New Stress & Strain Durability Fixture

Zylan Brennan\textsuperscript{1}, Josh Chong\textsuperscript{1}, Lily Vu\textsuperscript{1}, Gautama Bhamidi\textsuperscript{2}, Sylvia Chen\textsuperscript{2}

PACCAR Industry-Sponsored Capstone Project
\textsuperscript{1}UW Department of Mechanical Engineering, \textsuperscript{2}UW Department of Materials Science & Engineering

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.

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

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

- Calibrated and verified functionality of load cell and pressure regulator for constant stress testing
- Tested 12 adhesive T-peeled samples at 27lb load
- Baseline T-peel samples failed adhesively replicating the failure mode seen on parts in service
- 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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