

SID's TECHNICAL PORTFOLIO

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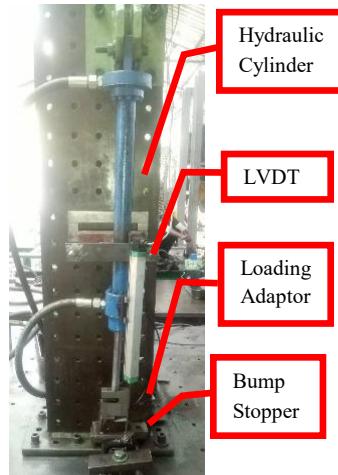
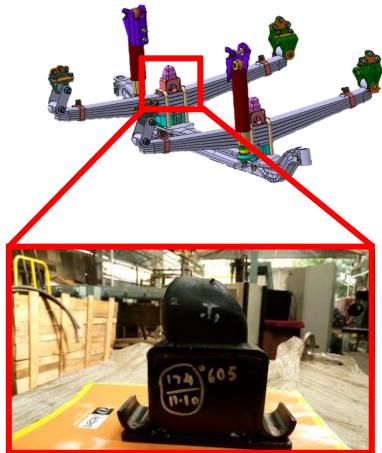
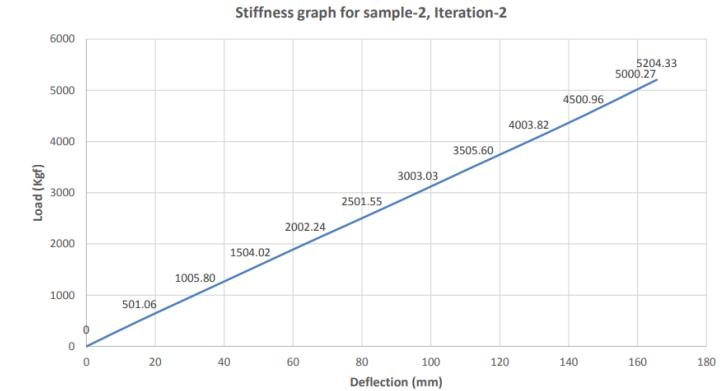
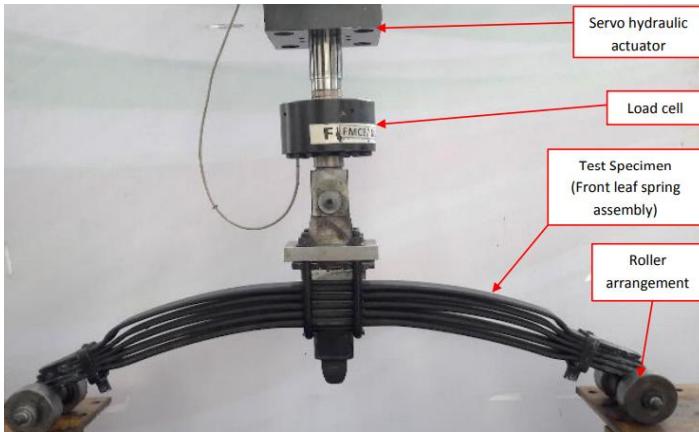
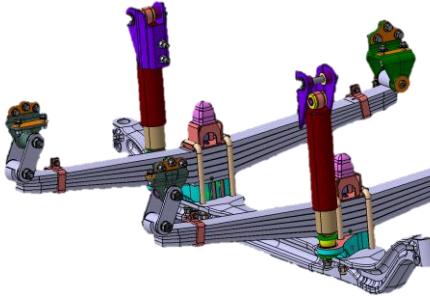
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Validation based design improvement

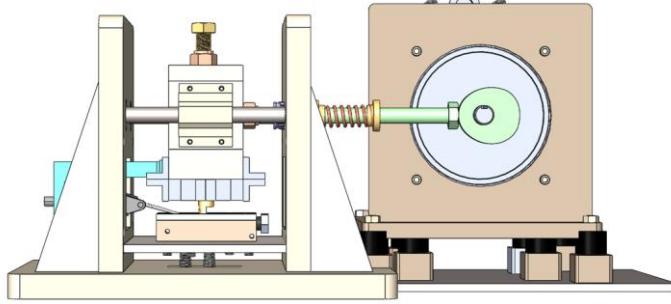
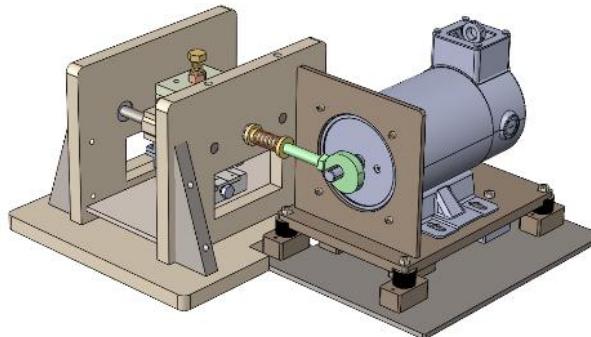


Suspension system design & prototype made based on theoretical vehicle dynamic calculations

SAE based Validation test set-up design for individual component

Validation tests results utilized to fine tune ride and handling benchmarks

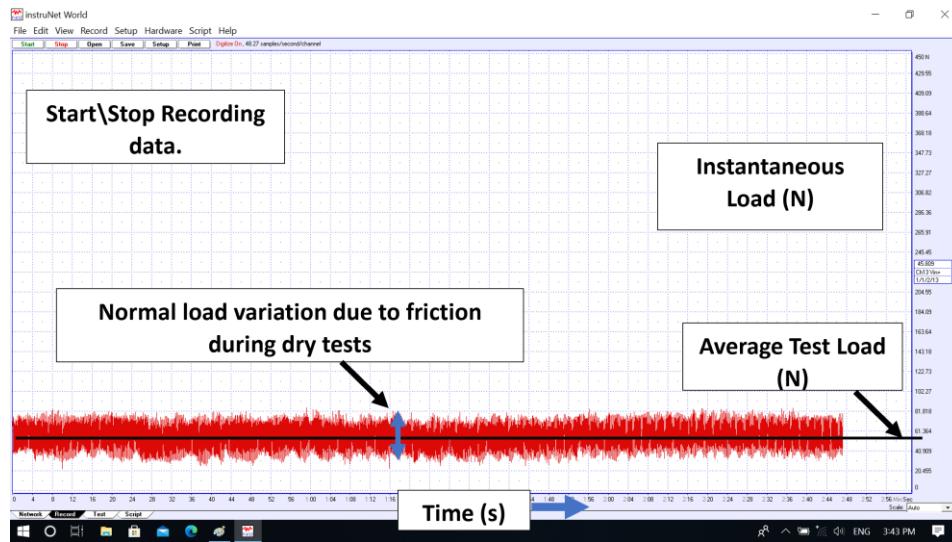
Design and Development of Tribometer



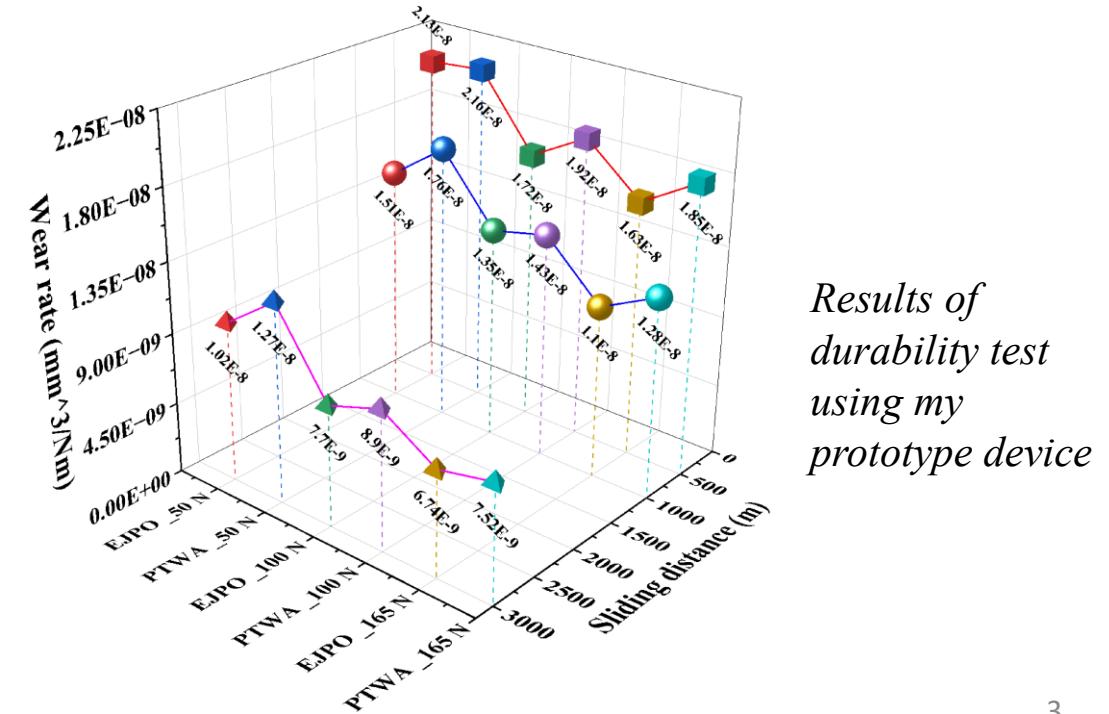
Design of the wear testing device on SolidWorks



Functional Prototype with dual sensor data acquisition



Load cell transducer reading



Design + Fab of hyd. inching drive to resolve material failure

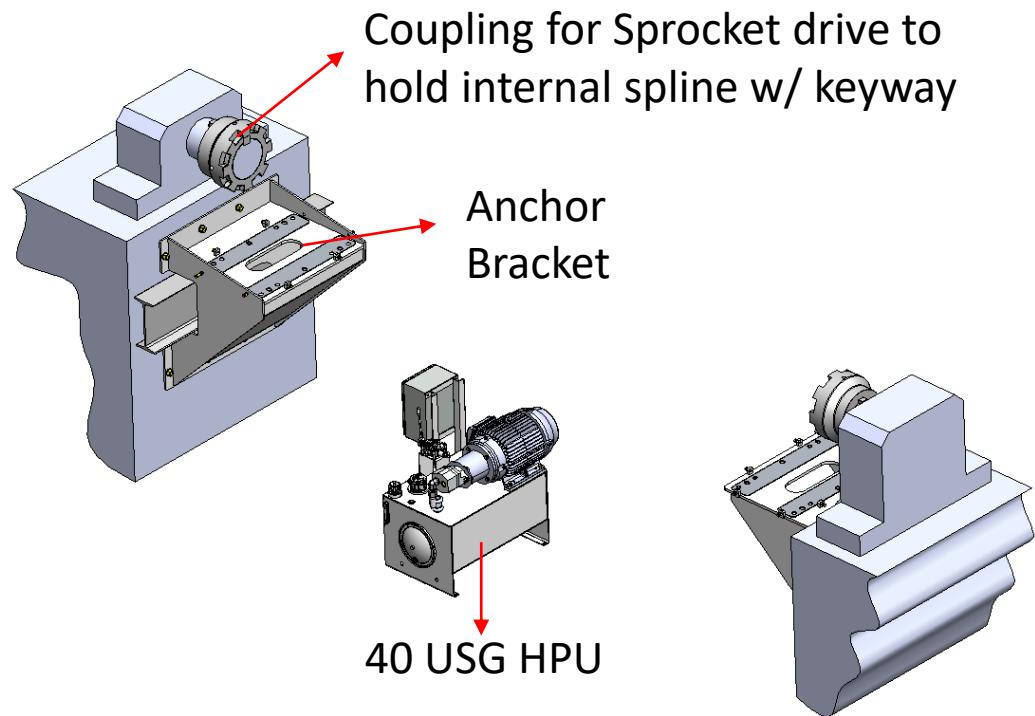


Figure: 1; Inching drive mechanism for controlled circumferential welding

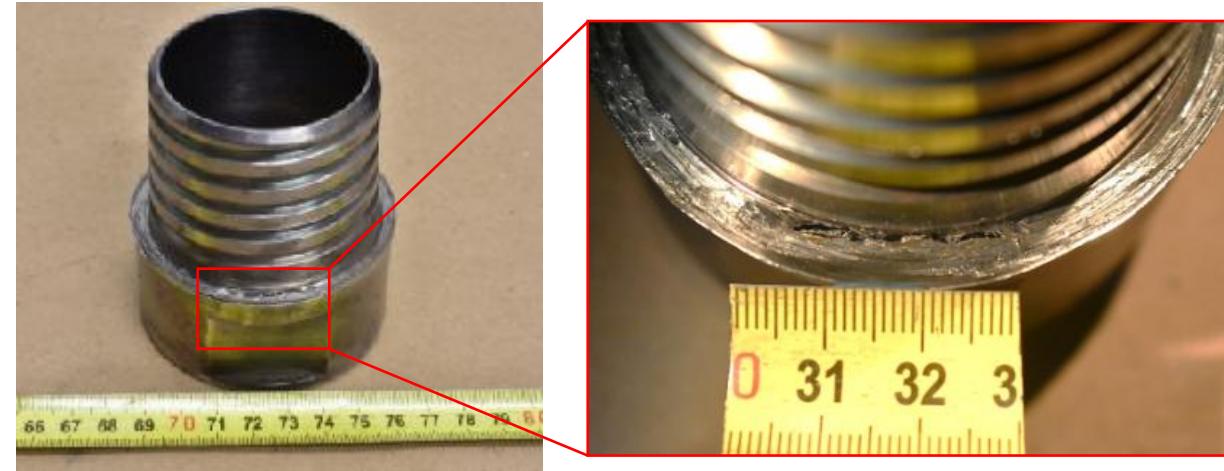


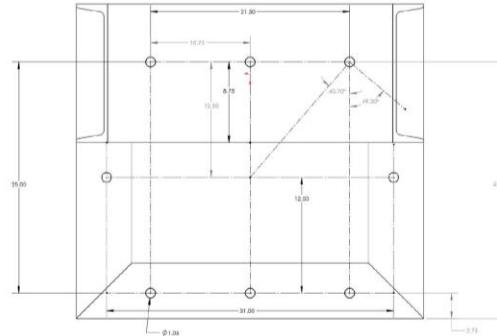
Figure: 2 ; fractured drill rod pin ends during torsional load.

- **Objective:** Make modular welding unit under the guidance of Engineering & Manufacturing lead to resolve the weld failure issue observed on torsional load test post pin weld on drill rod.

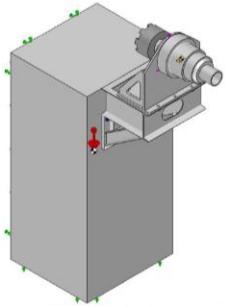
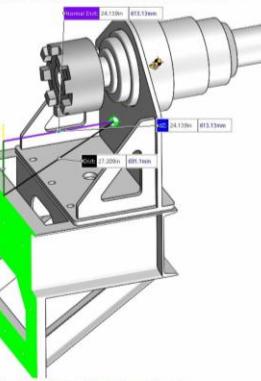
Challenge: Design an in-house drive system that can be controlled by the welder without affecting the weld pass precision and accommodating multiple rod lengths.

Bolt Stress Calc & Design of Inchng Drive for M/C Shop

WO# 50281-Bolted bracket calculation



JUL-27-2025
Referece: Machine Design-Bhandari Pa. 247



The bolts can be designed on the basis of principal stress theory or principal shear stress theory.

The principal stress σ_1 is given by,

$$\sigma_1 = \frac{\sigma_t}{2} + \sqrt{\left(\frac{\sigma_t}{2}\right)^2 + \tau^2} \quad (7.13)$$

The principal shear stress is given by,

$$\tau_{\max} = \sqrt{\left(\frac{\sigma_t}{2}\right)^2 + \tau^2} \quad (7.14)$$

Note: bolts 7 & 8 not considered

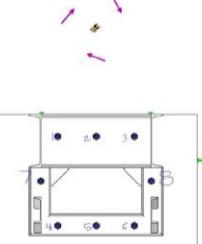
INPUTS

$V := 2800 \text{ lb}$ Weight including base, reducer, reducer bracket and male coupling

$P := V$

$T := 1052688 \text{ in.lb}$ Maximum output torque

$B_{TSA} := .472 \text{ in}^2$ Bolt tensile stress area



$N_B := 6$ Number of bolts

$Y_s := 60000 \cdot \frac{\text{lb}}{\text{in}^2}$ Anchor bolt Yield Strength, considering A354-Grade BD

CALCULATION

Primary Shear Forces, $P' = P'1, P'2, P'3, P'4, P'5, P'6$,

$$P' := \frac{V}{N_B} = 466.67 \text{ lb}$$

$P'_3 := P'$

Obtaining distances from center of bolt pattern to center of bolts $r_1 = r_4 = r_3 = r_6$ and $r_2 = r_5$

$$r_1 := \sqrt{(10.75 \cdot \text{in})^2 + (12.5 \cdot \text{in})^2} = 16.49 \text{ in}$$

$$r_2 := 12.5 \cdot \text{in}$$

$$r_7 := 15.5 \cdot \text{in}$$

From fig.1 we can deduct that bolts 3, 6, 1 and 4 would be under max. shear forces

$$P''_3 := \frac{T \cdot r_1}{4 \cdot (r_1^2) + 2 \cdot (r_2^2) + 2 \cdot (r_7^2)} = 9230.363 \text{ lb}$$

Resultant shear force on bolt 3 (P_s)

$$\Sigma F_y := P'_3 + ((P''_3) \cdot \cos(49 \cdot \text{deg})) = 6522.33 \text{ lb}$$

$$\Sigma F_x := P''_3 \cdot \sin(49 \cdot \text{deg}) = 6966.24 \text{ lb}$$

$$P_s := \sqrt{(\Sigma F_y)^2 + (\Sigma F_x)^2} = 9543.03 \text{ lb}$$



Hydraulic motor w/ CB valve for metered rotation

STRESS DUE TO TENSION CALCULATION
The moment $V \times e$ tends to tilt the bracket about the lower edge, this way the top bolt row is taking maximum forces

$e := 24.25 \cdot \text{in}$ base, reducer, reducer bracket and male coupling COG to mounting face

$l_1 := 27.75 \cdot \text{in}$ Lower edge to upper bolt row distance

$l_2 := 15.25 \cdot \text{in}$ Lower edge to lower bolt row distance

$l_3 := 2.75 \cdot \text{in}$

$$P_3 := \frac{P \cdot e \cdot l_3}{3 \cdot (l_1^2 + l_3^2) + 2 \cdot (l_2^2)} = 66.74 \text{ lb}$$

Resisting forces in bolts 1 to 3

$$\sigma_t := \frac{P_3}{B_{TSA}} = 141.39 \frac{\text{lb}}{\text{in}^2}$$

Stress in bolt due to tension

$$\tau := \frac{P_s}{B_{TSA}} = 20218.27 \frac{\text{lb}}{\text{in}^2}$$

Stress in bolt due to shear

$$\tau_{\max} := \sqrt{\left(\frac{\sigma_t}{2}\right)^2 + \tau^2} = 20218.4 \frac{\text{lb}}{\text{in}^2}$$

Maximum shear stress in bolts

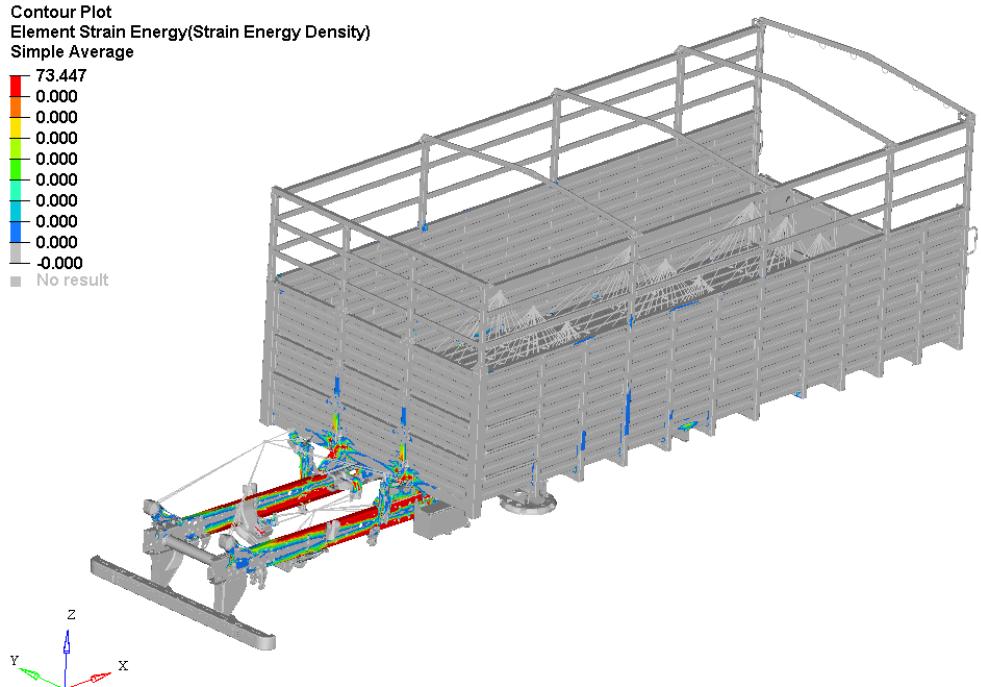
$$L_f := \frac{Y_s}{\tau_{\max}} = 2.97$$

Load factor top row bolts

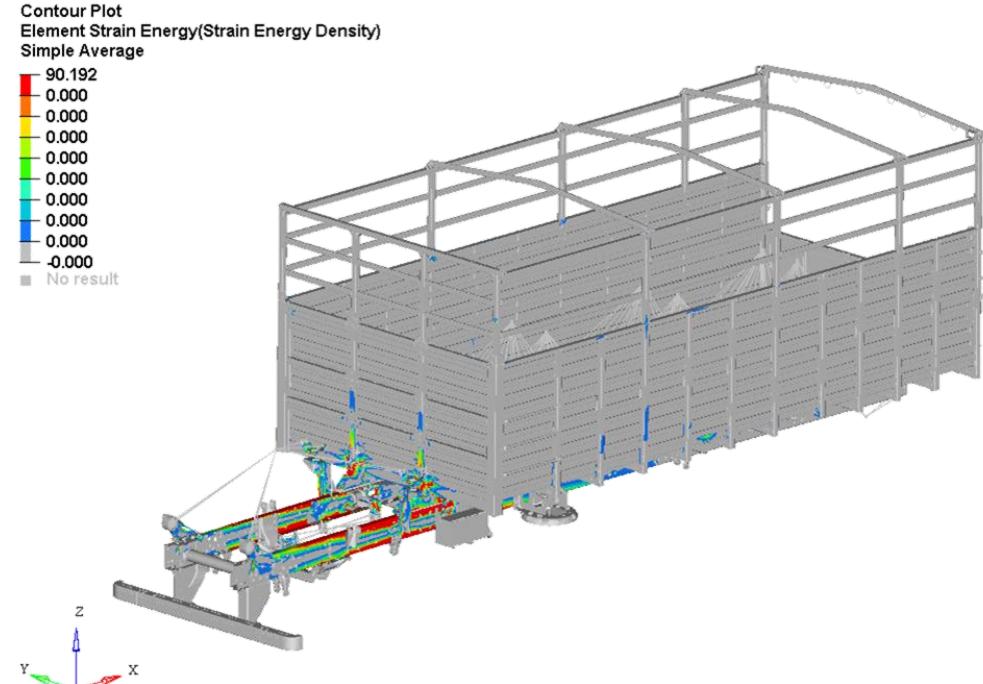
My contribution: Designing the structural components, outsource pump for hydraulic control based on Q-H curves, design hose paths and analyse shear stress.

Next Steps: Prototype validation

Stress-strain energy plot



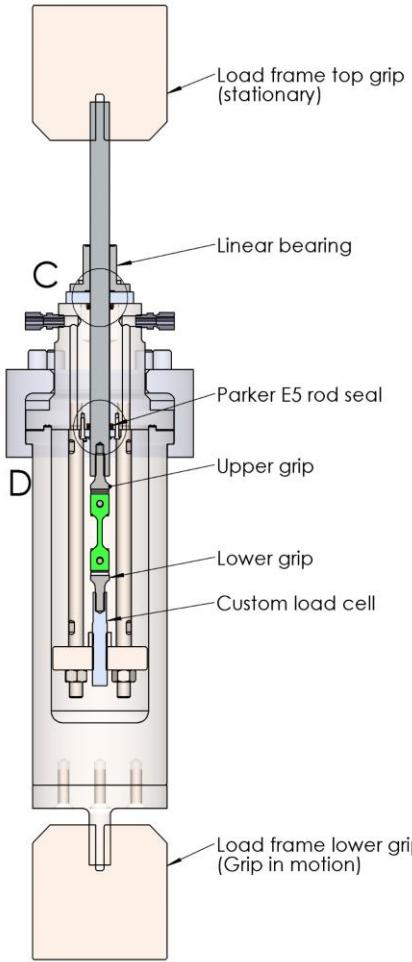
Cabin rear mount bounce: 5.6 Hz



Cabin rear mount bounce: 5.7 Hz

- Cabin rear suspension natural frequency plot based on ride and handling design validation trials for one of the new vehicle development projects.
- The stiffness of the rear cabin suspension was decided based on the study.

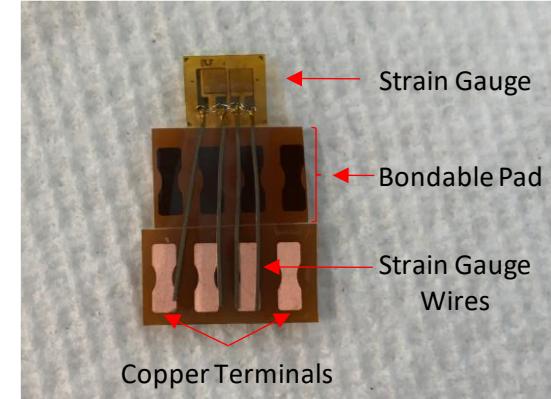
Instrumentation of HP autoclave



Sealed Autoclave design for HP Hydrogen embrittlement study

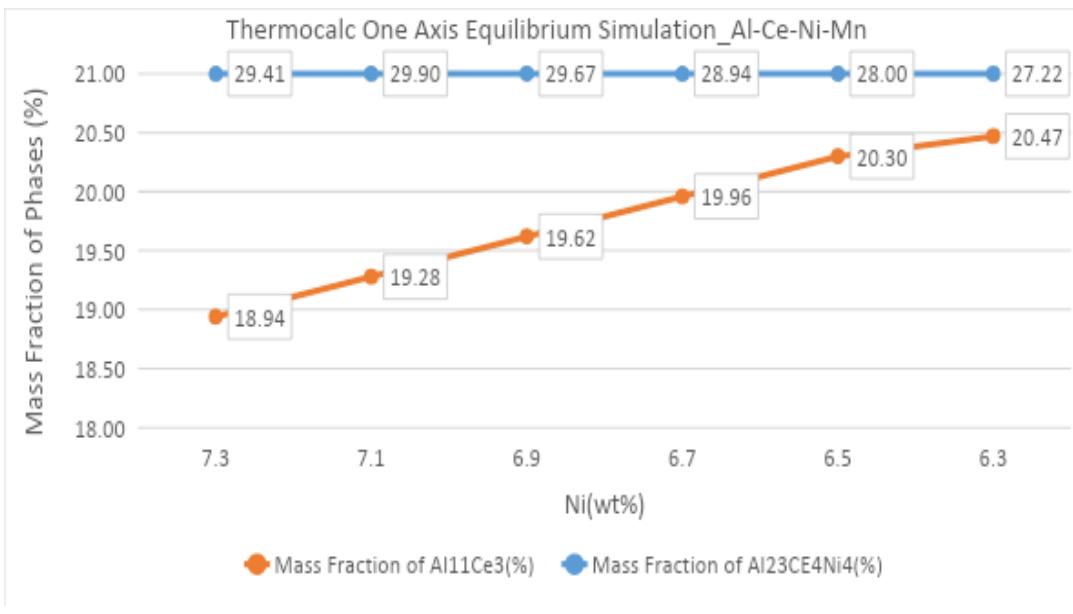


Autoclave installed on the
MTS UTM

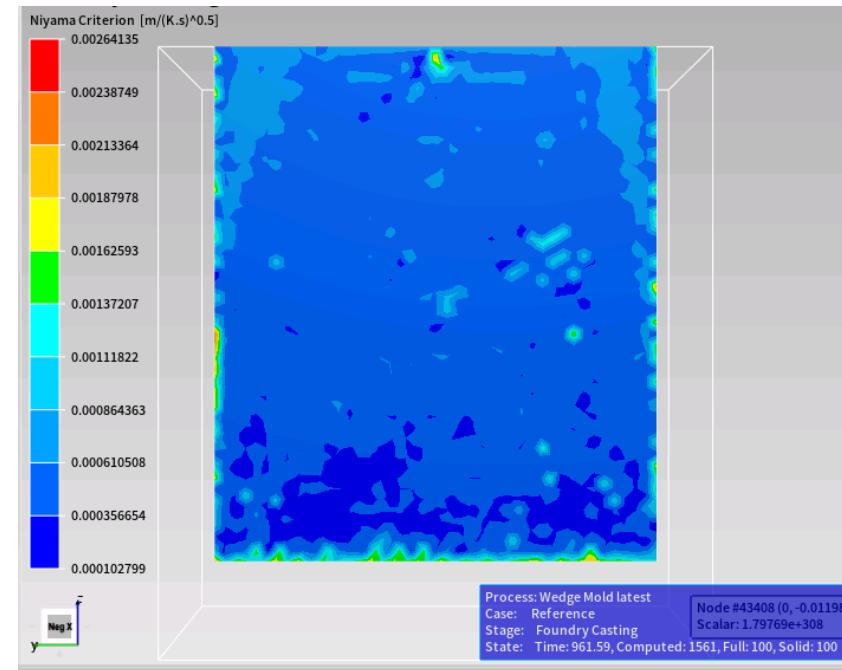


Strain gauge assemblies to
detect deformation of the
during tensile test specimen

Improving casting parameters using CFD



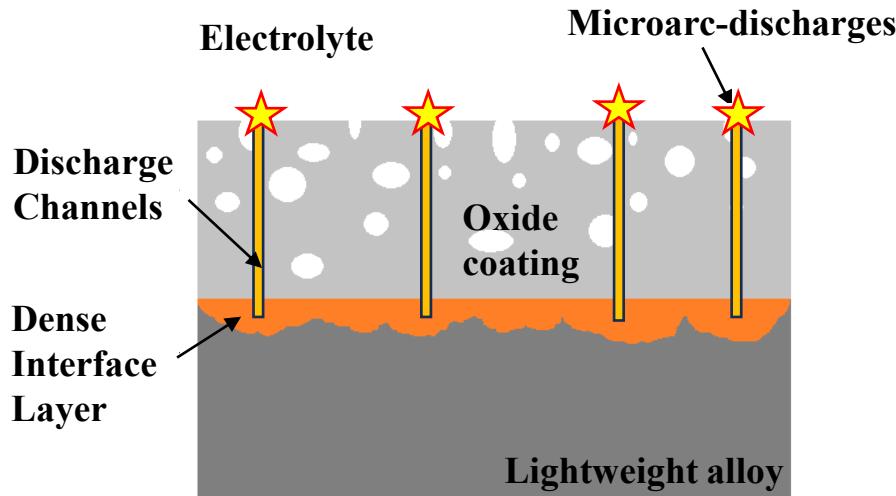
Phases post equilibrium solidification



Niyama shrinkage criterion

- Al₂₃Ce₄Ni₄ => Lower TCE
- Casting simulation showed low shrinkage in a V mold.
- Casting done with the composition of Ni = 7.3 (wt%) in Al-Ce alloys.
- Mechanical property test showed promising results.

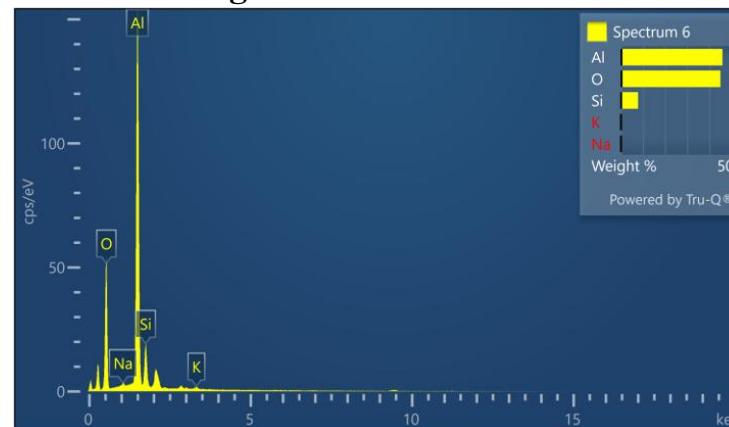
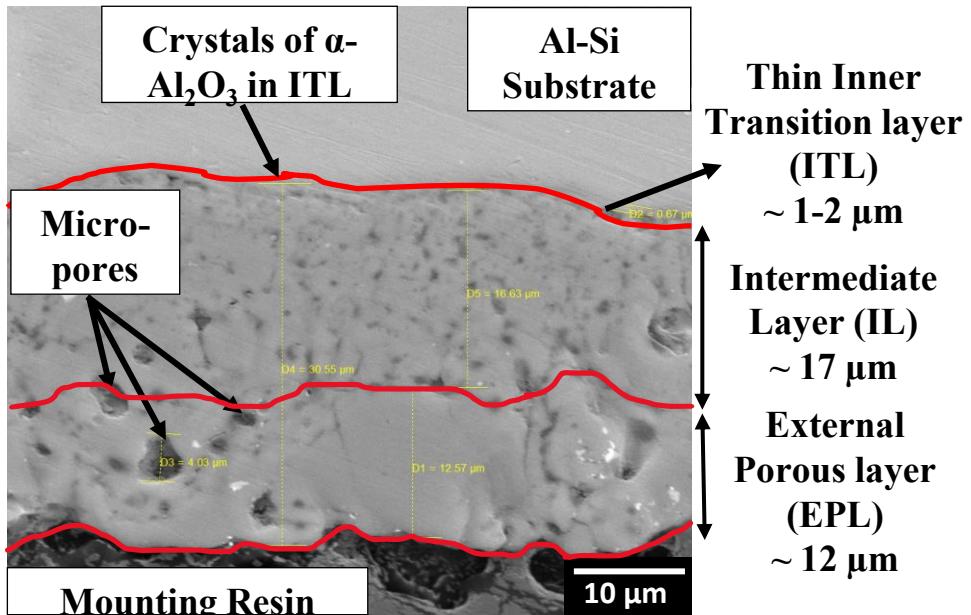
Fine-tuning of the EJPO coating process



Schematic diagram of the coating process

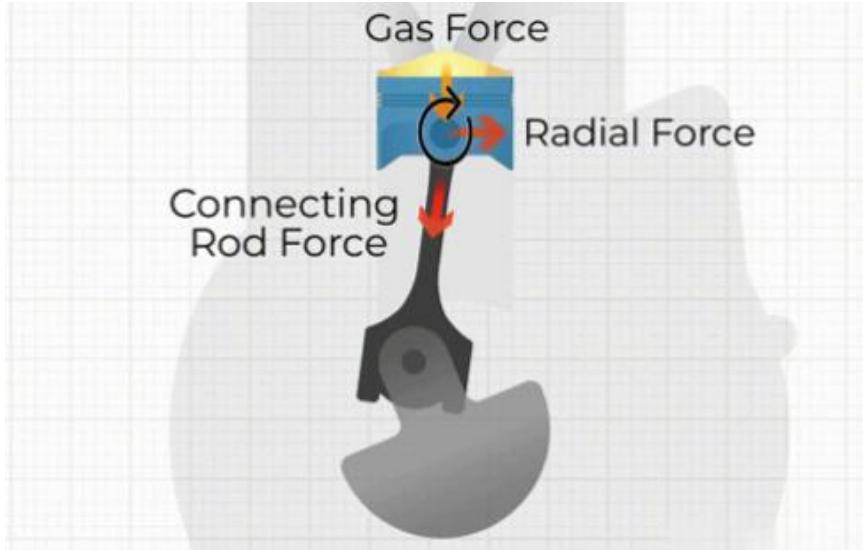


Plasma discharge around component immersed in chemically benign low-concentration electrolyte

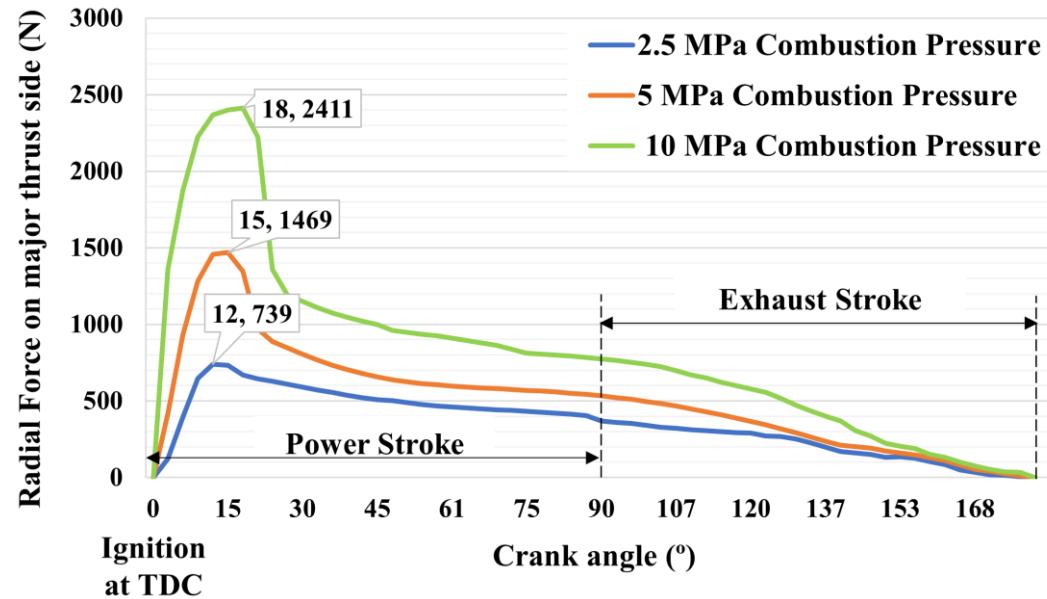


Side view of EJPO coating microstructure & elemental composition

Radial forces experienced by cylinder liner under varying combustion pressures (MATLAB coding)



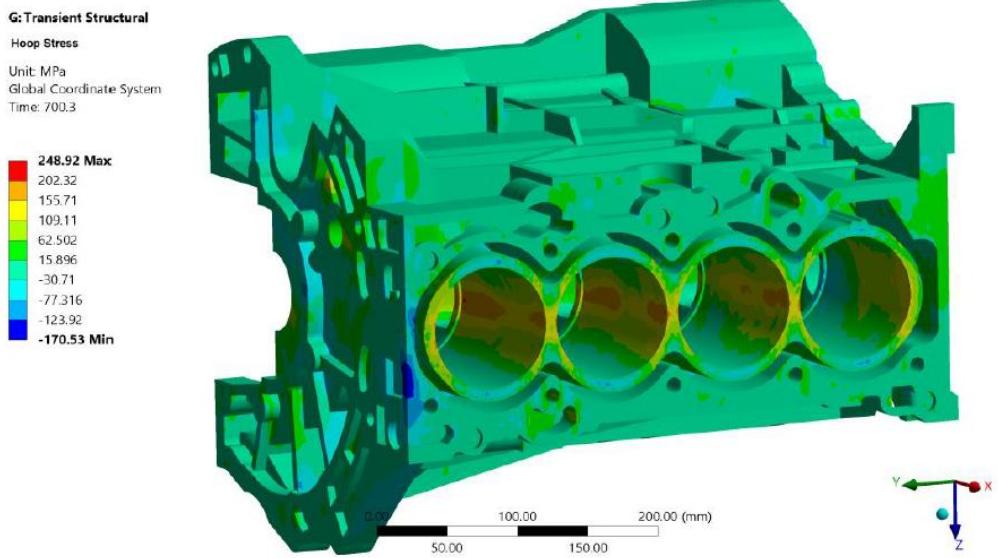
Kinematics of radial force



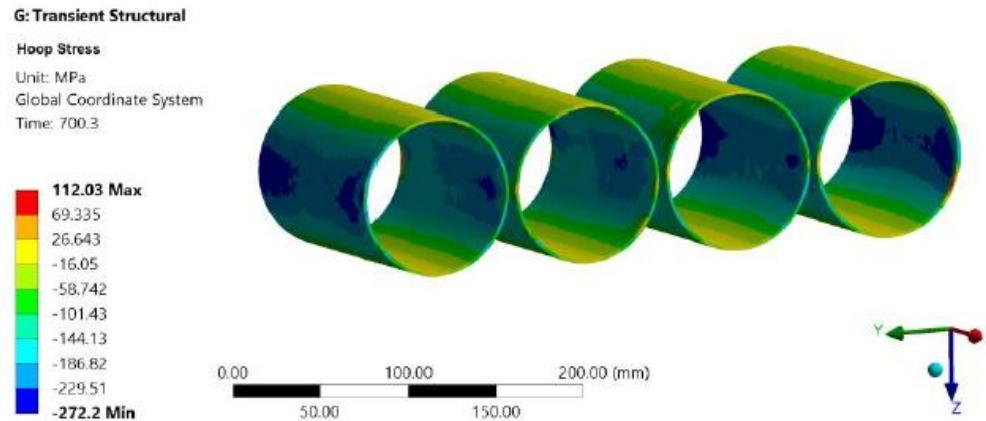
Resultant plot showing radial forces at varying crank rotation for the specified engine geometry

[MATLAB SCRIPT IN THESIS \(Page 108\) Click here](#)

Cylinder Liner Stress Study



Tensile residual stress in Inline Engine Block



Compressive residual stress in the CI liner of same block

- ANSYS thermal stress simulation on an as-cast Al-Si engine block.
- Maximum hoop stress observed along the adjoining bridge surface between cylinders due to compressive residual stress in CI liner of the same block .
- Residual stress develops in an aluminum engine block equipped with a cast iron liner due to the differential thermal expansion/contraction coefficients of the materials.

Calculator for static + fatigue load cases

- **Objective:** Make it easier for design engineers to draft assemblies with accurate bolt pre-load and torque values for various hardware configurations.