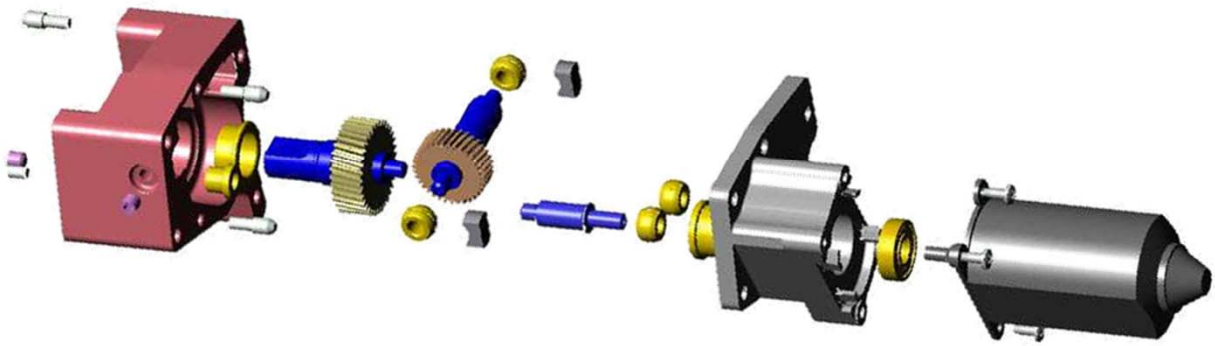
Virtual Engineering, Inc.

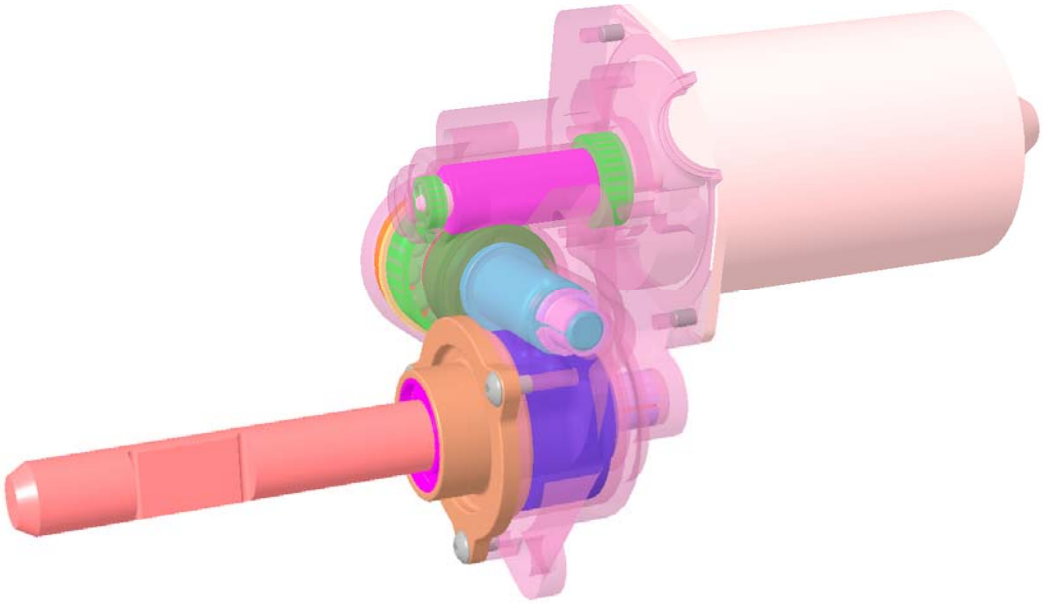
Engineering Your Competitive Edge…

Power Running Board – Transmission Design

- **Objective:**
  - Design a transmission for a Power Deploying Running Board for an SUV

- **Constraints:**
  - Linkage pivot locations and mounting points were defined (no changes possible)
  - Running Board deployment and stow angles were given
  - Meet or exceed performance specifications
  - Define motor torque / speed requirements
  - Consumer must be able to stow running board, manually, if power fails





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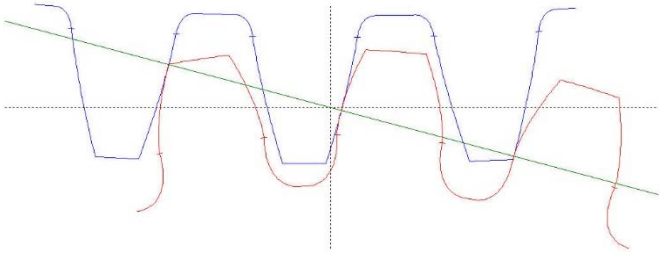
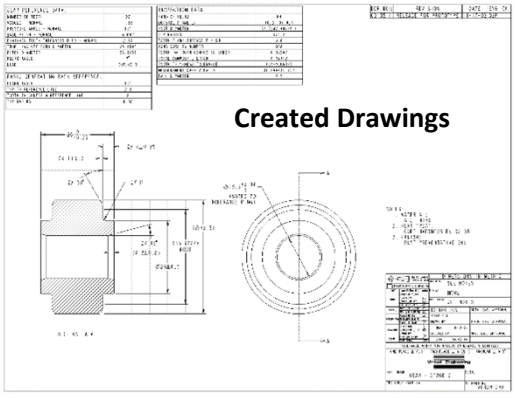
- **Process:**
  - Reviewed performance specifications and observed customer testing
  - Investigation determined two stage worm and gear was optimum
  - Created gear data and specified roller bearing requirements
  - Conducted gear mesh tolerance studies using UTS Gear software
  - Calculated motor power, torque, and speed requirements
  - Created proof of principle design for initial testing
  - Integrated motor end bell features into transmission housing to simplify design and eliminate one interface for potential environment damage from seal failure
  - Designed a tolerance ring into the appropriate gear shaft to enable stowing of the running board when no power is available
  - Created all CAD in Pro/Engineer, now Creo Parametric
  - Drafted prototype and costing drawings
- **Results:**
  - Robust product that passed performance requirements
  - Customer was awarded U.S. Patent 7,118,120 for the design

Stage 1

Environmental Condition Code	Statistical Effective Center Distance		Material Condition	Contact Ratio	Base Backlash
	Min	Max			
P	20.3380	20.5640			
A	20.3334	20.5593			
B	20.3181	20.5440	MMC	2.0787	0.1786
C	20.3228	20.5487	-		
D	20.3486	20.5746	LMC	1.4295	0.4089
E	20.3486	20.5746	-		

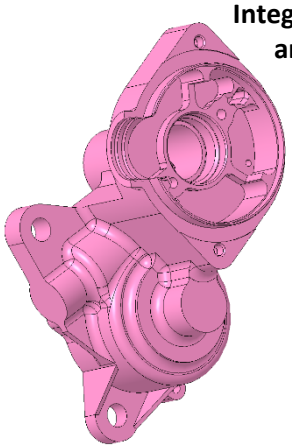
Gear Mesh Tolerance Analysis UTS Gear Software

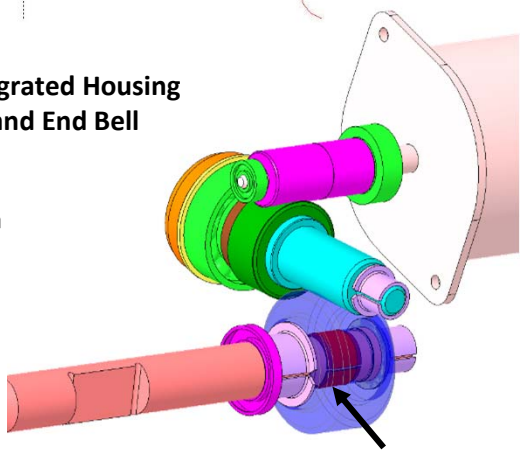




Created Drawings

Integrated Housing and End Bell





Tolerance Ring as Clutch

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