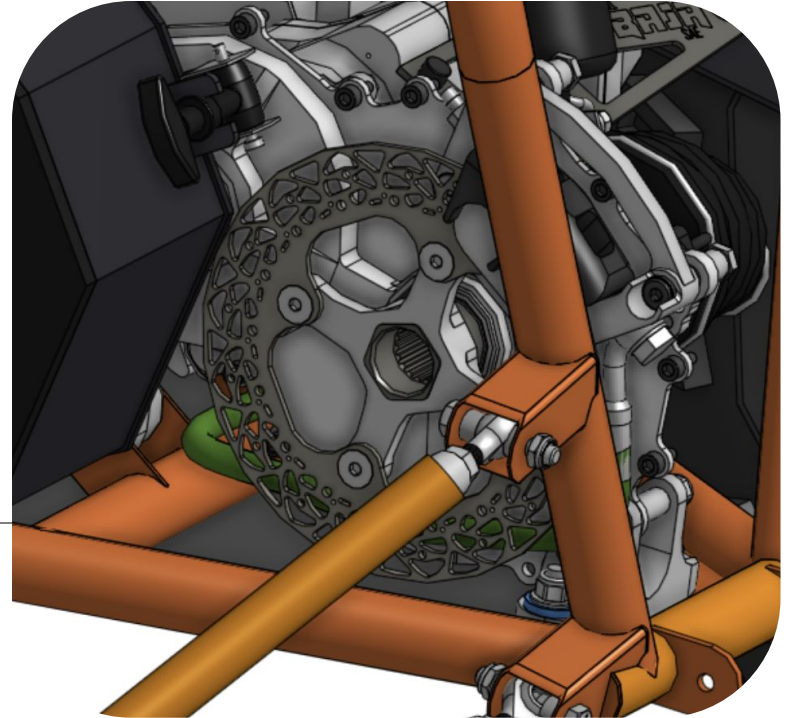




Brake Hub Simulation

Luis Daniel Weiss Quiroz

Dec 5, 2024

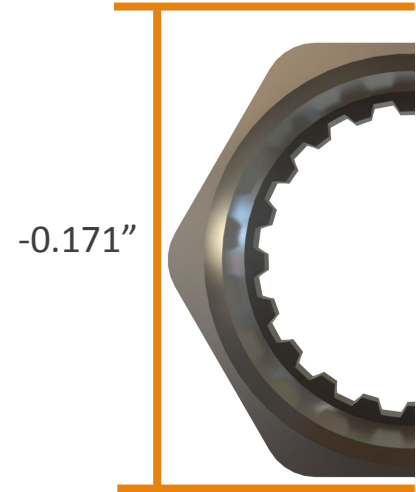


Background

OS Brake hex changed from R24s 1.193" to 1.022"

Raising concerns about the strength of an aluminium brake rotor hex.

The following analysis aims to show the strength of a smaller hex profile both at an ideal fit condition and at a clearance fit from manufacturing error



7075 Properties

Material	Yield Strength	Ultimate Strength	Young's Modulus	Source
7075	73,000 psi	83,000 psi	10,400,000 psi	MATweb

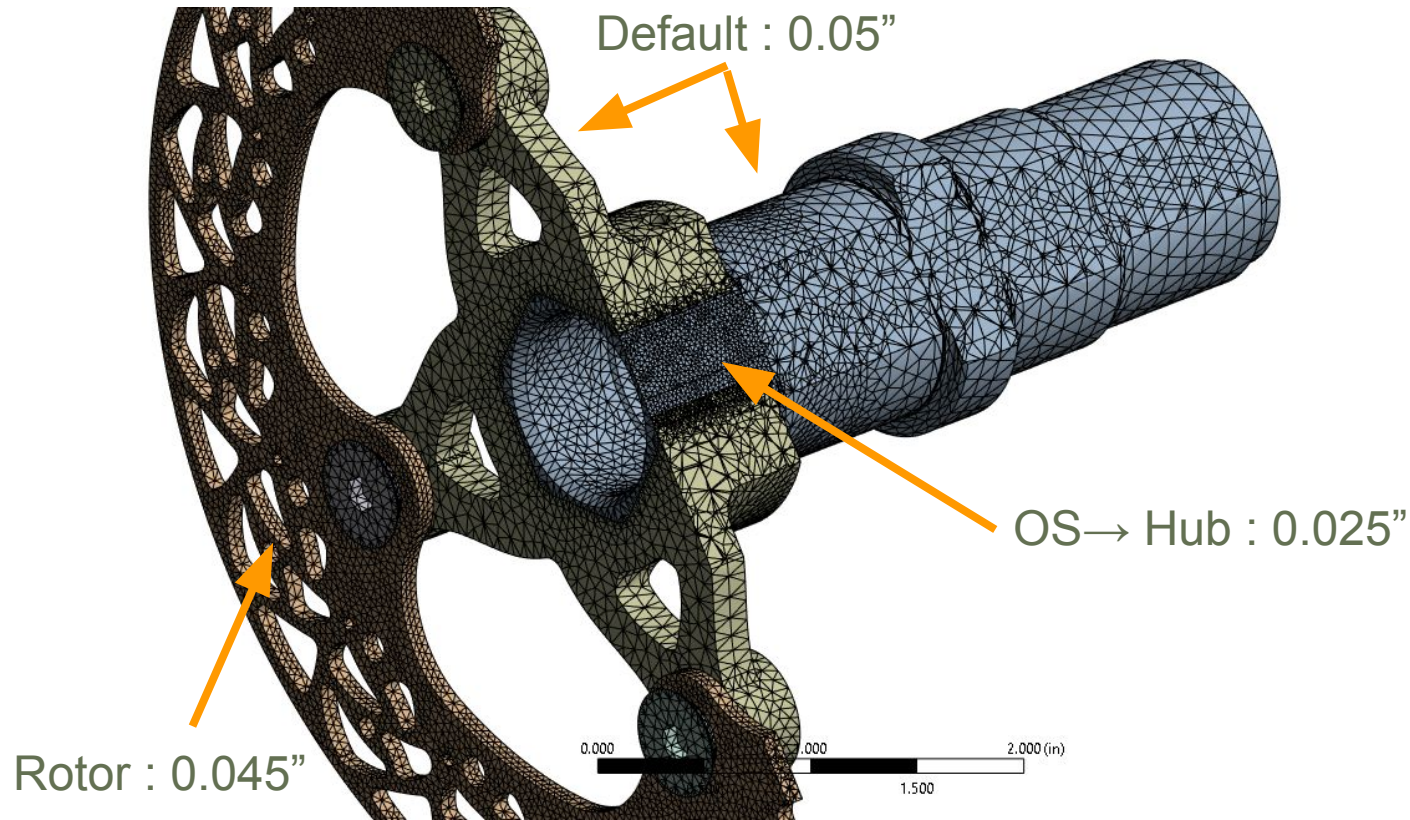
Fatigue Limit [psi]	64,000
AL. to Steel μ (Dry)	0.6
AL. to Steel μ (Lubricated)	0.3*

*Badly / roughly assumed from μ of AL to AL lubricated
https://www.engineeringtoolbox.com/friction-coefficients-d_778.html

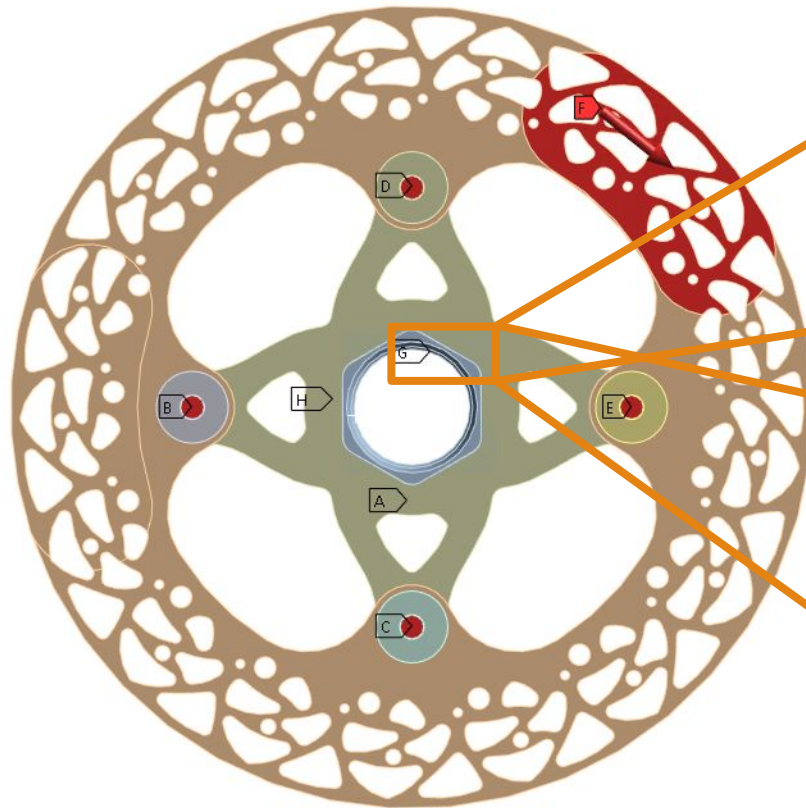
RIT Baja Fatigue Calculator
Total Damage: 25%
Minimum FOS: 1.17

Common	
a. Maximum Stress	64000 [psi]
b. Minimum Stress	0 [psi]
c. Cycles	180 [cycles]
d. Stress Conc. Factor, Kt	1.00 [factor]
e. Notch Radius, r	0.050 [in]
f. Surface Finish	Machined List
g. Material	7075-T6 Machined Finish 28 List

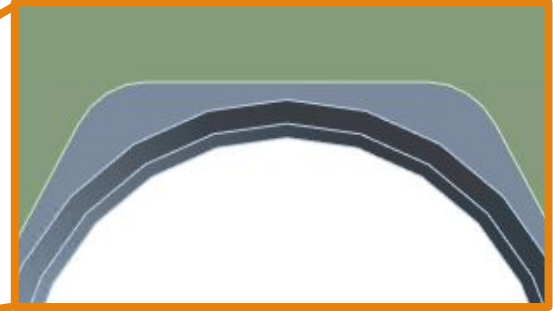
Mesh



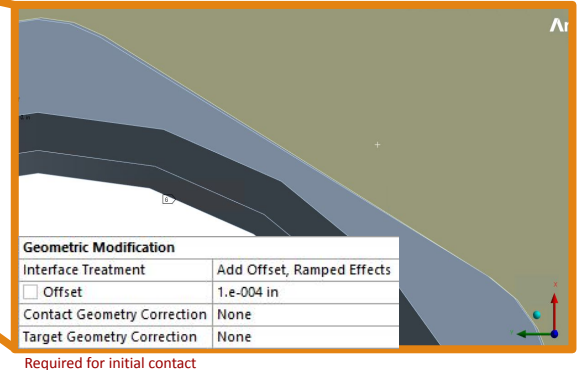
Geom. Setups



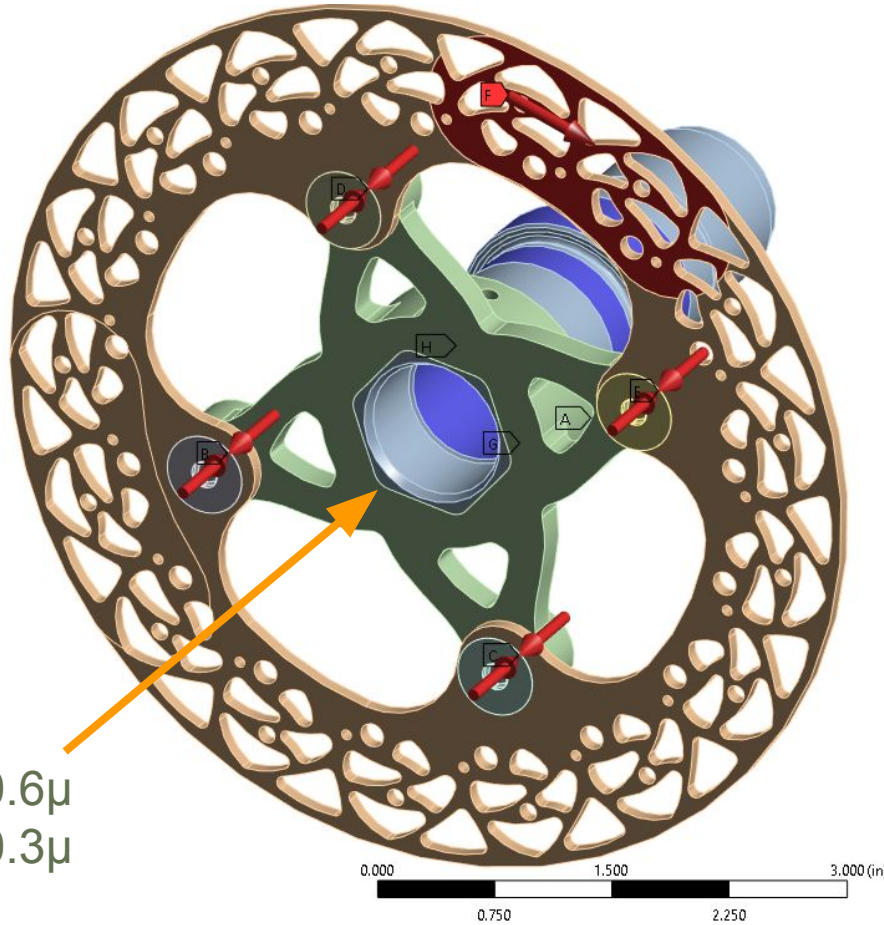
Setup A:
Line on Line



Setup B:
0.0015" Hub Wall Offset
(0.003" diametrically)



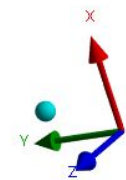
- A: Static Structural**
Static Structural
Time: 1. s
12/5/2024 8:05 PM
- A G4 OD Spline - Fixed Support
 - B Bolt Pretension: 400. lbf
 - C Bolt Pretension 2: 400. lbf
 - D Bolt Pretension 3: 400. lbf
 - E Bolt Pretension 4: 400. lbf
 - F Brake Pad Reacting Force: 680. lbf
 - G CV - Cylindrical Support: 0. in
 - H OS Journals - Cylindrical Support: 0. in



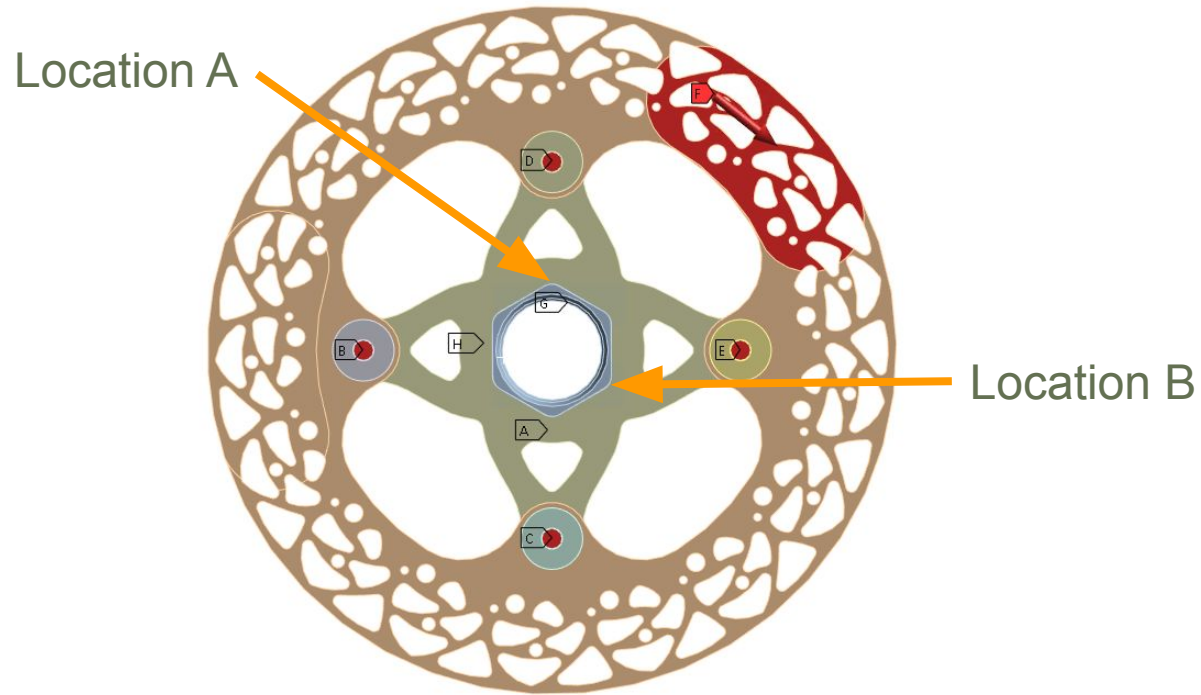
Frictional - 0.6μ
Frictional - 0.3μ

G:
Axial - Free
Radial - Free
Tangential - Fixed

H:
Axial - Fixed
Radial - Fixed
Tangential - Free



Max Stress Locations



Setup B - Line on Line - Frictional - 0.6μ

A: Static Structural

Equivalent Stress 2

Type: Equivalent (von-Mises) Stress

Unit: psi

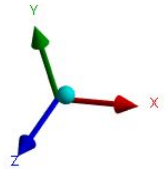
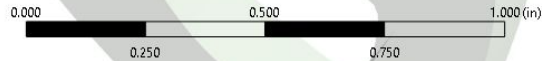
Time: 1 s

12/5/2024 8:12 PM



Max

Target FOS: 1.15
Fatigue FOS: 3.3
Static FOS: 2.5

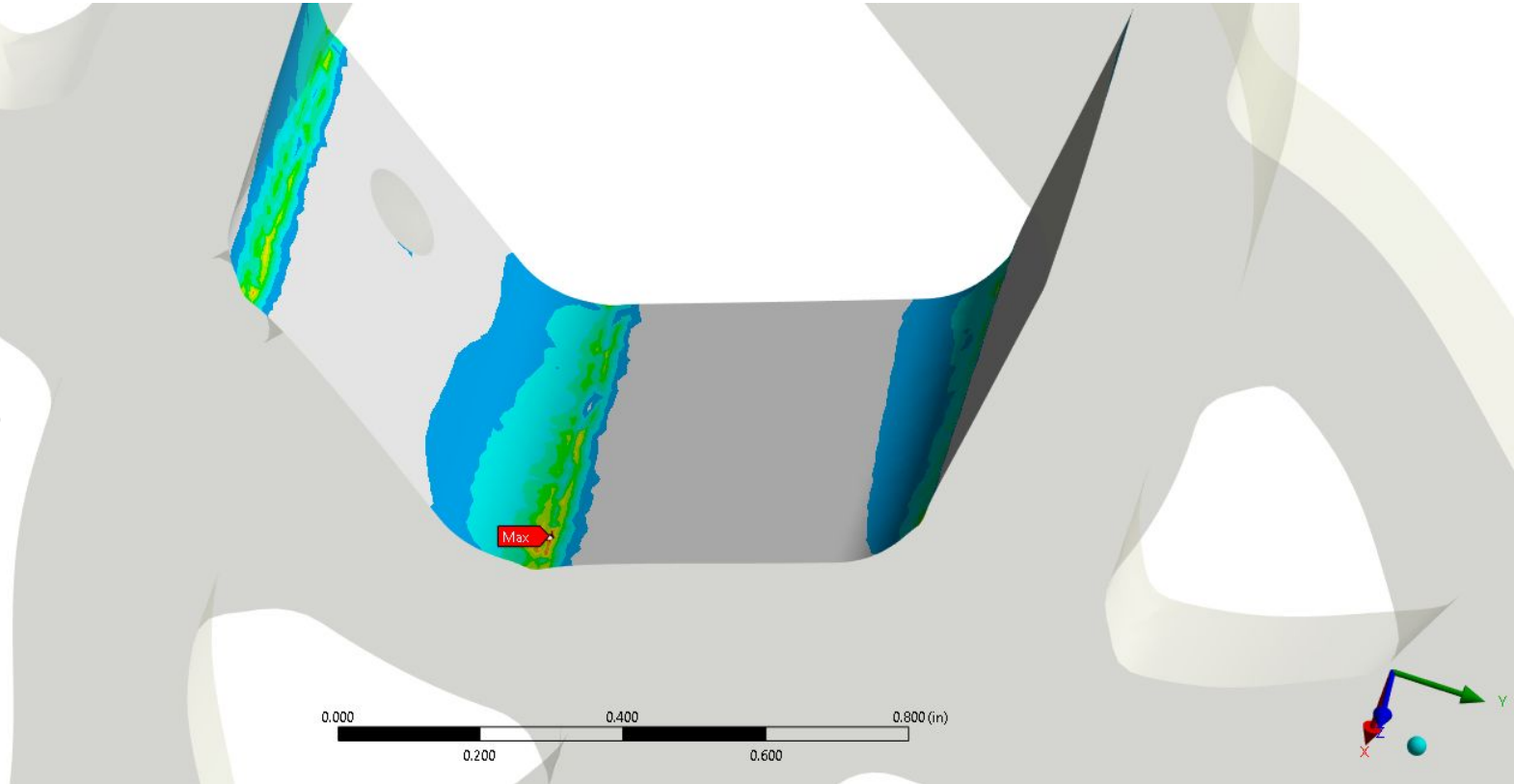


Setup A - Frictional - 0.6μ

B: Copy of Static Structural
Equivalent Stress 2
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1 s
12/5/2024 10:00 PM

61828 Max
54960
48093
41226
34358
27491
20623
13756
6888.4
20.993 Min

Target FOS: 1.15
Fatigue FOS: 1.2
Static FOS: 1.2



Deformation - Frictional - 0.6μ

C: Copy of Copy of Static Structural

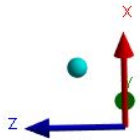
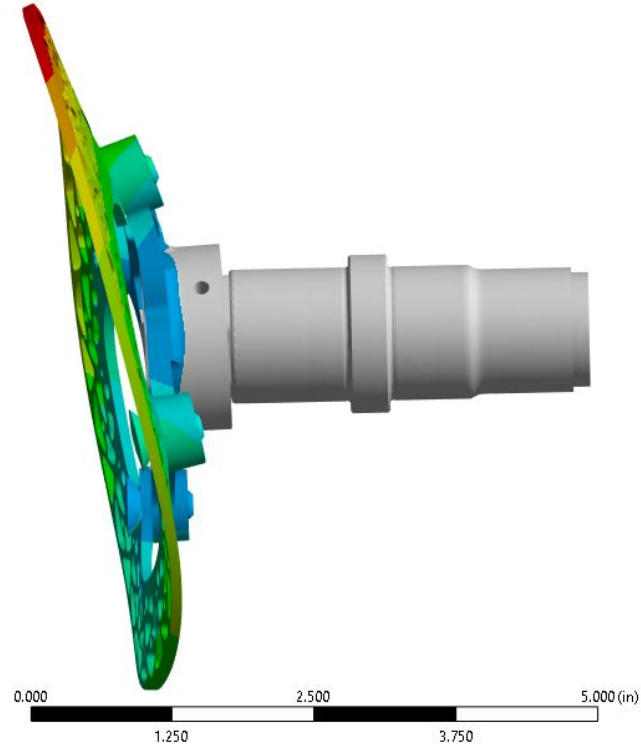
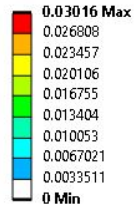
Total Deformation

Type: Total Deformation

Unit: in

Time: 1 s

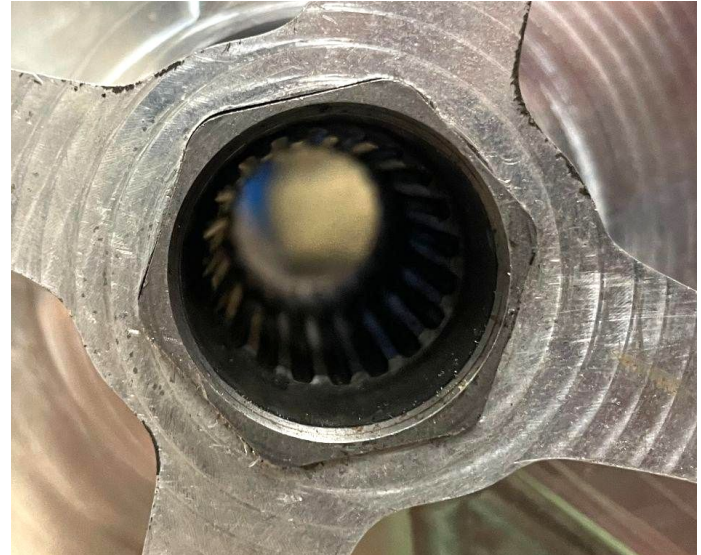
12/5/2024 10:20 PM



Results

Brake hub was designed to last 18 hrs.

Began to visibly wallow at 20 hrs similar to how the simulation predicted.



Miscellaneous

Bolt tension from : [Bolt Torque & Preload Calculator | MechaniCalc](#)

1/4-20

Preload (% Yield)	Preload Force, F_{PL}	Torque Coefficient, K_T	Install Torque, T
21.0%	400.0 lbf	0.200	20.00 in*lbf