

Virtual Engineering, Inc.

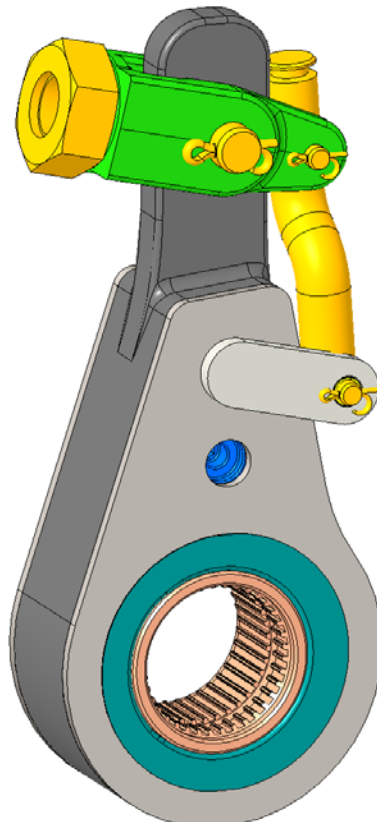
Engineering Your Competitive Edge...

Automatic Slack Adjuster - Brake System

- **Objective:**
 - Create a robust slack adjuster assembly for the truck industry
- **Constraints:**
 - Must meet current product function and service capabilities
 - Must be easily adaptable for various duty ratings
 - Must meet or exceed current performance specifications
 - Use unique gear drive system that distributes loading across multiple teeth
 - Design components using the customer's in-house casting processes while offering an option to use stampings as a potential cost/weight improvement



Baseline
Production Assembly



Gen 1
Castings



Gen 2
Stampings

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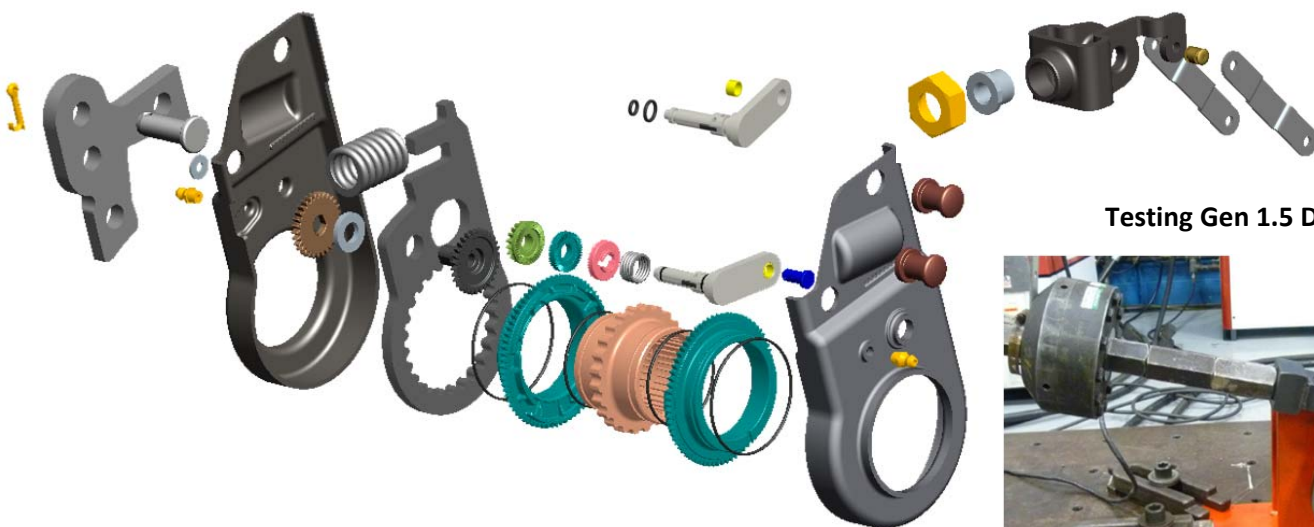
Automatic Slack Adjuster – Brake System

- **Process:**

- Researched foundation brake functions and slack adjuster service requirements
- Benchmarked several automatic slack adjuster systems
- Evaluated current product design, performance specifications, and testing
- Created multiple concept CAD models in Creo Parametric
- Created a Proof-of-Principle model (hybrid design) for FEA and physical testing
- Optimized design concepts based on FEA and test results
- Completed tolerance stacks and developed GD&T
- Created drawing package and BOM for quote
- Supported patent efforts with drawings, diagrams, mpeg videos demonstrating adjustment functions, and CAD models

- **Results:**

- **Weight savings of 31%, AND Cost savings of over 30%** were achieved in the Gen 2 option using stampings in place of a steel casting (one of the customer's in-house processes) for the housing
- A “drop-in” replacement for customer's current products
- Designed as “lube-for-life”; no service lubrication required as in current products
- Achieved better internal load distribution by using a cycloidal gear set
- Proof-of-principal model supported >36,000 in-lb. torque; 25,000 in-lb. was target
- Reinvented the ratchet and clutch adjustment mechanism
- Created video files in Creo Mechanism to demonstrate adjustment functions
- Customer was awarded U.S. Patent 10,240,652



Testing Gen 1.5 Design

