

Team #38 Certified Cases for Ruggedized Prices

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Objective Statement

- To design and manufacture an iPhone case that is cost effective, \$100-\$200 per case, and certifiable for use in Class 1 Division 2 hazardous locations
- To develop a business plan for mass-production of the case.

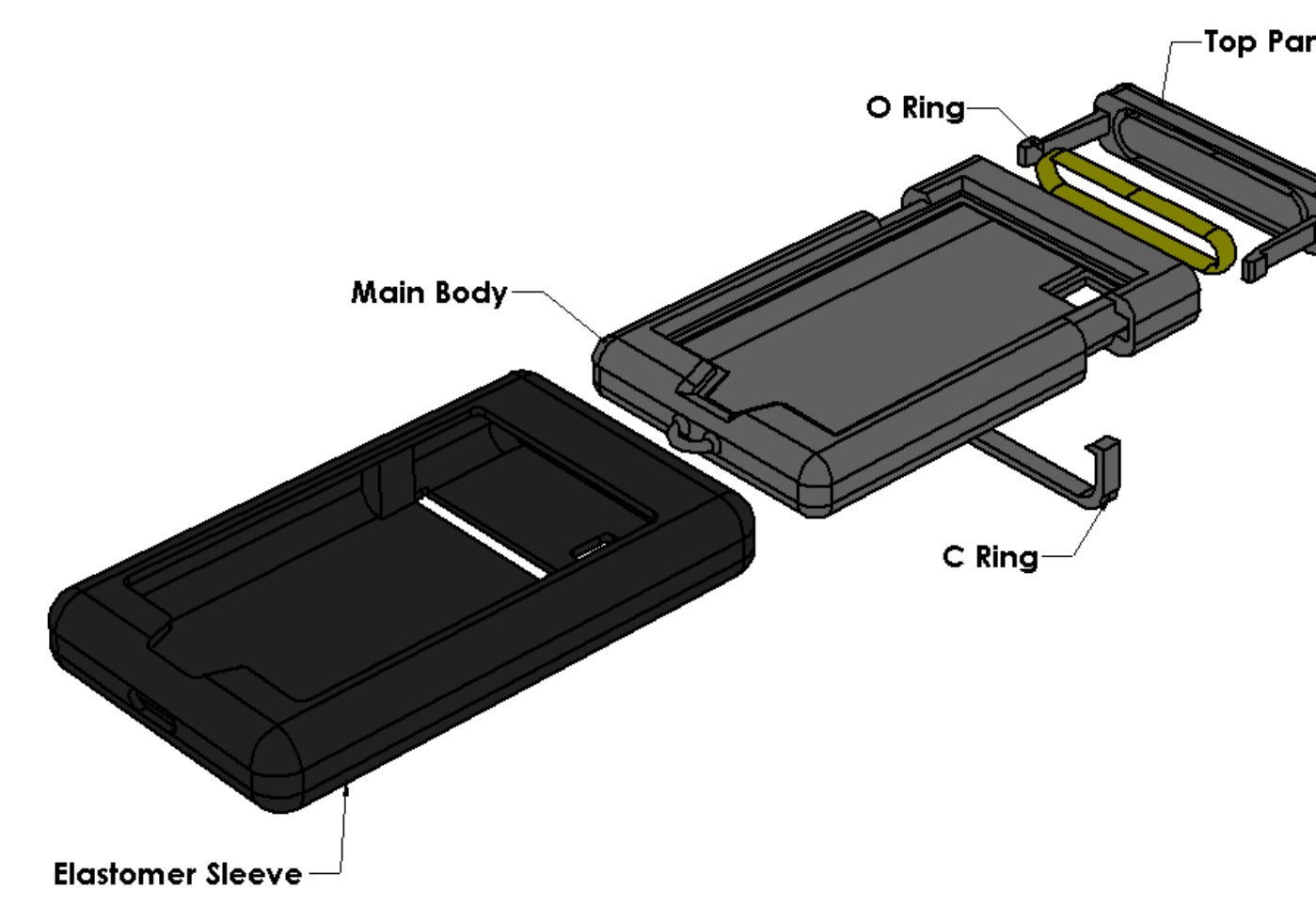
Background

- Shell Geismar Plant- Class 1 Division 2 Group B Hazardous Location
- iPhones must be sealed from the atmosphere to ensure an explosion does not occur
- Cases currently in use cost \$650 per case

Engineering Specifications

Specification	Value	Measurement
Touch Sensitivity Number of touches to get response	99 of 100 touches	100
Slip Angle	≥ 33°	60°
Height of Survivable Drop	≤ 10 feet	3 feet
Relative Volume of Case to iPhone Volume	≤ 300%	400%
Relative Weight of Case to iPhone Weight	≤ 200%	212%
Number of Parts in Case	≤ 5 parts	5
Number of Materials in Case	≤ 5 materials	3
Number of Assembly Cycles until Failure	1460 cycles	1500 cycles
Unit Cost per Case	≤ \$200	\$106.84
Certification Specification	Value	Measurement
Depth of Water Case Remains Sealed	25 mm	75 mm
Height of Survivable Drop	3 feet	3 feet
Max Surface Temperature of Outside of Case	< 175° F	113° F

Prototype Design



Manufacturing/ Assembly Plan

- 3D Printing: Markforged X7 and Stratasys Objet 260**
 - Elastomer Sleeve & O-ring- Tango
 - Main Body & Bottom- Kevlar reinforced Onyx
- Assembly**
 - Adhesive for Screen protector: Durable Resin



Testing/ Safety

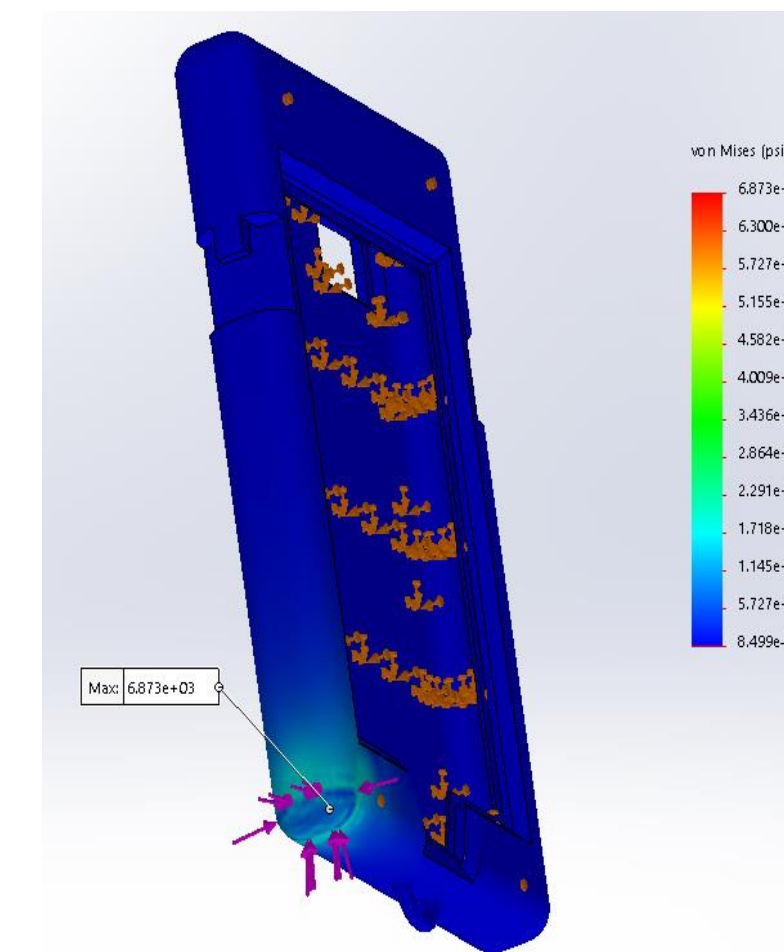
- Testing**
 - Fatigue of snap-fit legs
 - O-ring test
 - Creep test
 - Leak test
 - Drop test
 - Slip Angle test
- Safety**
 - Case must be sealed when in a hazardous location
 - Check case for leakage after impact



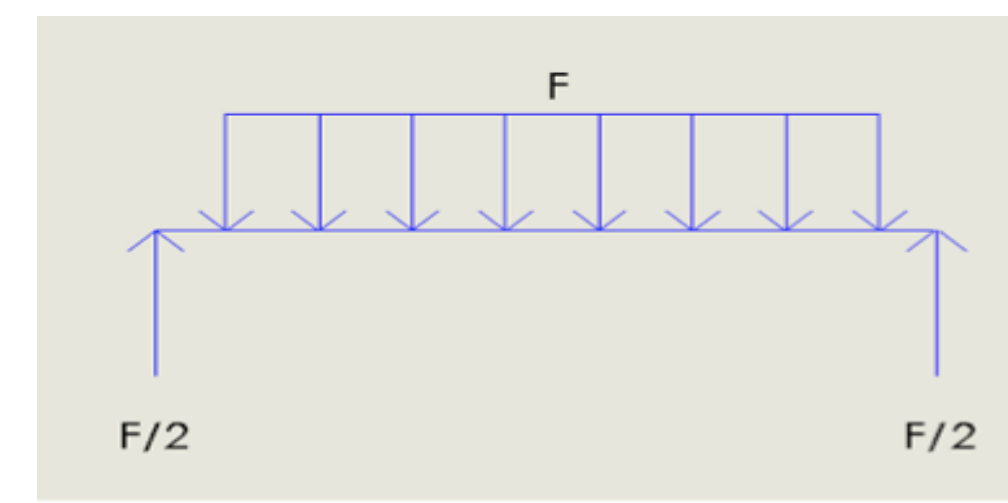
Leak test after drop

Engineering Analysis

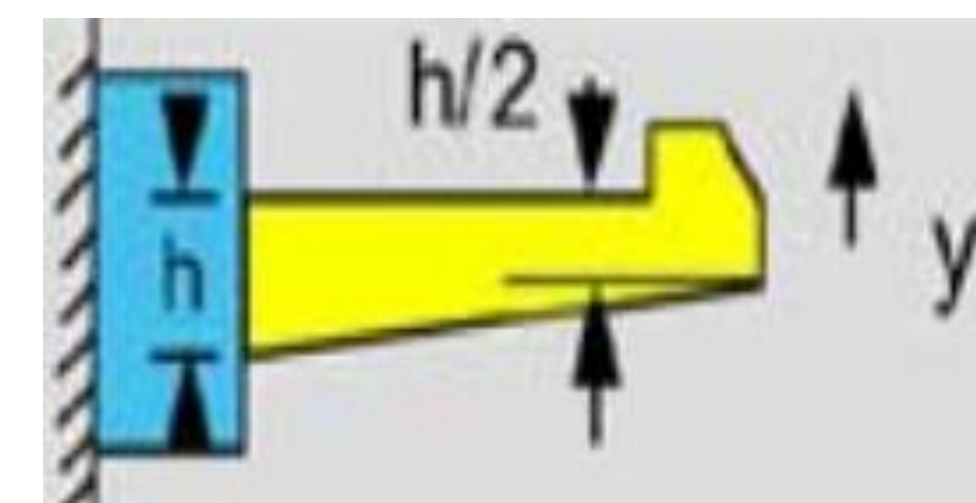
- Force to compress O-ring:**
 - $F = 30 \text{ lbf}$
- Snap Fits**
 - Length= 1.00 in
 - $h = 0.125 \text{ in}$
 - Deflection: $y = 0.125 \text{ in}$
 - Deflection Force: $P = 0.347 \text{ lbf}$
- Impact Force from 10 ft drop:**
 - $F_{\text{impact}} = 515 \text{ lbf}$
- Material Indices**
 - $M_1 = E/\rho$ $M_2 = \sigma_y/\rho$



FEA of Impact Load on Case



Free Body Diagram of Top Part of Case



Snap Fit Design

Mass Production

- Certification Cost:** \$21,700
- Screen Protector:** \$0.10 per case
- Injection Molding**
 - Mold cost: \$37,000
 - Price per case: \$3.53
- O-ring**
 - Tooling: \$3,000
 - Price per ring: \$0.36

No. Units	Unit Cost	No. Units	Unit Cost
50	\$1,238	500	\$127
100	\$621	1,000	\$66
200	\$312	10,000	\$10
315	\$200	100,000	\$5

Budget

