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INTRODUCTION

- Current methods cannot replicate observed material field failures
- Unable to perform comparison testing of adhesives to solve debonding issues
- Aim to improve solution from 2021 capstone team
- Goal is to efficiently test and identify an adhesive that will reduce field failures and costs for PACCAR

PROBLEM STATEMENT

A way to verify environmental wear on materials used in the commercial vehicle industry so that PACCAR can efficiently test and better select materials to increase the product lifespan of their vehicles.



CORE FUNCTIONS

Performance Criteria

- Actuator capable of applying 500lb load
- Control system that maintains a constant load throughout thermal cycling
- Data collection of time, load, displacement, and temperature during testing

Tested Environmental Conditions

- Hot air exposure to 200°C
- Cold air exposure to -40°C
- Salt spray exposure at 35°C, 100% humidity
- Hot water bath at 88°C

MECHANICAL ENGINEERING UNIVERSITY of WASHINGTON

New Stress & Strain Durability Fixture

DESIGN & DEVELOPMENT









Mechanical Design

- Pneumatic actuator, T-slotted aluminum 6061 frames, and load cell upper assembly
- Clevis rods to secure specimens in aluminum tube with double window slots
- 316 stainless steel flanges and ceramic washers to reduce heat transfer
- 3D printed mechanical enclosure
- Base plate with handles and potential to duplicate fixture design









Output

Electrical Design

- Arduino Mega used as computer
- 24 bit load cell amplifier measuring load up to 1000lb
- Displacement and pressure sensor with 0-5V output
- 12 bit output signal to electronic pressure regulator
- Type K thermocouples for temperature measurements
- SD card for recording data
- Code controls the load based on a tiered category system

RESULTS & VALIDATION



- pressure regulator for constant stress testing failure mode seen on parts in service

- Calibrated and verified functionality of load cell and • Tested 12 adhesive T-peeled samples at 27lb load • Baseline T-peel samples failed adhesively replicating the • Alternative adhesives failed after fewer cycles • Useful tool to validate material behavior and lifespan • Further testing of alternative bonding processes or
- adhesives is necessary

CONCLUSION & FUTURE WORK

- Successfully created an improved durability test fixture meeting performance requirements
- Beneficial to guide material recommendations
- Iterate and optimize prototype design for smoother user assembly experience
- Condense and organize electrical wiring system

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Mechanical Engineering Capstone Exposition

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