 262 MPa \]
\[ A_{Br} = (7.09 \text{ mm})(6.35 \text{ mm}) = 45.02 \times 10^{-6} \text{ mm}^2 \]
\[ P_{Bru} = (1.2)(296 MPa)(45.02 \times 10^{-6} \text{ mm}^2) = 15991 N \]
\[ P_{Bry} = (1.1)(262 MPa)(45.02 \times 10^{-6} \text{ mm}^2) = 12975 N \]

Adjusted Margin calculation
\[ MS_u = 2.16 \]
\[ MS_y = 1.88 \]