



Excerpts from the 7th English edition of DESIGNING PLASTIC PARTS FOR ASSEMBLY by Paul A. Tres,
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AUTOMOTIVE DESIGN

Avoiding Plastic Design Pitfalls

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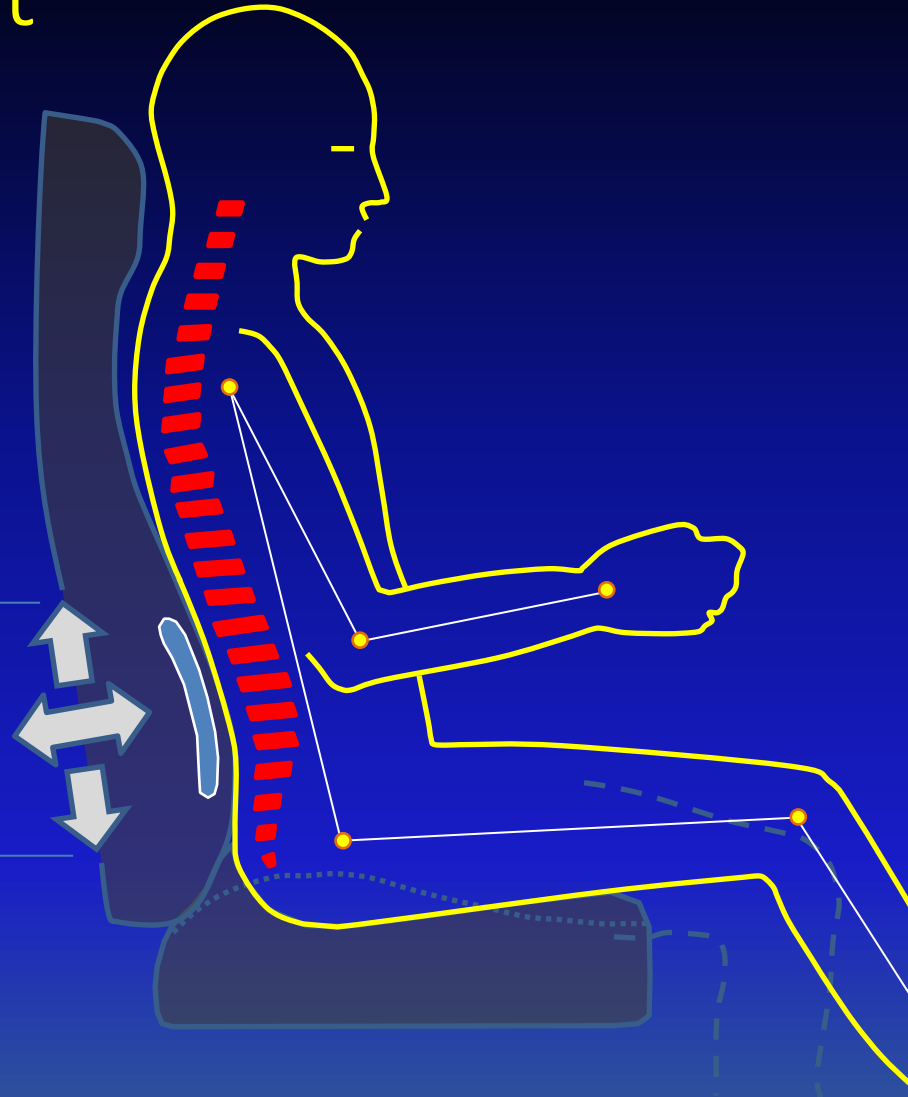
Fixing Honda Pitfall

Lumbar Comfort

↔ FORE & AFT ADJUSTMENT
Provides 2" (50 mm)
of infinitely adjustable
fore and aft displacement

↑
↓ VERTICAL ADJUSTMENT
Five positions allow 2"
(50 mm) of vertical
adjustment in 0.5"
increments

Lower
Back
Comfort
Zone



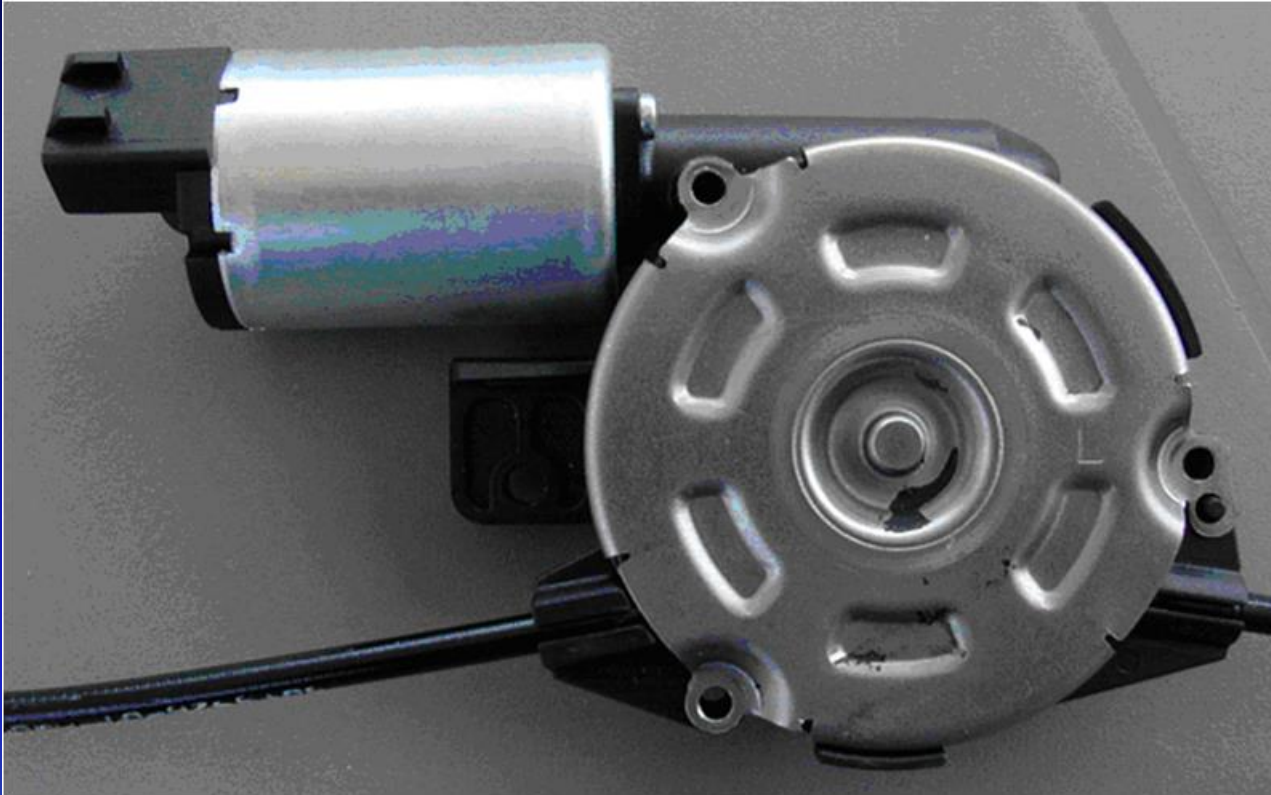
Aftermarket Lumbar Support

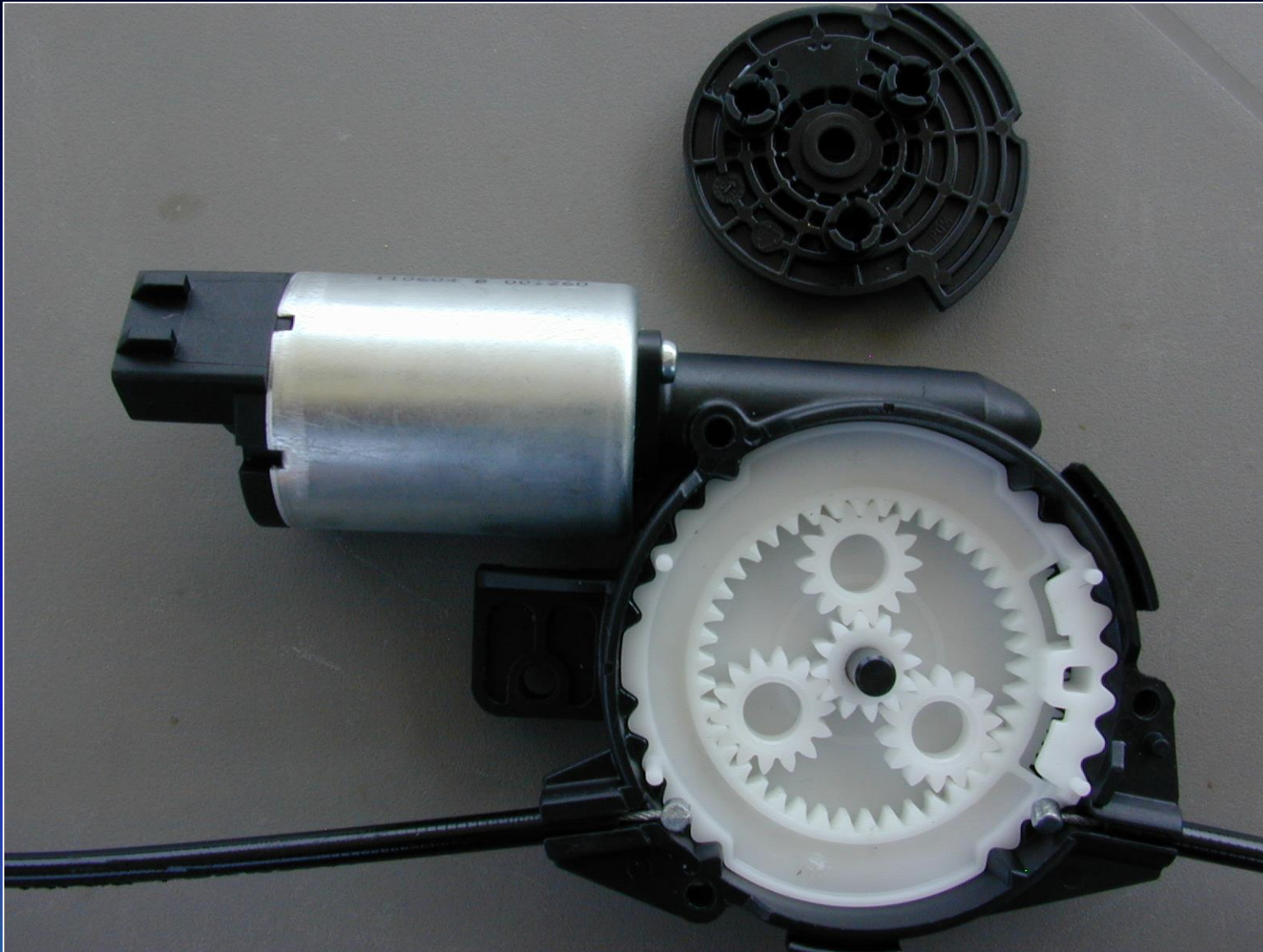


Honda Accord



Lumbar Gear Drive

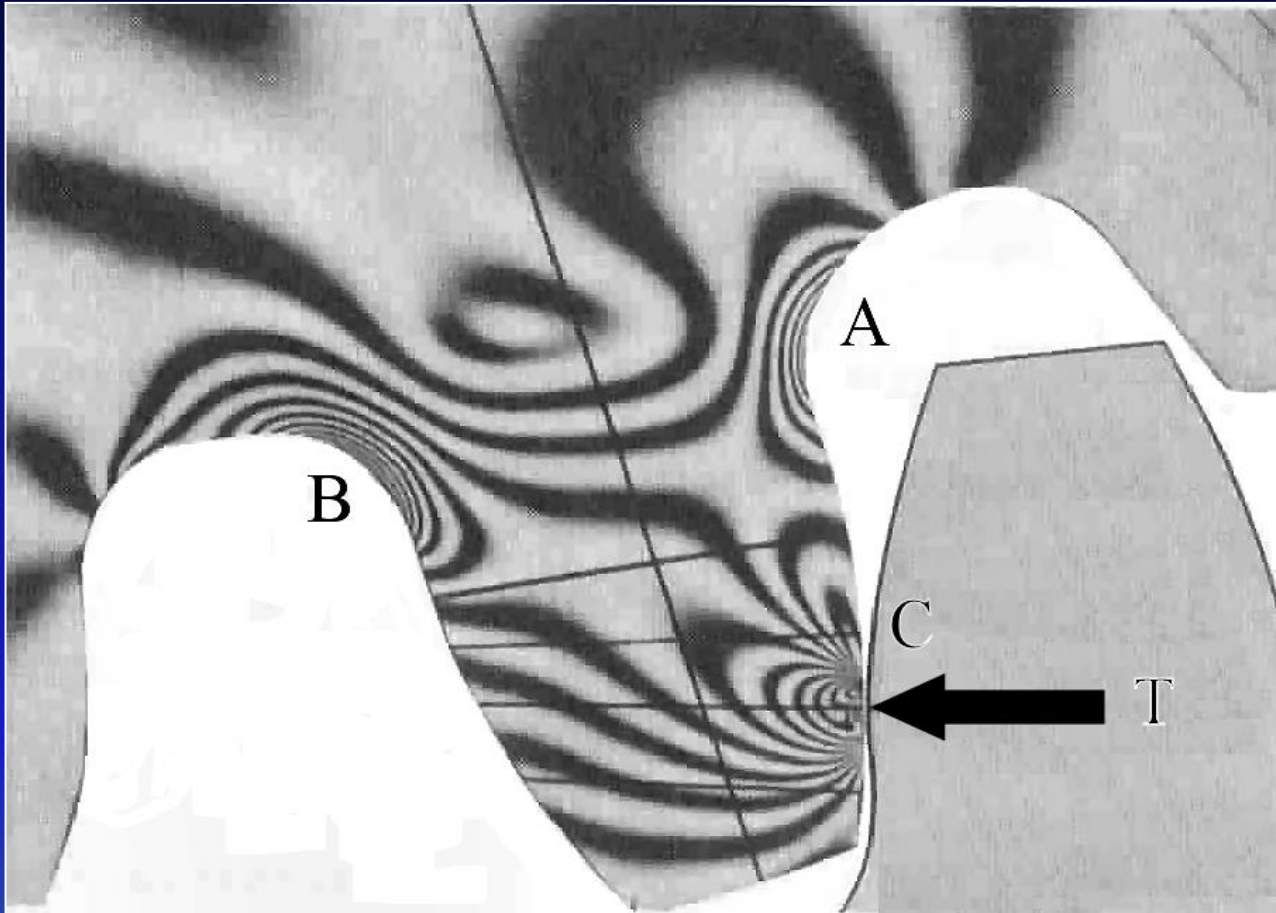




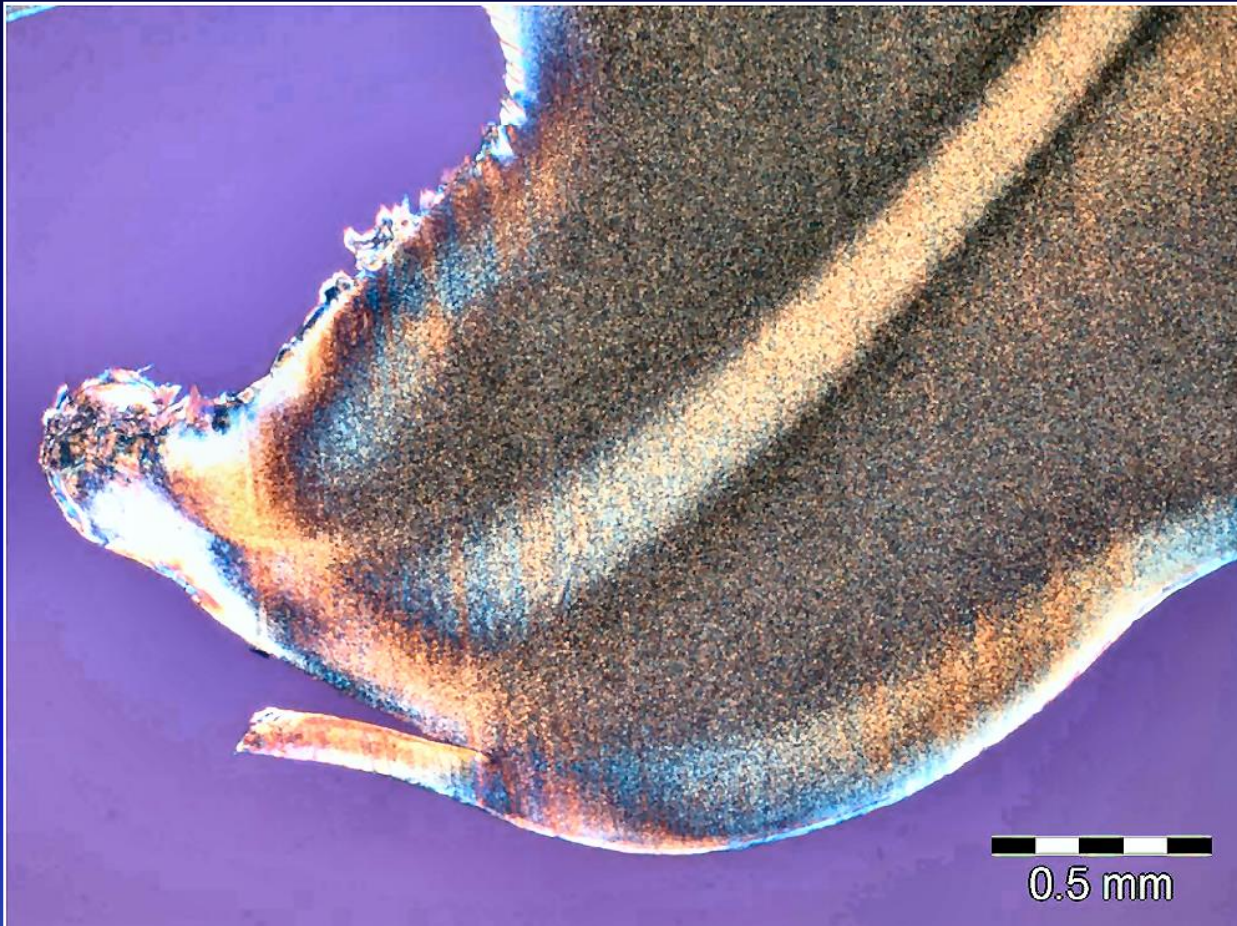
Satellite Gear Calculations

- Number of gear teeth = 14
- Metric module = 1.00
- Pressure angle = 20°
- Tooth arc thickness = 1.83 mm
- HOB addendum = 1.33 mm
- HOB tip radius = 0.43 mm
- Roll angle for loading = 42.556°
- Tooth face width = 4.5 mm
- Gear input torque = 953.5 N·mm
- Root diameter = 12.052 mm
- Y –Lewis form factor = 0.37039
- Load tangent to base circle = 144.956 N
- Load normal to tooth center line = 119.872 N
- Parabola height = 1.72
- Parabola base = 1.995
- Bending moment arm = 1.422 N·mm
- Load radius at center of tooth = 7.954 N

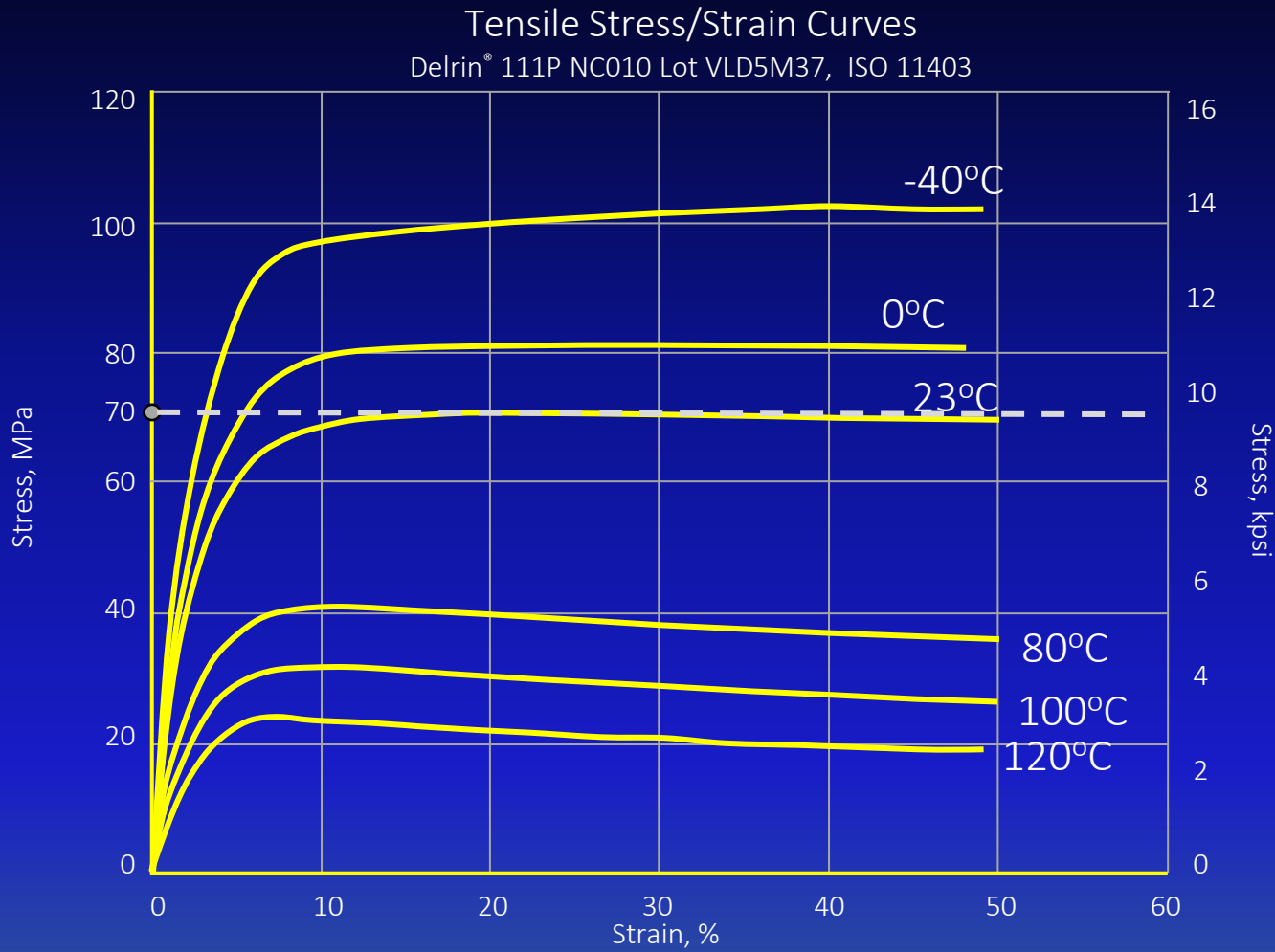
Satellite-Sun Gears FEA



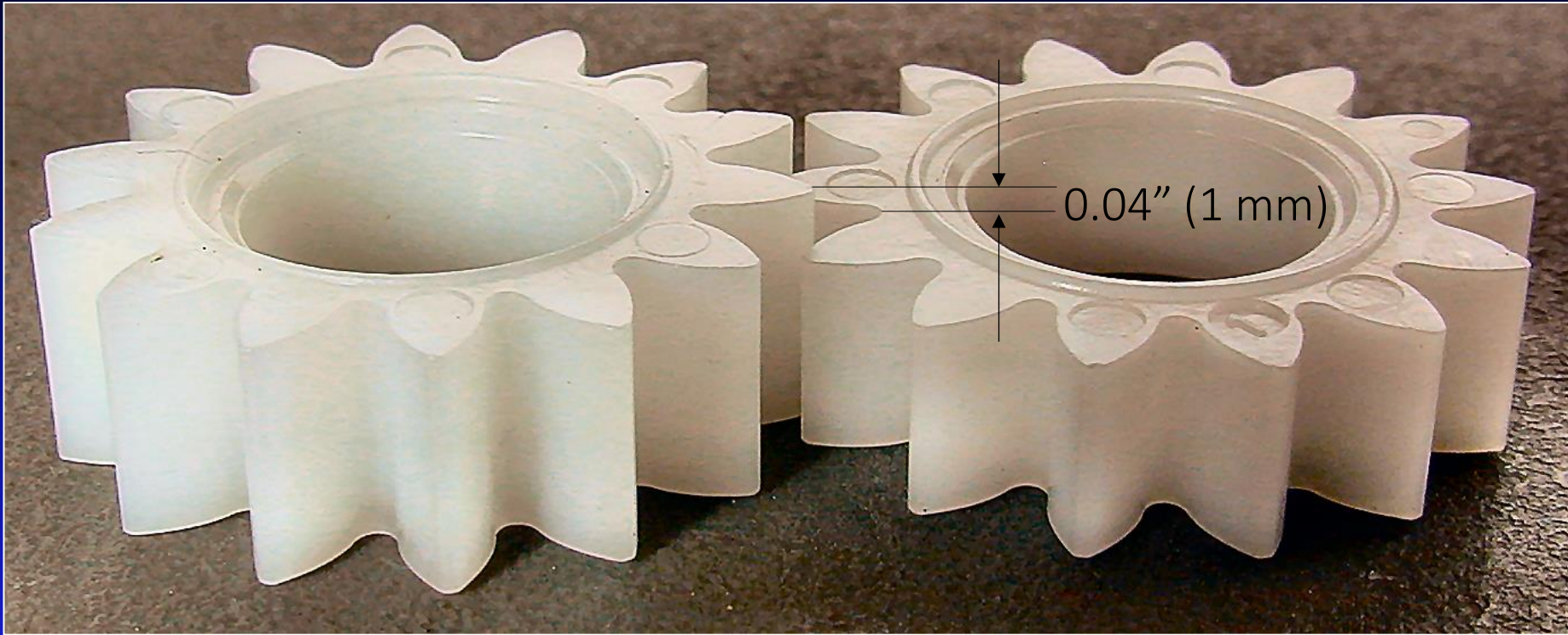
Satellite Gear MSA



Polymer Used: Delrin[®] 111P NC010



Solution

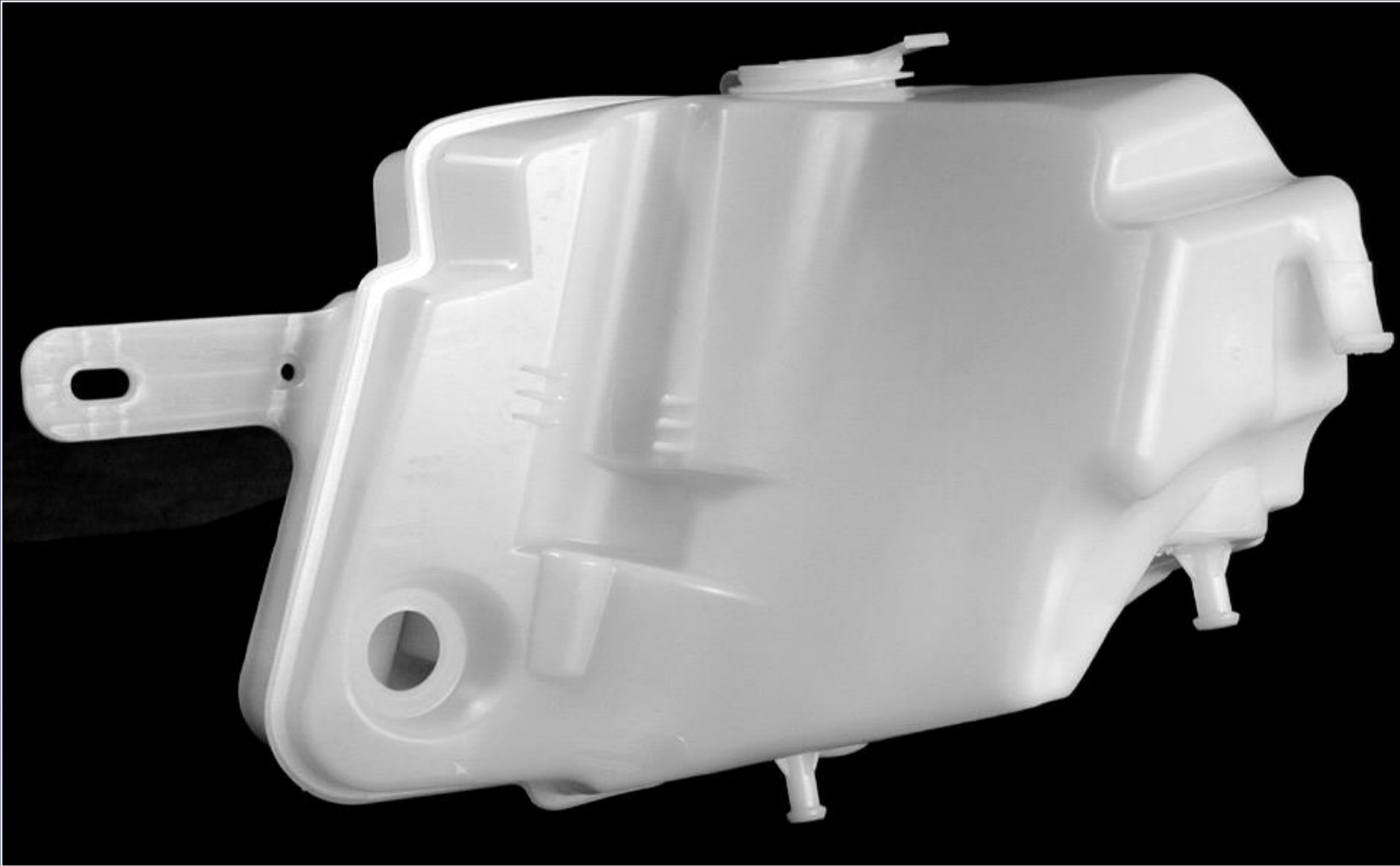


Fixing Mercedes Pitfall





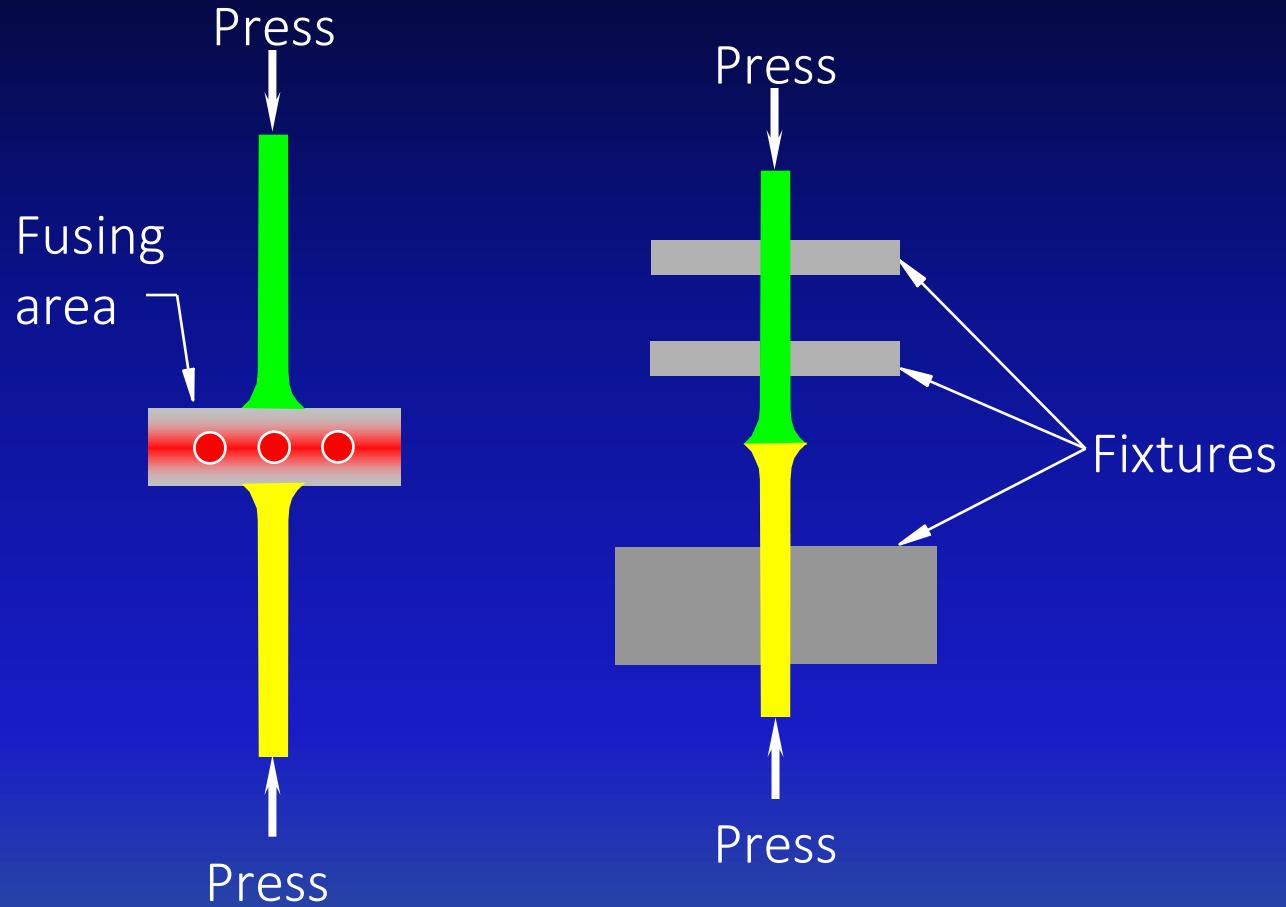
Washer Fluid Bottle



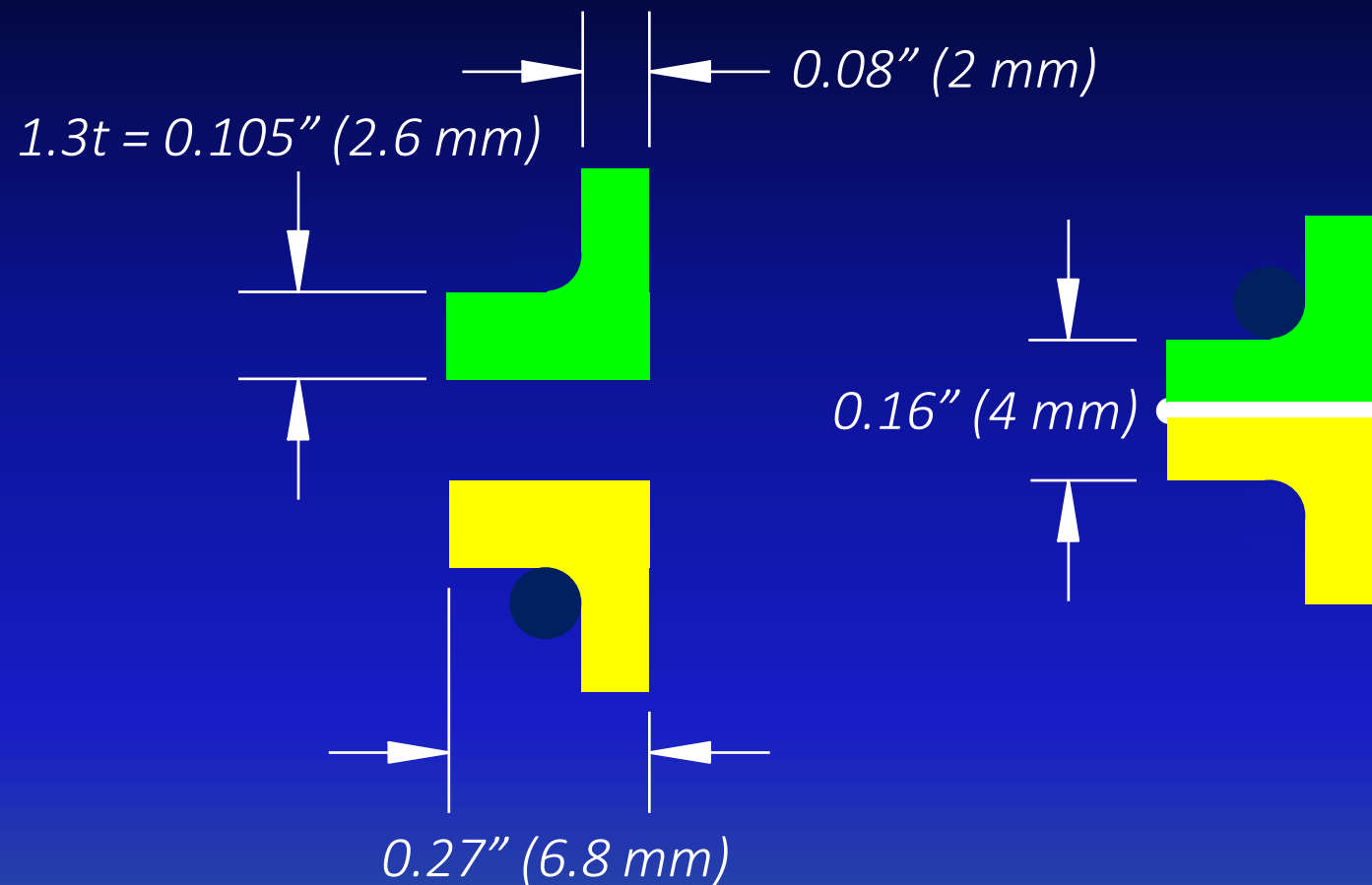
Polypropylene Properties

PP Grade	PD-626	Units
Yield Stress	4,400	psi
Yield Strain	13	%
Flexural Modulus @ 1% secant	170,000	psi
Rockwell Hardness	N/A	R Scale
Heat Deflection Temperature @ 66 psi	190	°F
Notched Izod Impact @ 73°F	0.5	ft·lb/in
Water Absorption after 24 hour	N/A	%
Density	0.9	g/cm ³
Melt Flow Rate	12	dg/min

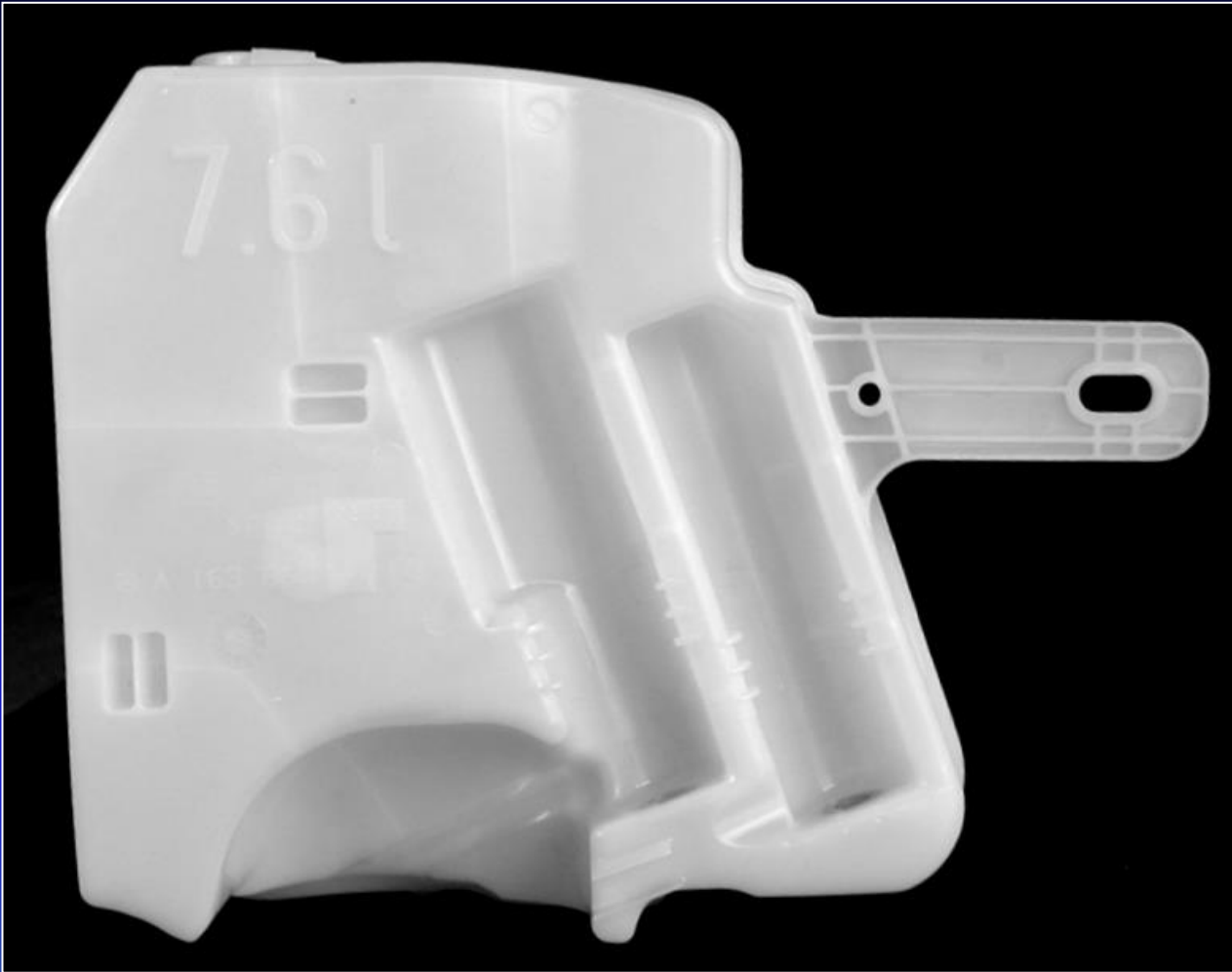
Hot Plate Welding Process



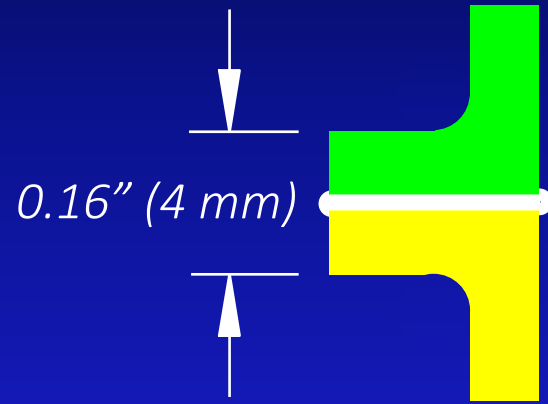
Weld Joint Design



Bottle Volume Increased - 7.6l



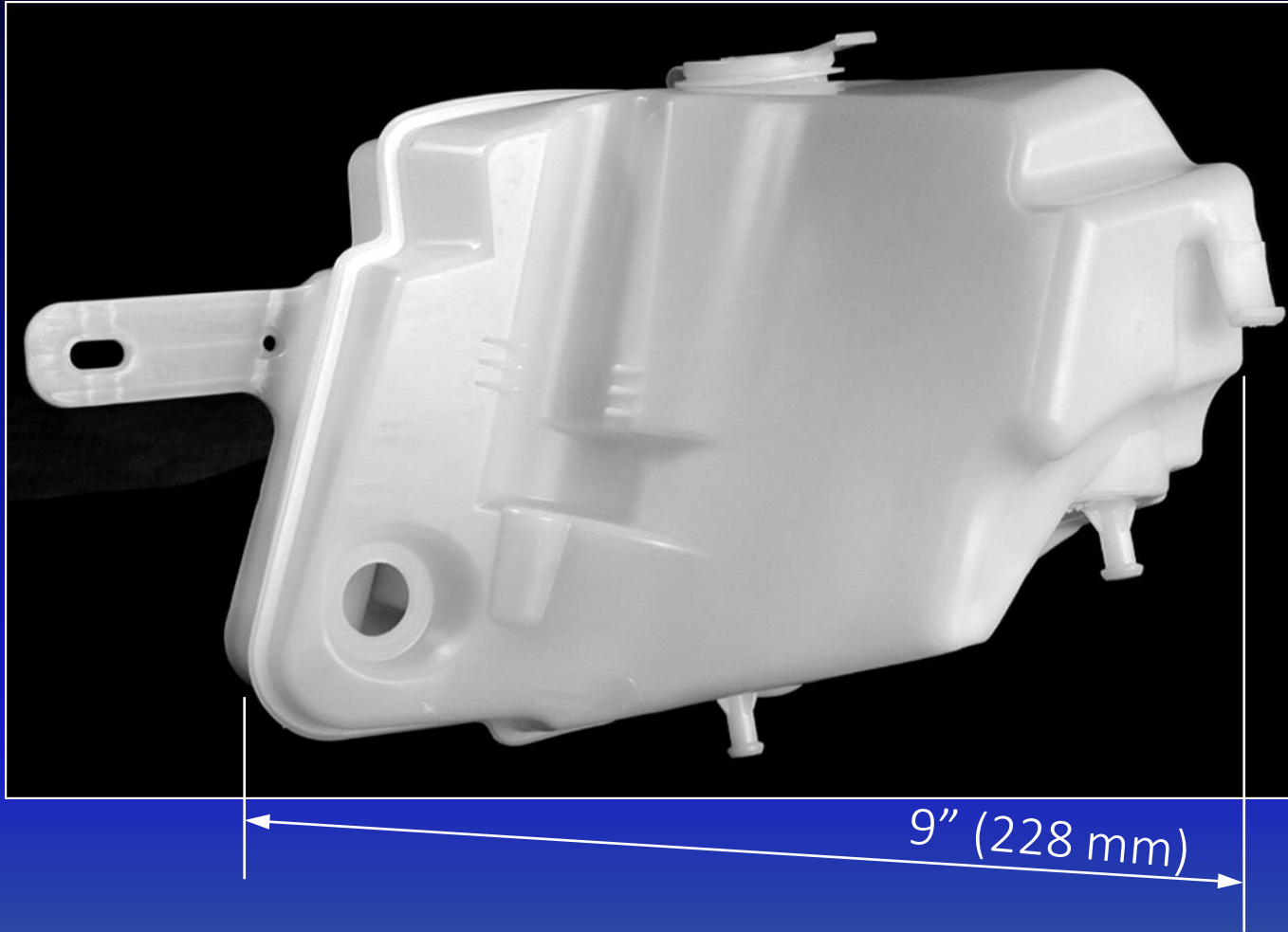
Weld Joint Desired



Weld Joint Achieved



Deep Draw Warpage



Blow Molding for Redesign

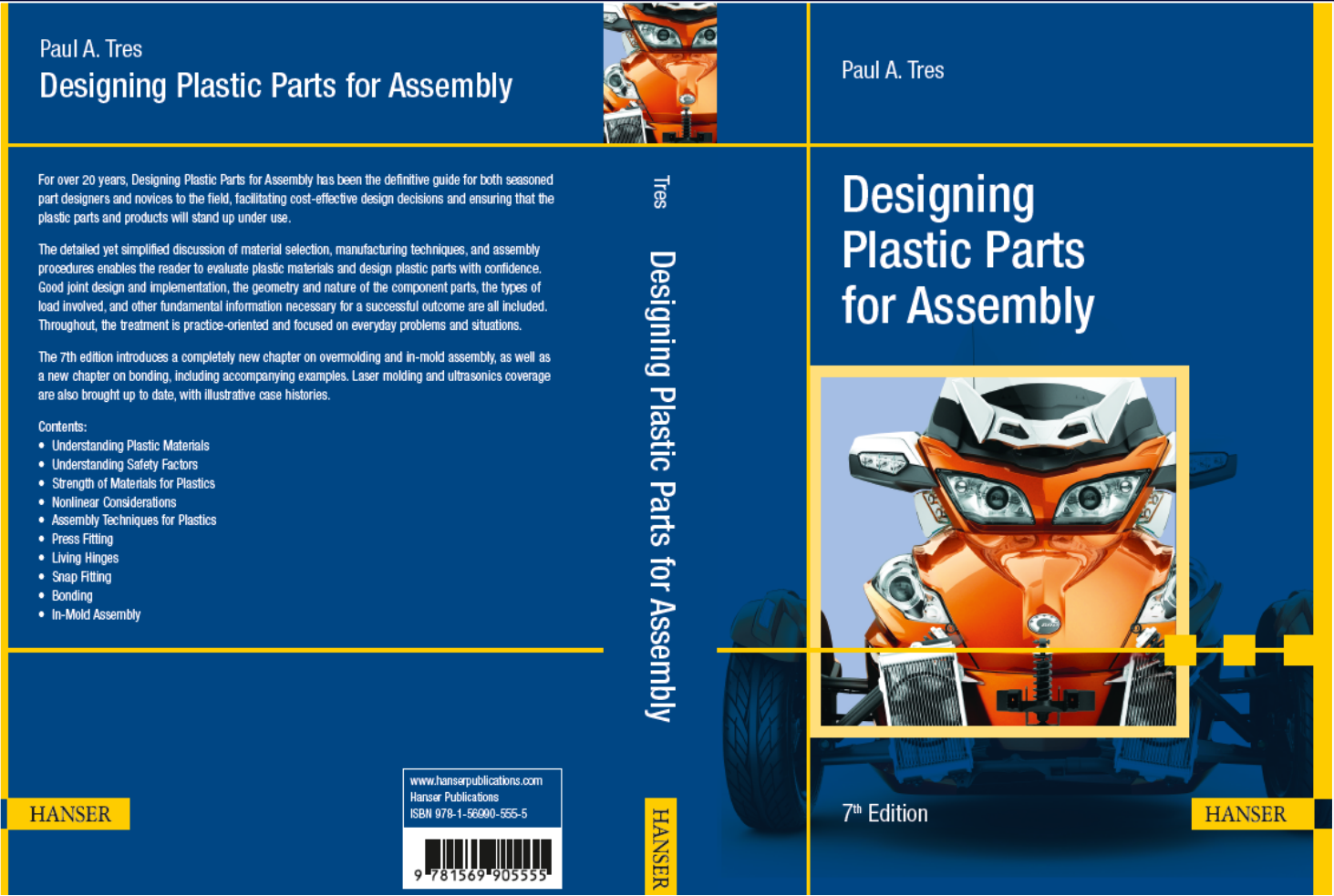
- 9" deep draw induces large warpage
- Increasing 5l initial volume to 7.6l compounded the problem
- Welding tried to compensate for warpage
- Creates pre-stress condition in the weld joint

Solution

Blow molding process

eliminates the design pitfall





Thank you!

Questions??