

AMERICAN ENGINEERING GROUP

Company Capabilities



Presented by

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ISO 9001:2015

AEG Presentation Outline

- AEG Company Overview
- AEG Capability Review
 - Technical
 - Resources
- AEG Projects - Industry Problems
 - Prototype Development.
 - Finite Element Analysis(Advantages and Challenges)

Presentation Topics

- Mission / Vision of AEG
- Company background
- AEG Value / Portfolio Presentation
- AEG Design Process
- Key Partnerships
- AEG Service Offerings
- AEG Projects - Industry Problems
 - Prototype Development.
 - Finite Element Analysis(Advantages and Challenges)

AEG Company Overview, Capabilities and Projects

Presented by

Dr. Jon Gerhard

Technical Director, AEG &

Design Professor, University of Akron

AEG Mission

- AEG is focused on being the best engineering resource for product development, product design and manufacturing. AEG will efficiently utilize advanced engineering material and design technology combined with our extensive experience to provide our customers with the right product manufacturing solutions for the customers.

AEG Vision

“ We convert good concepts into great products ”

AEG Overview

- ISO 9001 : 2015 certified company. Designs, develop prototypes & manufacture high quality engineering products.
- 9 Engineers in Akron (20 consultants)
- Started in Akron, OH in 2000.
- Experience providing integrated manufacturing engineering solutions in the field of automotive, aerospace, rail, defense, medical, sports recreation and consumer goods.

AEG - at a Glance

- AEG is located in Akron, OH
- The AEG team has engineering and project management experience in a wide variety of industries, including:
 - US Defense: Army (Army vehicle components, Armor, solid tires and composite Tires)
 - US Defense: Air Force (Fighter Jet Components)
 - Aerospace
 - Recreation
 - Automotive
 - Medical
 - Consumer goods
 - Construction & Machinery

Where can 'AEG' bring value to your engineering products?

Product Manufacturing Experience

- Manufacturing capability in Metal, Rubber, Plastic and composite components

Composite Product Experience

- Flexible Armor (recent projects)
- Composite Military Shelter
- Honeycomb Aircraft Wing
- Carbon Fiber Tires

Material Knowledge

- Metal, Rubber, Ceramics, Composites and Plastics

Simulation and Analysis

- Solid Modeling
- Analysis Capabilities (FEA, CFD and NVH)

Innovation: Patent (AEG IP)

AEG, through its founders, holds numerous utility and design patents pending by the United States Patent Office.

Following are some examples:

- Torsional Damper
- Three Piece Golf Ball
- Bi-polar plate for Fuel Cell
- Fuel cell dual seal
- Polyurethane solid tires
- Tire Performance, Durability & Quality Prediction
- Flexible Personal Armor
- Dual Damper
- Carbon Fiber Tires
- Posture Perfect Backpack
- Carbon Fiber Knee Brace

Design Analysis Process - Concept

- The purpose of product research is to identify the critical end customer requirements for the product. This phase establishes both performance and function for the targeted market segment.
- Competition product benchmarking analysis and reverse engineering
- Technical requirements
- Product Engineering Requirement Specification.
- Concept development
- Concept review and down “stream” Select
- Industrial Design and customer patent submission.

Design Analysis Process - Feasibility

- Technical Feasibility
- Create Solid models based on Industrial Design.
- Preliminary Manufacturing Supplier Selection
- Manufacturing suppliers identified based on preferred method of product fabrication and required expertise.
- Costing Analysis
- Engineering prototype development
- Rapid prototypes with increased functionality are created for evaluation.
- Feasibility Review

Design Analysis Process Development

- Parametric 3-D Solid Models are created for design validation. Changes from Engineering prototypes and Design Review are incorporated.
- Engineering Drawings with bill of material (BOM)
- Preliminary engineering drawings are created with the necessary critical to Quality (CTQ) /performance (CTP)/durability (CTD)/manufacturing (CTM) features and critical dimensions.
- Engineering Analysis
- Dynamic (vibration), modal, structural, mold filling and thermal analysis are conducted on sub- systems with noted high risk in the appropriate area of the product design. Design changes are updated in the solid models.

Cont...

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- Create Design Validation Plan
- Manufacturing Analysis Design Failure Mode and Effects Analysis (DFMEA), Production Failure Mode and Effects Analysis (PFMEA), Design for Assembly (DFA), Tolerance Analysis of all components.
- Product Design and compliance review.
- Engineering prototypes Samples
- Initial engineering / pre-production “prototypes” units are built. These units are intended for evaluating the design and giving the production suppliers an early look at what the industrialization requirements will be.
- Test and Verification
- Environmental tests and validation test plan. Design Refinement
- All solid models are updated and drawings are finalized for tooling.

cont...

- Production Design and compliance review
- Production tooling and secondary operation support
- Release all files and data for production tooling.
Production design Validation Testing
- Parts tested according to design validation plan.
- Design Analysis and approval
- Final design revisions are updated in the solid models.
Drawings are updated and supplier
- Completion of Design and Documentation

Design Analysis Process – Production Support

- Design Analysis Process – Production Support
- Production Part Approval Process
- AEG works with selected suppliers to get all parts approved per specification for long term production. AEG will work with the supplier to resolve any manufacturing related issues. Early work with suppliers in prior phases ensures a smooth hand-off.
- Product Launch Support
- AEG ensures product assembly to design intent and can provide support if required.

AEG Partnerships

The value AEG brings to our customer extends beyond our product manufacturing experience. AEG has an extensive network of partners who specialize in areas critical for product design:

- Product capital “raise” – Market analysis and development
- Marketing – Market analysis and development
- Mechanical Design – Device Solutions,
- Machined Prototypes
- Rapid Prototypes – Prototyping
- Industrial Design

AEG Engineering Services

- Product Innovation
- Innovative Product Concepts
- Technical Feasibility
- Project Management
- Material Selection
- Engineering for Form & Function
- Cost Reduction Ideas
- Design Improvements
- Concept Illustrations
- Technical Feasibility
- Project Management

AEG Engineering Services

- 3-D Modeling
- Computer Rendering & Animation
- Failure Mode Effects Analysis
- Test & Verification Definition
- Product Requirement Specification
- Technical Specifications
- Rapid Prototyping
- Reverse Engineering
- Competitive Analysis

AEG Engineering Services

- Product Development
- Project Management
- Product Layout/Configuration
- Custom Components and Assemblies
- Enclosure/Housing Design
- Mechanical and Electronics component Packaging
- Mechanisms and Gear Trains
- Thermal Management
- NVH analysis
- CFD Analysis
- Vibration and Noise Mitigation

AEG Engineering Services

- EMI Shielding
- 3-D Modeling (Parts and Assemblies)
- Engineering Documentation
- GD&T (ASME Y14.5M-1994)
- Design for Manufacturing & Assembly
- Prototype Tooling
- Manufacturing Support
- Engineering Analysis
 - - Tolerance Analysis
 - - Finite Element Analysis
 - - Mold Filling Simulation
 - - Thermal Analysis
 - - Vibration Analysis

AEG Technical Capability – Summary *(Current Projects)*

- Design rubber parts – Rubber, Plastics and Metal parts for Automotive and Rail.
 - Finite Element Analysis
 - Molded Rubber and plastic parts, rubber-metal bonded parts.
- Technology assessment projects
 - Honeycomb Armor- US Air force
- Product development projects
 - Lightweight Composite Control Surfaces
- Manufacturing cost reduction projects
 - Military Tank Track-Fabric reinforced track
- Warranty cost reduction projects
 - Fabric reinforced Army Shelter Beam

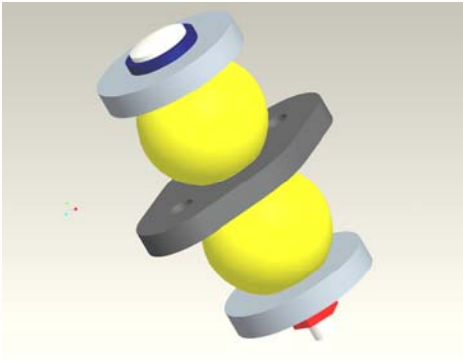
AEG Current Defense Projects

- Light weight Composite Armor
- HUMMWV Carbon Fiber Tire
- Lightweight Composite Aircraft Armor
- Army Air Shelter
- HUMMWV Pressure Attenuation Panel

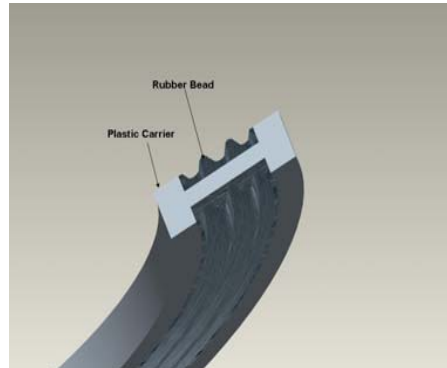
Prototype Development

“Concept to Market” Product Development Process

- US Defense (Air Force/Military/Navy) SBIR projects
- Product development projects for various engineering industrial applications.



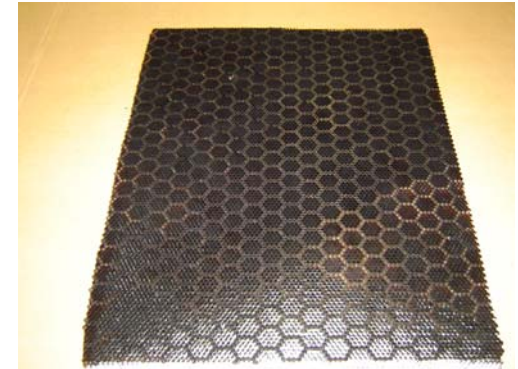
**Dual Structure
Shock Mount**



**Double Lip Fuel
Cell Seal**



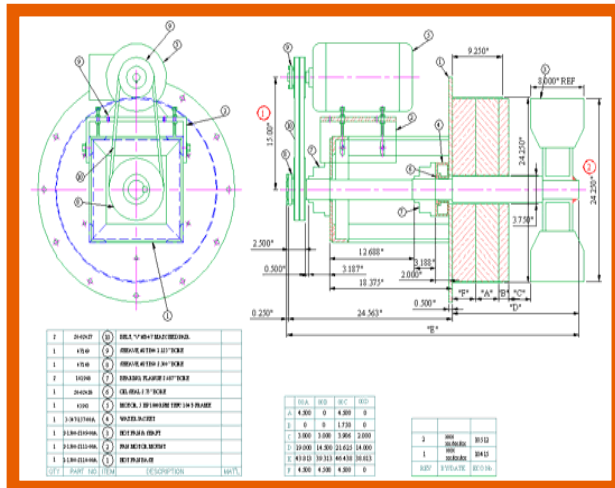
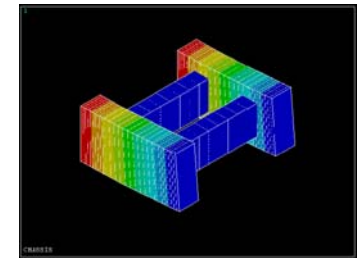
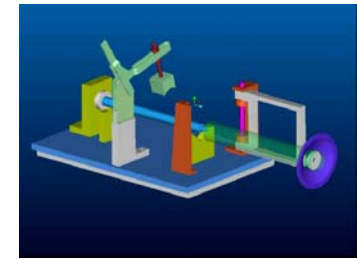
**Run Flat
Tires**



**Honeycomb
Structure**

Engineering Services

- CAD (Design & Modeling)
- CAM (CNC code generation)
- CAE (FEA)
- CFD (Flow Analysis & Simulation)



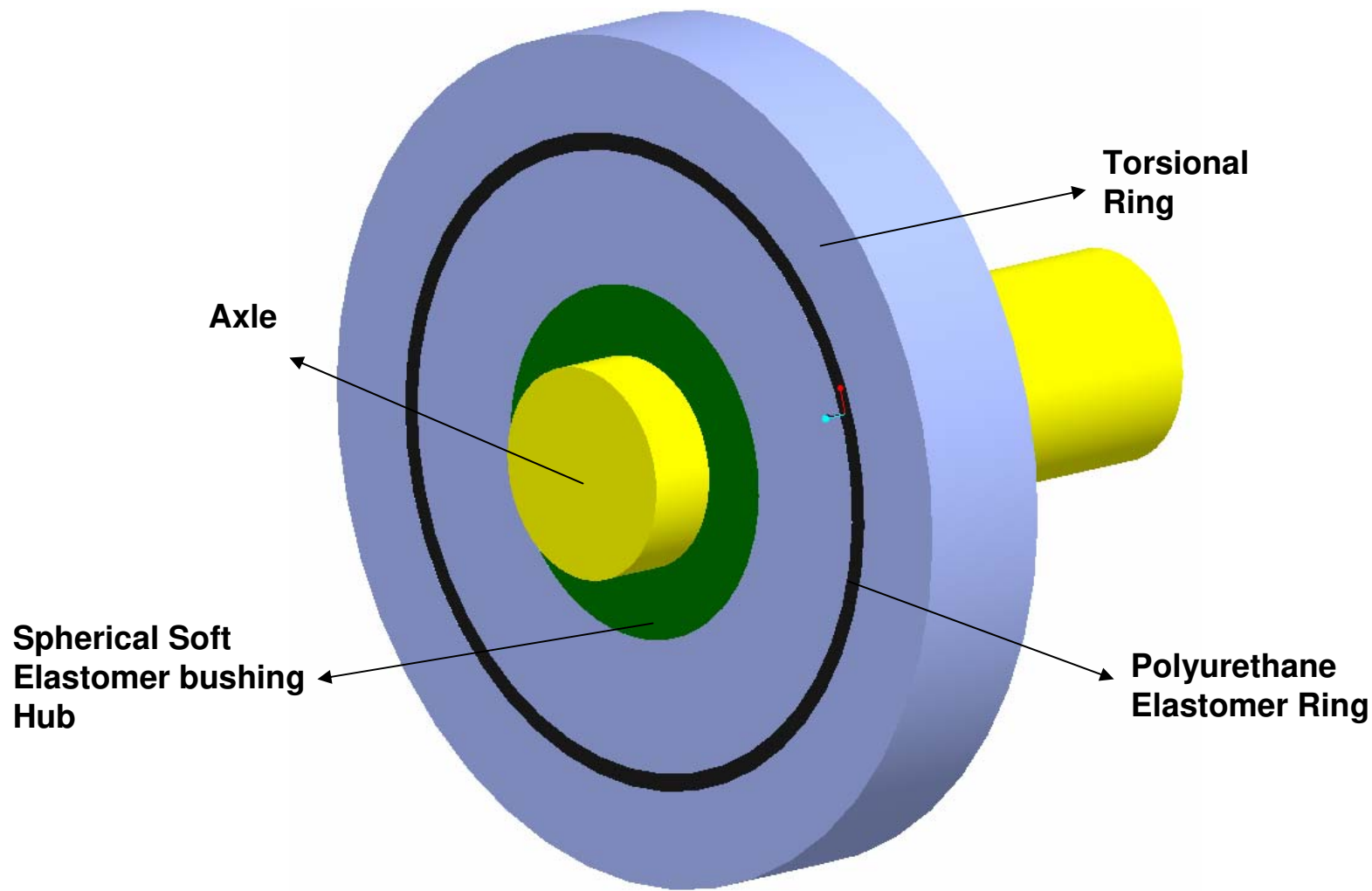
Consulting Services

- Prototype design & development
- Product failure analysis
- Component testing
- Cost reduction

Golf Ball

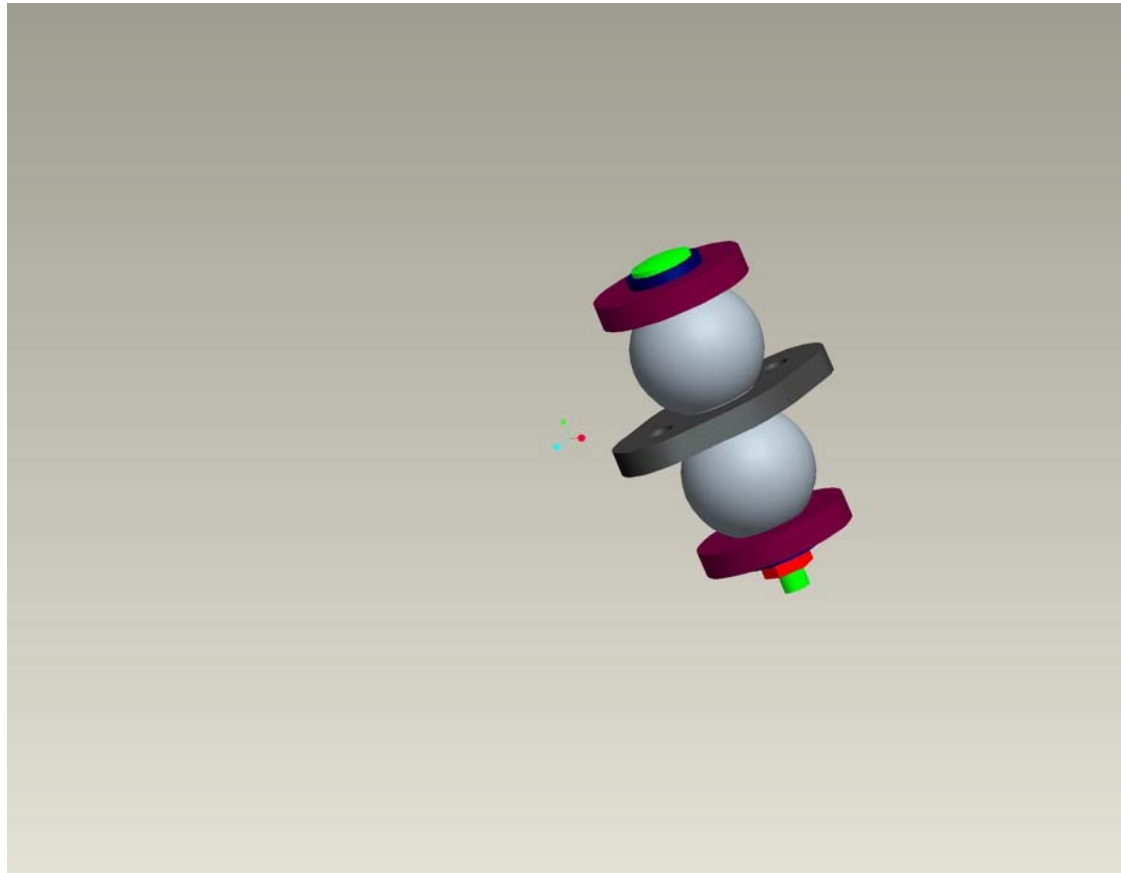
- 3 piece core golf ball design
- Elastomer Development
- Dimple Design



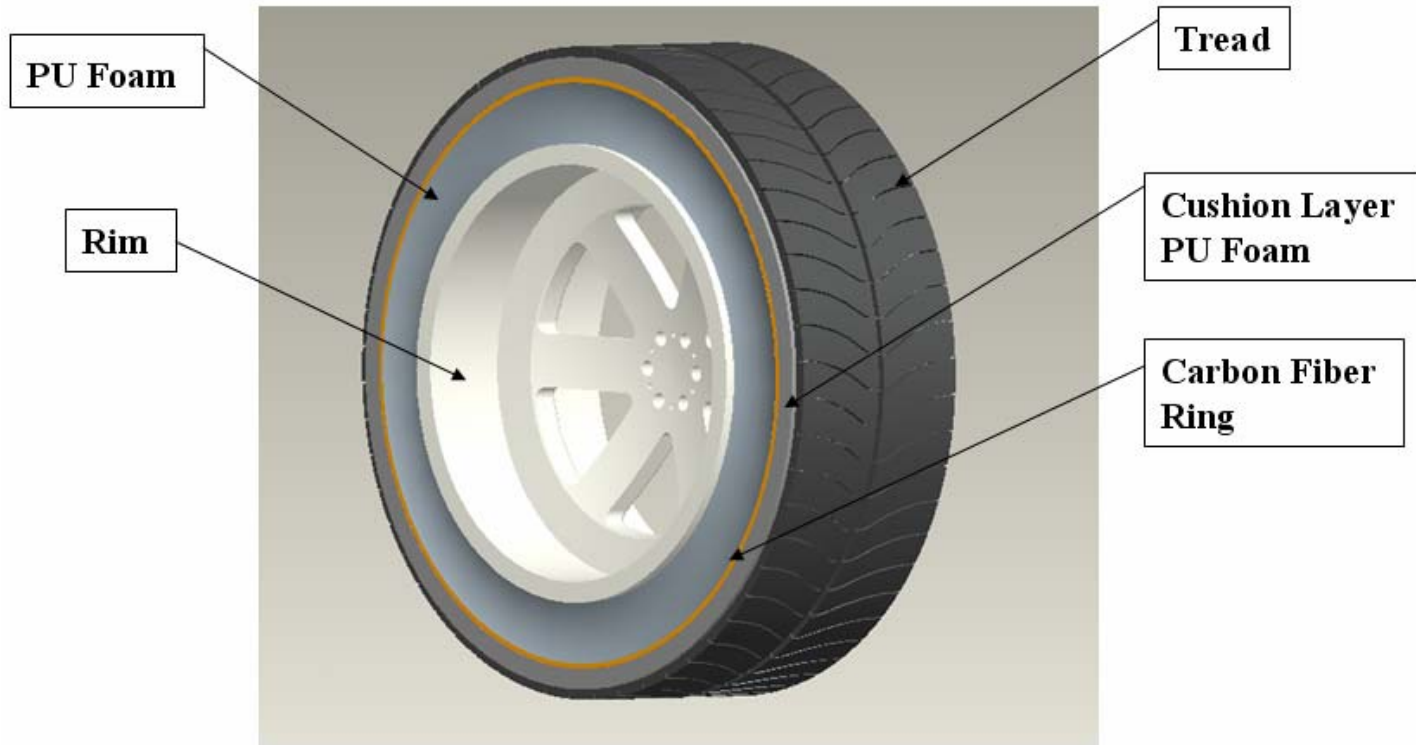


AEG Torsional Damper

SHOCK AND VIBRATION MOUNTING SYSTEM (Fluid-filled system)



Polyurethane Solid Tire



AEG Fabric Reinforced ARCH

(Army Shelter beam)



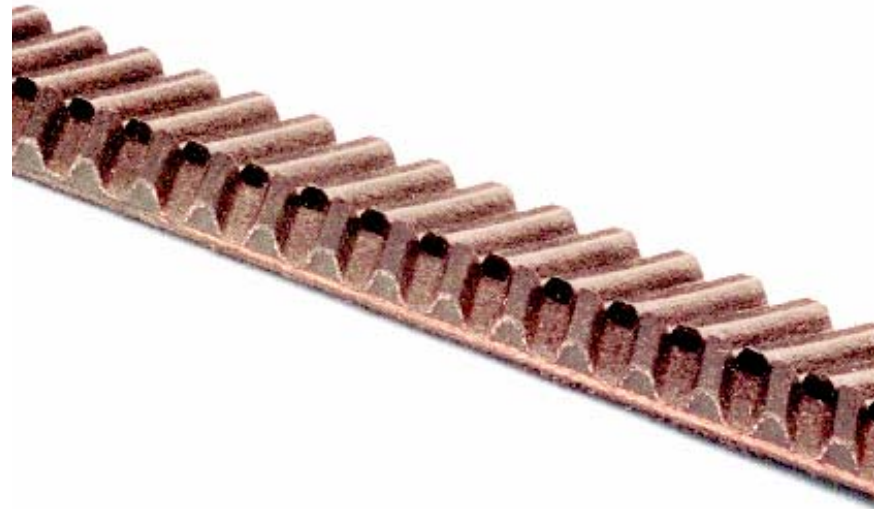
AEG Project Scope and Objective

- Do you have a product development need?
- Do you have a product design analysis need?
- Do you have a product failure analysis need?
- Do you have a product manufacturing need?

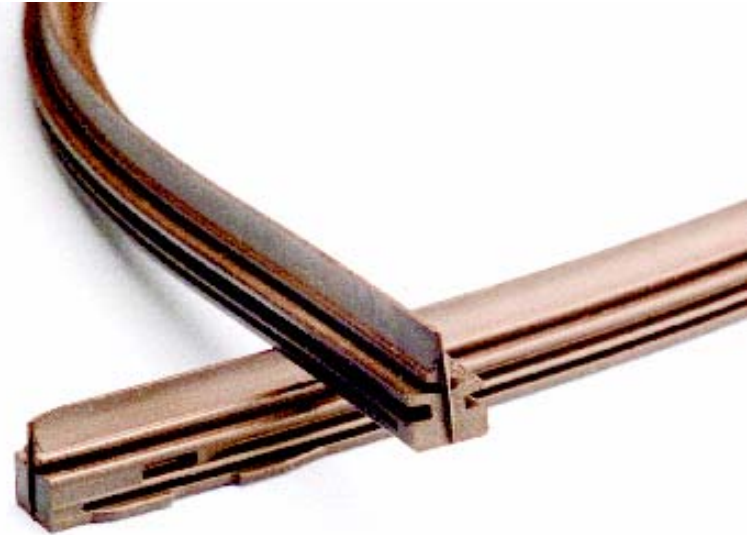
FINITE ELEMENT ANALYSIS: ADVANTAGES & CHALLENGES

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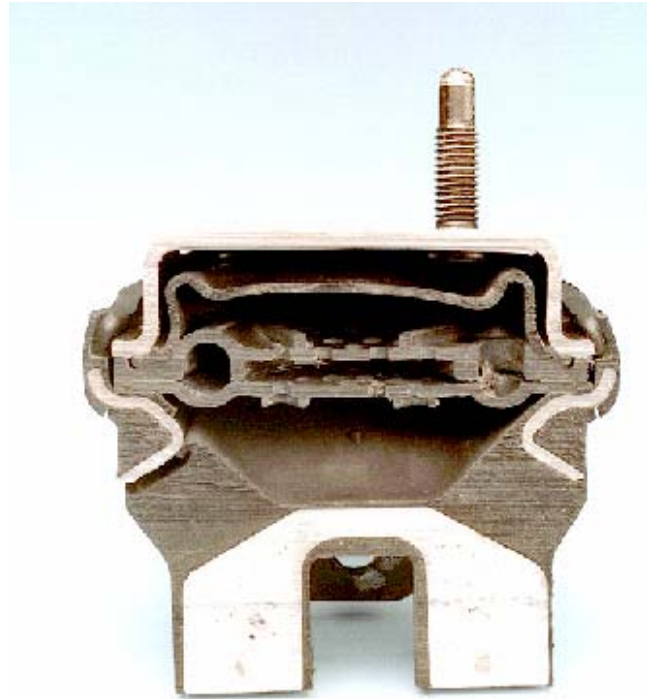
Staple/Nail Gun - Timing Belt



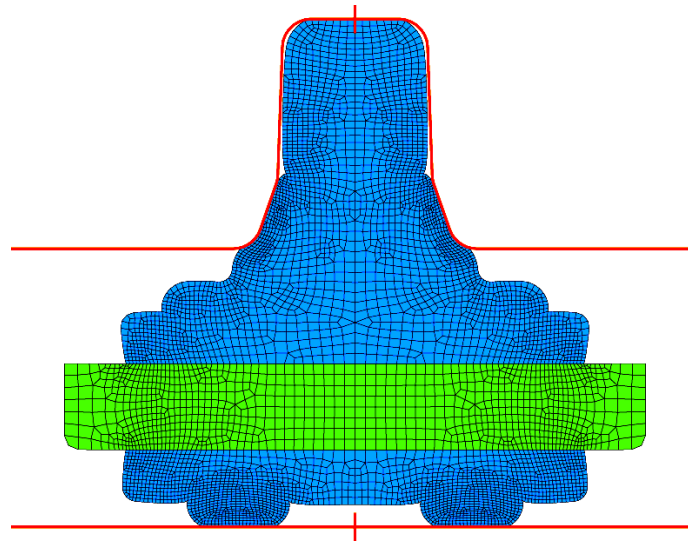
Tires - Wiper Blades



Fluid-filled Engine/Transmission Mounts



Valve Cover Gasket



Engineering Design & Analysis is Approximate

- idealization
 - physical to FEA
 - geometry, manufacturing tolerances, use, mechanics
- FEA
 - numerical procedure
 - discrete vs. continuum
 - mechanics available in software
 - material models
 - post processing
- interpretation
 - impact on design
- practical constraints
 - incomplete information
 - very tight time frame
- *outcome significantly affected by expertise of FEA engineer*

Material Properties

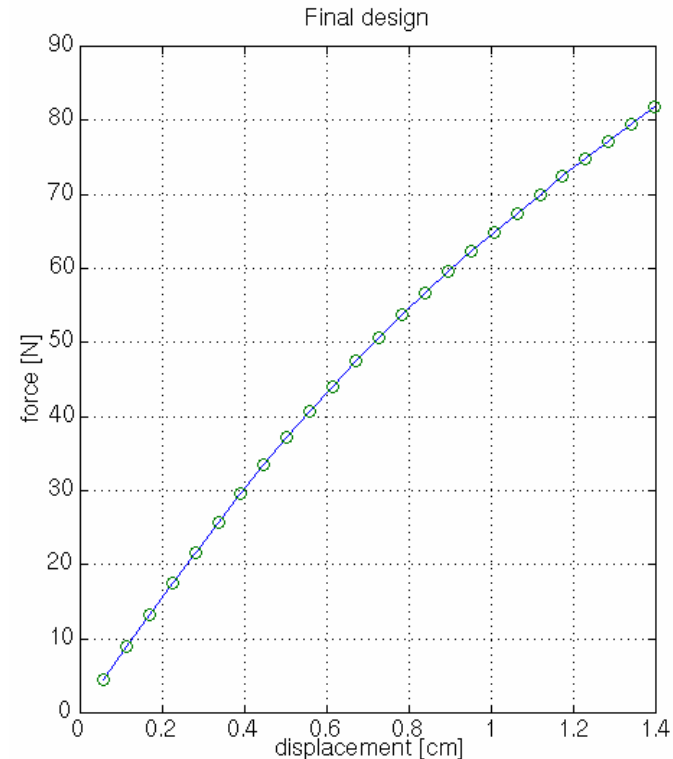
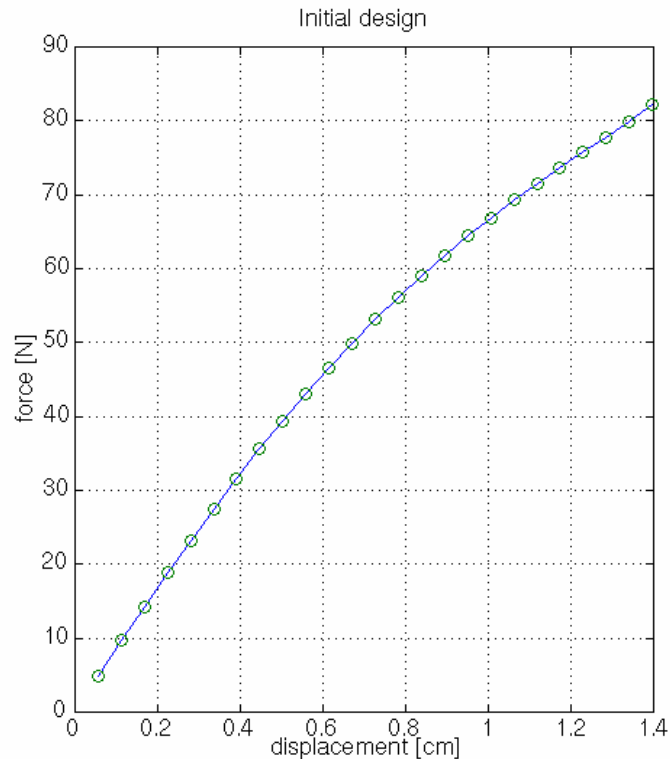
- A poor material model will prevent your model from running or could give you misleading results.
- The off axis modes in rubber are significantly more complex than most other materials.
- Given uniaxial data only ABAQUS will sacrifice the biaxial and shear behavior to fit your data.

ENGINE MOUNT SHAPE DESIGN

- **Objective:** Minimize Area of the Structure
- Design Constraints:**
 - Maintain the same stiffness as the initial shape design
 - Pressure in a critical area is required to be smaller than 50N/cm^2 in magnitude
- Side Constraints** on Each Design Variable

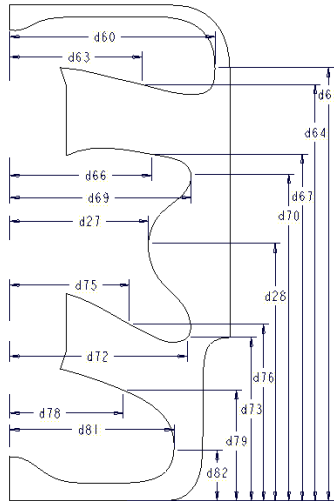
ENGINE MOUNT

(Stiffness Characteristics at Initial and Optimum Designs)

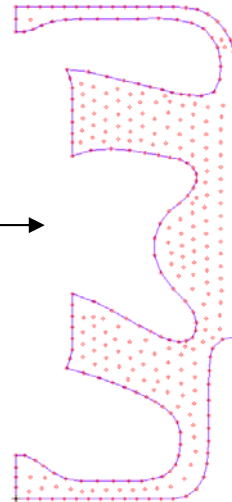


FEA OPTIMIZATION : ENGINE MOUNT

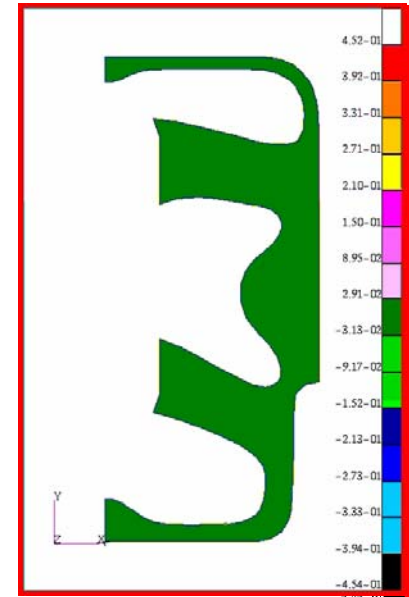
Pro/E
Model



meshing

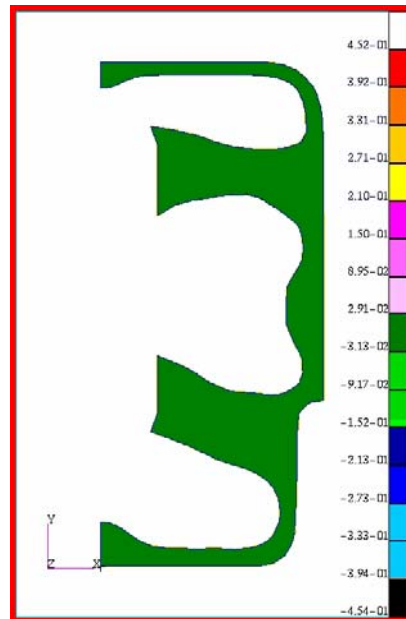


FEA
Analysis



Optimization

Area reduction:
- 12.5%

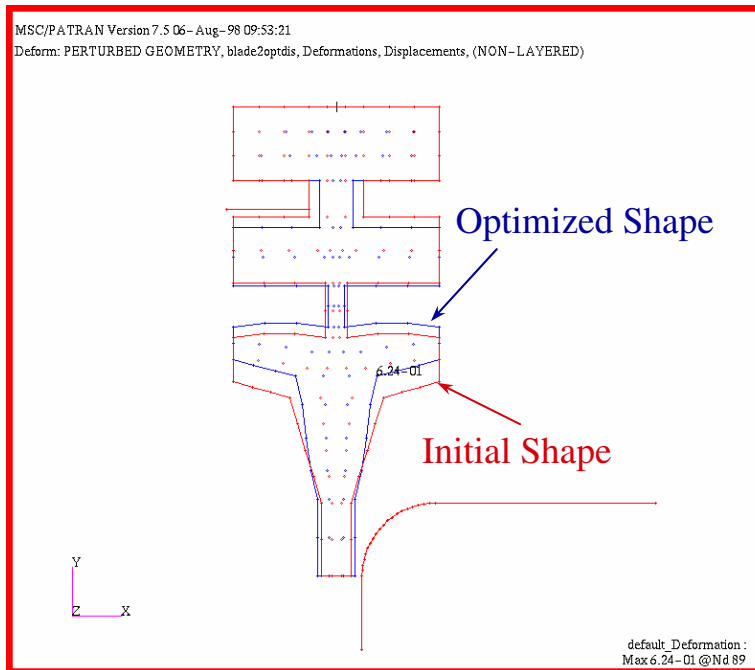


Optimization Problem:

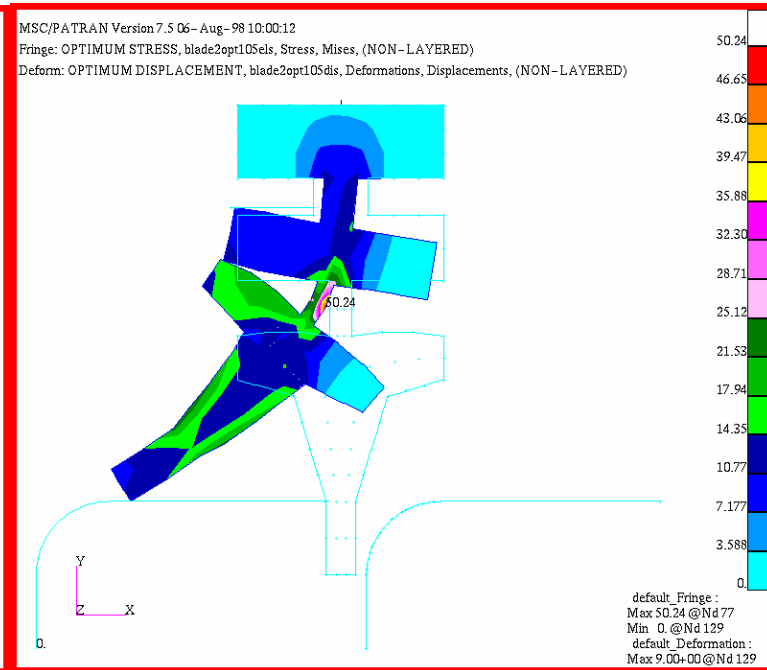
- Objective: minimize area of the mount
- Constraints:
 - maintain the stiffness as in the initial design;
 - keep the hydrostatic pressure at critical points in an admissible range

OPTIMIZED WIPER BLADE

Optimum Shape

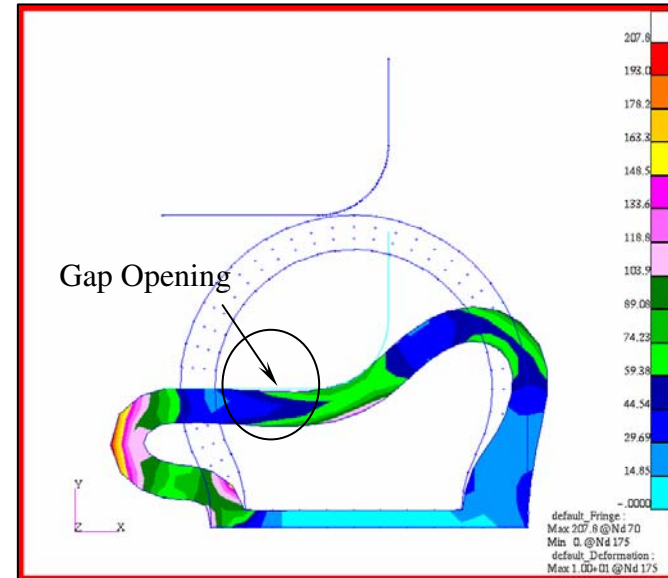
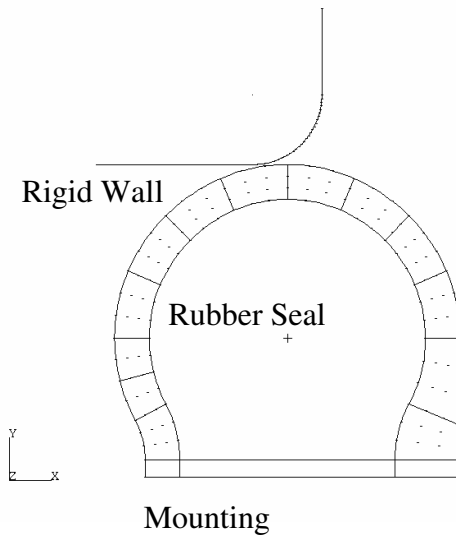


Analysis of Optimum Design



DOOR SEAL DESIGN

Original Design

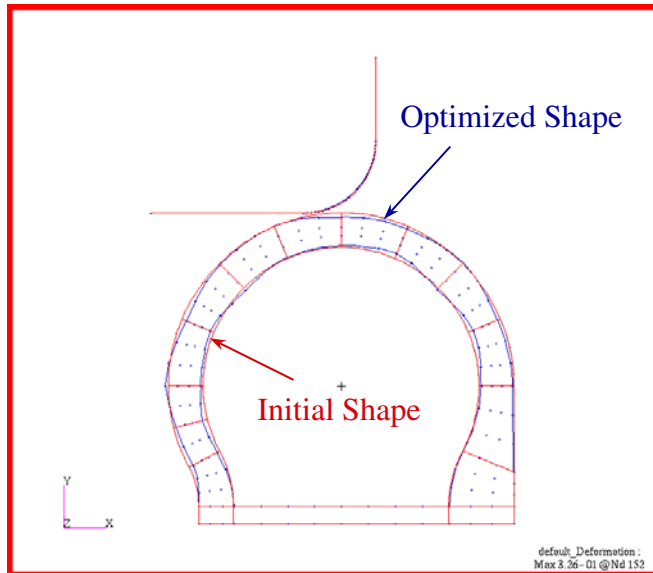


Material Constant $C_{10} = 70$ kPa, $C_{01} = 10$ KPa

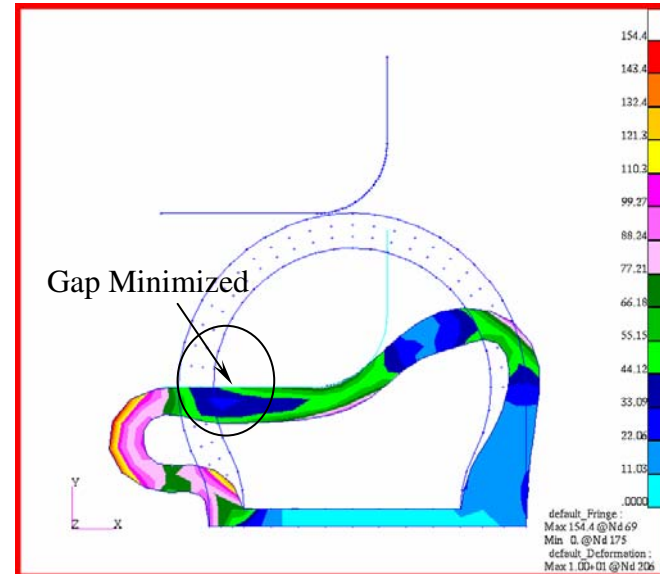
Bulk Modulus $K = 80$ MPa

Frictional Coefficient $\mu = 0.25$

OPTIMIZED - DOOR SEAL



Optimized Geometry

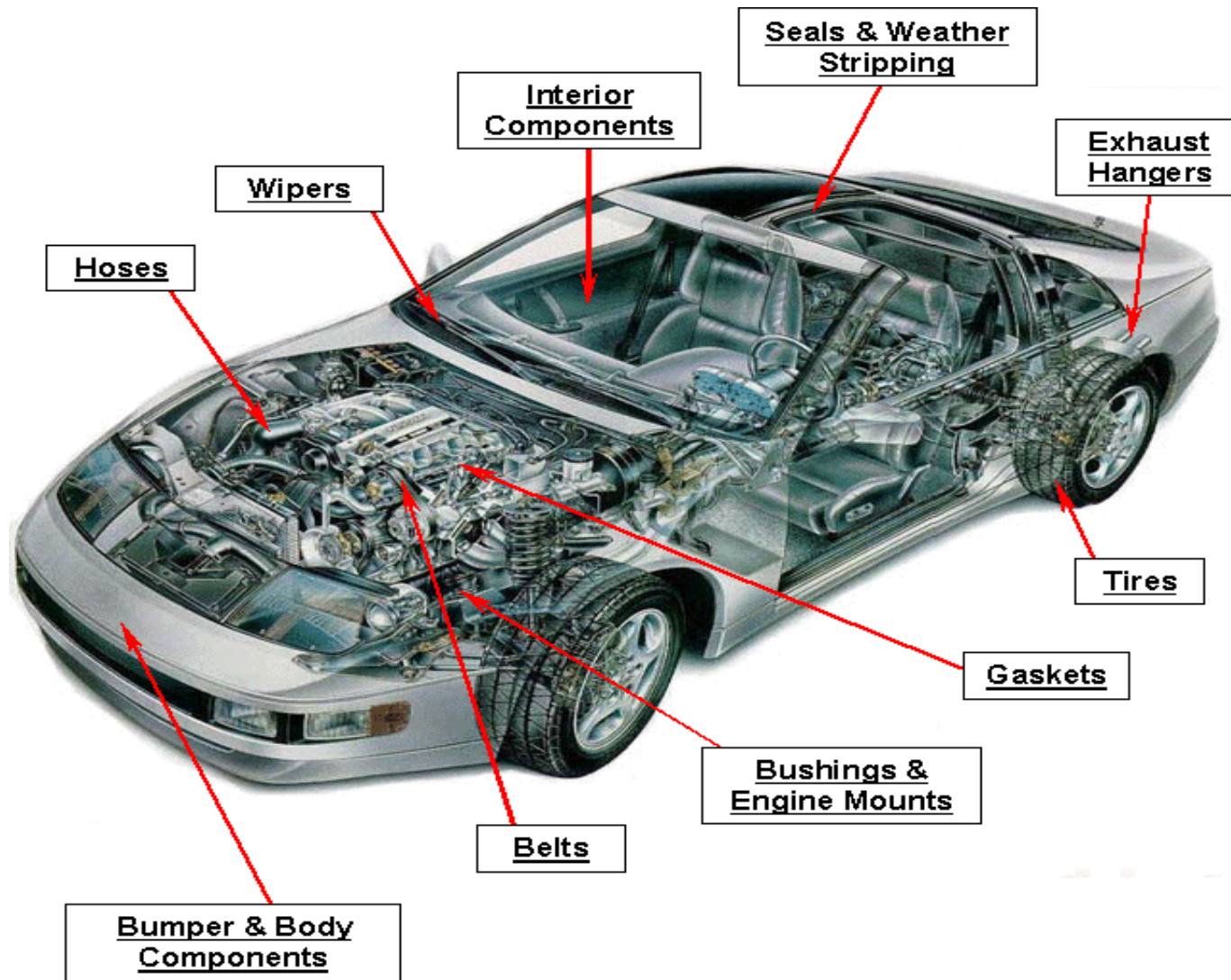


Optimum Result

AEG FEA Projects

- Indentation of an elastomeric foam
- FEA of an automotive boot seal
- FEA modeling an air spring
- Analysis of an automotive boot seal
- Pressure penetration analysis of an air duct seal
- Modeling of jounce bumper
- Self-contact in rubber/foam components: rubber gasket
- Tire FEA static analysis and steady-state rolling analysis
- Steady-state dynamic tire analysis
- Polyurethane solid tire analysis
- Tire inflation, footprint, and natural frequency analysis
- FEA windshield wiper
- FEA rubber bushing

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10 Major Automotive Components

OEM Outlook - 2017 & Beyond

- CAE / Virtual prototyping / Math tools
- 6-month product cycle (instead of 24-36 months) will help faster deployment of new technologies

AEG Typical Project

- Fixed cost and Fixed time project (1-3 month)
- Complete project (Testing & Analysis)
- CAE design and analysis
- Prototype development
- Product manufacturing

Customer Testimonials

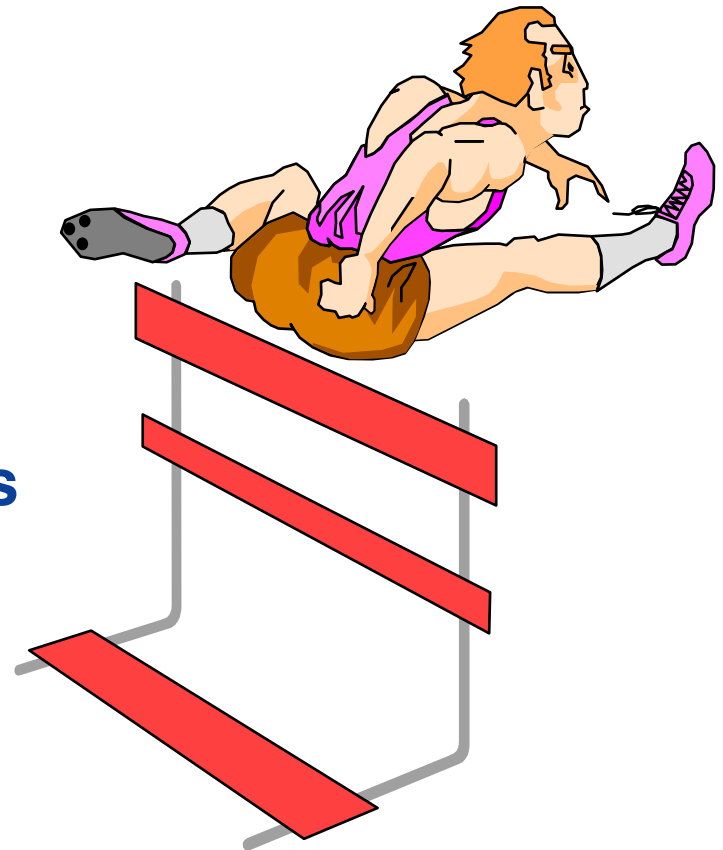
AEG is a cost effective product engineering services company that can help customer succeed.

- Passion for Innovation
- Problem Solving Track Record
- Excellence in Product Engineering, Material Engineering and Manufacturing

-Panam Communication, New York, 2008

Thank you

- Product Development
- Product Manufacturing
 - FEA
- Product Design Analysis
 - Project partnership
 - Confidentiality
 - ISO 9001:2015



“Progress through continuous innovation, technology and customer success”